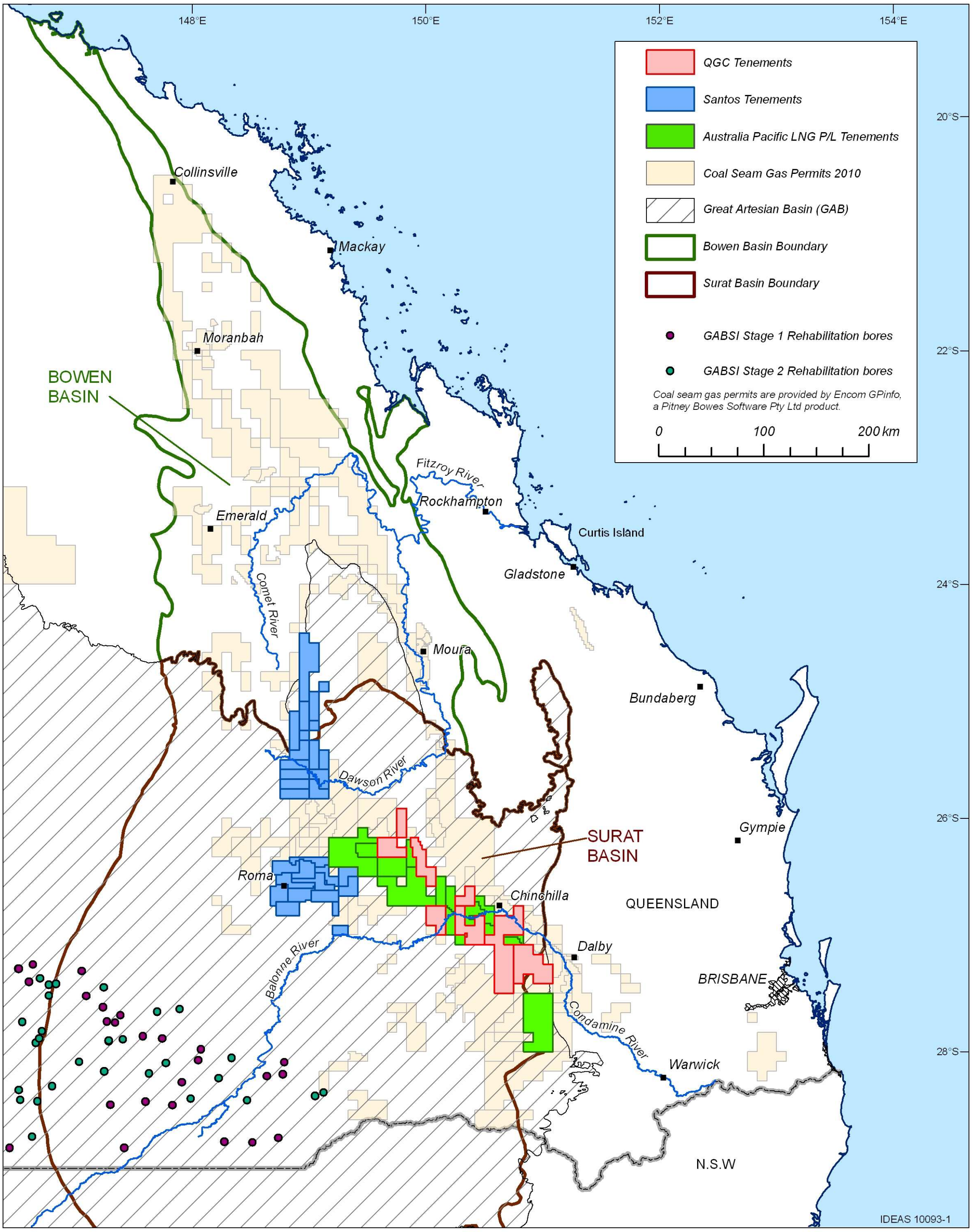

Figure 1.2-1. Map showing the location of existing and proposed coal seam gas permits in Queensland, with tenements considered in the current assessment coloured by proponent. Boundaries of the Surat, Bowen and Great Artesian Basins are indicated, as are major surface drainage systems and GABSI rehabilitated bores.

2. Assessment and Advice

2.1 AUSTRALIA PACIFIC LNG (APLNG)

2.1.1 Project Summary

Australia Pacific LNG proposes to extract coal seam gas (CSG) from the Jurassic-aged coal measures in the eastern part of the Surat Basin in Queensland. The Walloon Coal Measures gas fields are located in Queensland's Surat Basin on the Eastern Downs. The APLNG tenements in the region cover an area of approximately 5700 km^2 and are shown in Figure 2.1-1.

The development will involve drilling up to 10,000 wells over 30 years with a maximum of 600 wells drilled per year. Well spacing for field development is envisaged to be between 500 m and 1500 m. However, an average well spacing of 750 m has been used for development planning and impact assessment purposes. Approximately 5,000 wells will be drilled in the period from 2011 to 2021 to meet the demand of a two train or 9 Mtpa LNG facility to be constructed at Gladstone. An additional 5,000 wells will be drilled over the remaining years of the Project to supply the LNG facility when it is upgraded to four LNG production trains. Coal seam gas fields will produce gas at rates ranging from 75-450 TJ/day.

Associated groundwater production is expected to peak at around 170 ML/day, and this is predicted to occur within the first 20 years. However there remains a high level of uncertainty regarding both the magnitude and timing of this estimate.

The APLNG tenements fall predominantly within the Surat and Surat East Groundwater Management Areas, and partly within the Surat North Management Area, as defined in the Great Artesian Basin Water Resource Plan (DNRM 2005).

The Surat Management Area overlies the full Jurassic to Lower Cretaceous sequence in the Surat Basin and the Upper Triassic sediments of the Bowen Basin in the west.

The Surat East Management Area overlies sediments of Kumbarilla Beds, Walloon Coal Measures, Hutton and Precipice Sandstones of the Surat Basin and the Clematis Sandstone of the Bowen Basin.

The Surat North Management Area covers the sediments of the Westbourne Formation, Injune Creek Group, Hutton and Precipice Sandstones within the Surat Basin and the Clematis Sandstone within the Bowen Basin.

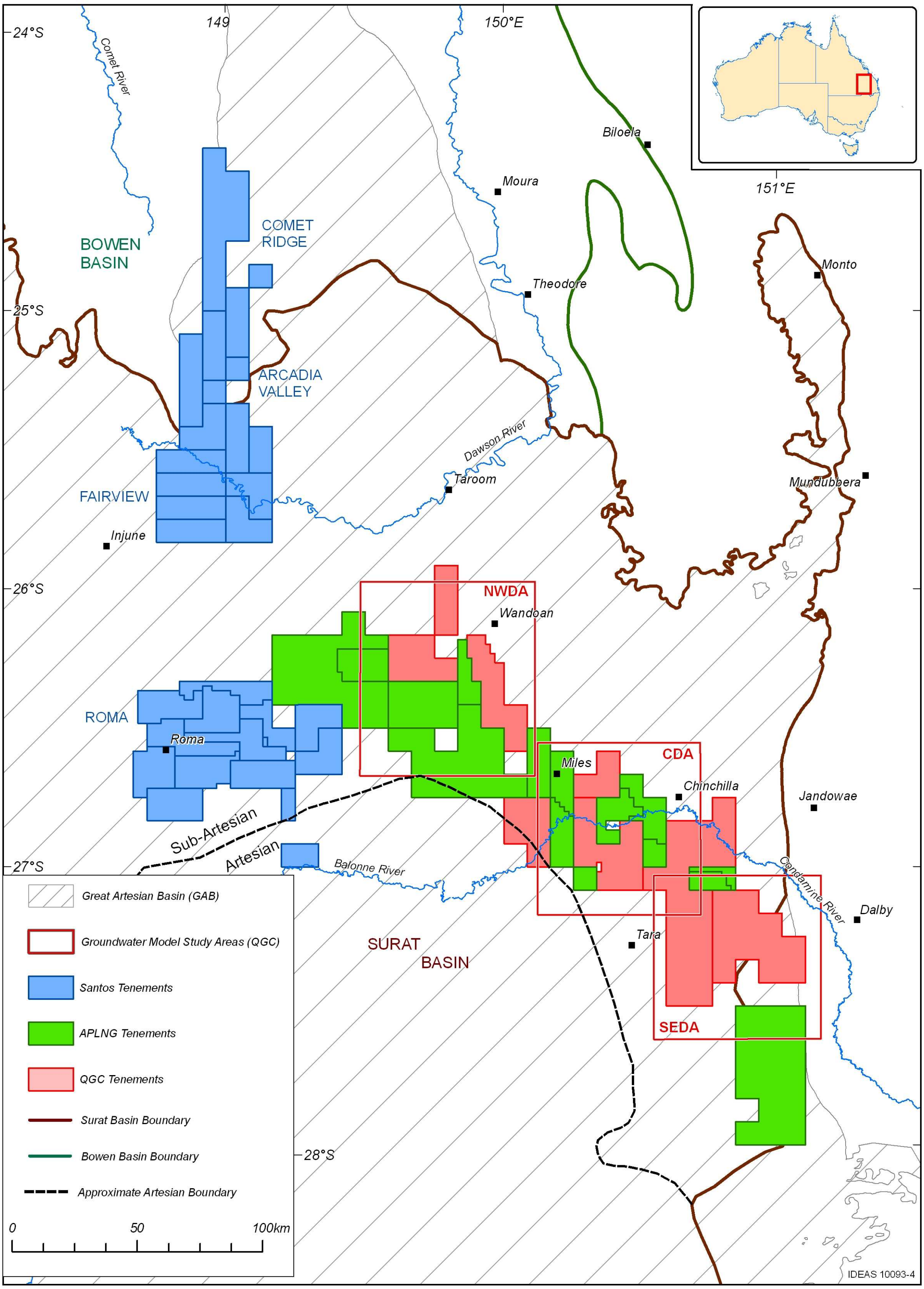

Figure 2.1-1. Location of coal seam gas tenements considered in the current assessment. The location of the artesian/sub-artesian divide, surface drainage and basin boundaries are also shown.

2.1.2 Summary of Assessment

The following summarises our assessment of the QGC proposed CSG development activities.

The adequacy of the proponents' hydrogeological models for estimating hydrogeological impacts on and within the Great Artesian Basin (GAB) and other affected surface and groundwater systems (this would include an initial assessment of the potential of one or more aquifers to depressurise and dewater and the likely impacts).

APLNG present two numerical hydrogeological simulation models – one 'project-scale' model which predicts impacts for their proposed operations, and the other a 'cumulative' model which attempts to account for impacts resulting from multiple CSG operations in the region. Based on the information provided by APLNG in their EIS documents, and discussions with APLNG, our assessment concludes that:

- Within the limitations of available data, the 'project-scale' simulation model produced is suitable for estimating hydrogeological impacts on and within the GAB and other potentially affected surface and groundwater systems within the influence of the APLNG operations. We have, however, noted some shortfalls in the modelling approach.
- The modelling results reported by APLNG require further work to fully establish the uncertainties and sensitivity of the models to the large predicted drawdowns that will occur in the coal measures, and hence does not provide a level of confidence in the model outputs and the conclusions drawn from them.
- The modelled occurrence, magnitude and extent of depressurisation in the Springbok, Hutton and Precipice Sandstone aquifers is consistent with the proposed groundwater extraction operations, and represents effective maximum drawdown values when compared with impacts from existing CSG operations in the region.
- The 'cumulative' numerical groundwater simulation model represents a useful preliminary assessment of potential hydrogeological impacts resulting from a range of groundwater extraction activities, and provides a good starting point for development of a regional model to underpin groundwater impact prediction and management.

Potential impacts of groundwater extraction on aquifer interaction (e.g. water flow, cross contamination), vertical recharge, structural integrity and artesian pressure as a result of the CSG activities. This applies to both quantity and quality of groundwater.

Potential impacts of groundwater extraction on aquifer interaction have, in general, been adequately addressed with, while there is scope for further elaboration regarding some aspects. Based upon consideration of the hydrogeological, geological and project development information provided, we conclude that:

- The modelled vertical recharge and artesian pressure changes resulting from coal seam depressurisation are realistic and likely to result in groundwater flow into the coal measures from adjacent aquifers. We consider that these changes are reversible over timeframes of decades to centuries, depending on the specific aquifer and the management strategies applied.

- Cross-contamination is likely to be of little consequence as the majority of inter-aquifer transfer will involve the migration of higher quality water from adjacent underlying and overlying sandstone aquifers into the Walloon Coal Measures.

- The structural integrity of aquifers in relation to groundwater transmission is unlikely to be significantly impacted by the proposed groundwater extraction. We note that groundwater extraction may cause some aquifer compaction that is likely to result in subsidence (as identified by the proponent and discussed below).

Potential impacts of groundwater extraction on the EPBC Act listed endangered ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.'

Based upon consideration of the hydrogeological, environmental and management information provided, we agree with APLNG that the risk of impact from groundwater extraction to the EPBC Act listed endangered ecological community '*The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*' is low, based on the following:

- With one exception, documented and/or surveyed natural discharge sites (springs) are located outside the CSG fields and the modelled zones of groundwater drawdown.

- Proposed monitoring programs are likely to enable detection of potentially deleterious changes to groundwater level or quality.

- Proposed controls on the location and construction of infrastructure would avoid physical impacts on environments suitable for hosting EPBC Act listed communities.

- A small number of additional natural discharge sites proximal to the CSG fields may need to be investigated and assessed to determine their EPBC Act significance.

Uncertainties in the extent of modelled groundwater drawdown, however, lead to the conclusion that a small number of additional natural discharge of groundwater sites (springs) proximal to the CSG fields may need to be investigated and assessed to determine their EPBC Act significance. We suggest that the outcomes of such investigations could provide input to the adaptive management process proposed by APLNG and ensure that the baseline datasets upon which monitoring and mitigation measures are based are both robust and complete.

Potential for recharge into the GAB to be impacted in these areas due to CSG activities and the likely long-term impact(s).

- Insufficient data was provided in the EIS or upon request to enable an assessment of the impact of associated water production upon recharge in terms of the GAB water balance.
- We note that the total magnitude of annual average proposed extraction by APLNG represents 15% of total annual recharge to the potentially affected GAB aquifers including the Walloon Coal Measures.
- The majority of existing groundwater users and environmental values in the Hutton and Precipice Sandstone aquifers are located up-gradient of the proposed extraction activities.
- Long-term impacts of the proposed CSG activities on recharge are possible, and would most likely manifest as a reduction in recharge volumes downgradient and basinward of the CSG developments, which could result in reduced artesian pressures and potential impacts on EPBC Act significant spring communities much further afield.
- We are unaware of any existing data or modelling results that would be suitable for assessing the likelihood or potential timeframes for such impacts, although groundwater movement rates in deeper GAB aquifers suggest that any impact (and recovery) would be extremely long term (i.e. occurring over many thousands of years or more).

Potential impacts of fraccing on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes.

Based upon the geological and technical information provided by APLNG with regards to the potential impacts of hydraulic fracturing (‘fraccing’), we consider that the potential risks posed by fraccing are low. We conclude that:

- The assessment completed by APLNG identifies and assesses relevant factors and risks involved in the process.
- While the potential for fraccing activities to impact on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes, can never be completely eliminated, the competent application of industry standard technologies, techniques, and monitoring/mitigation measures proposed by APLNG are considered appropriate for minimising the risk.

Initial advice on the likelihood and materiality of subsidence as the result of the proposals.

Based upon our assessment of the geological and geotechnical information provided, and relevant information from other sources, we agree with APLNG that there is a likelihood of subsidence, and that this could result in several centimetres of surface subsidence.

However, based on the estimated magnitude of the subsidence (in the order or centimetres to tens of centimetres), and with reference to subsidence assessments for CSG activities in similar geological environments elsewhere, we consider that the risk of impacts to surface water and shallow groundwater systems are very low.

We suggest that the monitoring measures currently proposed by APLNG could be strengthened by assessing deformation at the land surface as well as in the aquifers and coal seams.

Initial advice on the likelihood and materiality of any impact on MDB groundwater or connected surface water resources.

On the basis of the available information, we consider that there is a limited likelihood of impact on MDB groundwater or connected surface water resources as a result of the proposed APLNG operations.

This assessment is based primarily on information suggesting that the small number of APLNG tenements proximal to the Condamine River Valley are located in an area where there is no known hydraulic connection between the Walloon Coal Measures (which will undergo depressurisation) and alluvial aquifers.

2.1.3 Assessment of Proposed Development

a. The adequacy of the proponents' hydrogeological models for estimating hydrogeological impacts on and within the GAB and other affected surface and groundwater systems (this would include an initial assessment of the potential of one or more aquifers to depressurise and dewater and the likely impacts).

Model Description

APLNG have developed a finite element groundwater simulation model (FEFLOW) to predict changes in hydraulic head in the Walloon Coal Measures and overlying and underlying aquifers in response to CSG depressurisation activities within their tenements. The model domain extends over almost all of the Surat Basin in Queensland and occupies an area of 172,740 km^2. The model is partitioned into 22 layers to represent the 11 hydrostratigraphic units in the Surat Basin (11 of the model layers are located in the Walloon Coal Measures and the Hutton Sandstone is divided into 2 layers based on permeability). The regional mesh consists of 3 km-sized triangular finite elements around the APLNG tenements, 6 km-sized triangular elements within a 70 km buffer of the tenements and 12 km-sized elements in distal areas.

Model Parameters

Hydraulic parameters estimated for each model layer include horizontal and vertical hydraulic conductivity, storativity and specific yield. Preliminary estimates of *Kh* for all model layers except the Walloon Coal Measures were essentially text-book values derived from the literature and theoretical relationships between permeability and (API) gamma ray counts from drill-holes. These were modified during model calibration. Vertical hydraulic conductivity values were estimated by applying an anisotropy multiplication factor to the calibrated *Kh* values. The anisotropy factor was 300 for aquitards and formations with pronounced layering and 30 for aquifers. *Kh* values for the Walloon Coal Measures were measured from drill stem tests (DST).

A uniform storativity value of 4×10^{-6} was assigned across the entire model domain. This value was derived from a pump test in the Precipice Sandstone at the Kogan Creek power station, and it looks to be artificially low for a permeable sandstone. A uniform specific yield value of 0.03 was assigned to the uppermost model layers. Again, this may be artificially low for a permeable sandstone.

Recharge in layer 1 was assigned according to chloride mass balance estimates for the GAB intake beds from Kellett et al. (2003). Recharge for the Upper Condamine alluvium was assigned according to Lane (1979) and Huxley (1982). Minimal groundwater recharge of 0.025 mm/year was applied over areas where Cainozoic alluvium overlies Evergreen Formation or Moolayember Formation rocks and a low recharge rate of 0.5 mm/year was applied over the large model area southwest of the tenements where Cainozoic alluvium overlies the Rolling Downs Group.

Aquifer-stream bed interaction in the model is accomplished using a channel bed conductance term. This conductance is constrained by inferred stream losses in the Condamine River and its tributaries (Huxley, 1982).

Model Boundary Conditions

No-flow boundaries are set in all layers along the perimeter of the model, except in layers 1 and 2 in the southwest of the model domain. This was to allow shallow groundwater to flow out of the model domain at the downstream ends of the Condamine and Moonie River systems and was handled by assigning a constant head boundary in these elements. The base of the Precipice Sandstone was defined as hydraulic basement (i.e. specified as a no-flow boundary condition). This implies there is no hydraulic connection between the Bowen and Surat Basins.

Model Predictions

Predicted drawdown of the potentiometric surface of the Walloon Coal Measures is not documented in the EIS or supporting documentation, however there is a plot indicating drawdown of greater than 5 m in the Taroom Coal Seams for the year 2049 (APLNG Vol. 2, Ch. 10). This shows the cone of depression >5 m extending up to 10 km beyond the tenement boundaries, but is no more specific than that. Subsequently, APLNG have supplied predicted drawdowns for the key aquifers in ten year time steps from 2019 to 2199. For the Springbok Sandstone the maximum drawdown is predicted to occur in a small area south of Miles (the Undulla Nose) and be of the order of 300 m from 2019 to 2039, declining to about 200 m after 2029 until about 2069. Lesser drawdowns of the order of 150–200 m in the Springbok Sandstone are predicted to be generated within the tenements until at least 2059.

Drawdowns of 5-10 m are predicted to occur in the Hutton Sandstone in a small area west of Miles from 2059 to 2149. Zero drawdown is predicted to occur in the Precipice Sandstone over the life of the project. Drawdowns of 5-10 m are predicted to be generated in the Gubberamunda Sandstone south-west of Miles from 2029 to 2199. The predicted drawdowns in the Springbok, Hutton and Precipice Sandstones are for the APLNG operations only, whereas cumulative operations are taken into account for the Gubberamunda Sandstone predictions.

In summary, the model predicts depressurisation of the Walloon Coal Measures and the Gubberamunda, Springbok and Hutton Sandstones, but there is no predicted dewatering.

Adherence to MDBC Groundwater Modelling Guidelines

The APLNG groundwater model has been evaluated for compliance with key criteria under the MDBC best practice modelling guidelines (Middlemis et al. 2001) which document state-of-the-art standards for undertaking and reporting groundwater modelling. Specifically, we have assessed the simulation model against the guidelines for conceptualisation, calibration, prediction and sensitivity / uncertainty analysis.

Conceptualisation

In our opinion, the APLNG model represents a realistic and defensible translation of a complex hydrogeological physical system into a simulation model. Each of the 11 hydrostratigraphic units are represented as separate layers in the model with the main layer of interest (the Walloon Coal Measures) partitioned into 11 discrete layers to reflect the abundance of information on physical parameters in that unit. The choice of the finite element code (FEFLOW) over the conventional finite difference code (MODFLOW) by APLNG for model simulation appears to be a good one because the triangular-prismatic elements allow better definition of the complex geology, particularly within the tenements. The finer discretisation of the model mesh around the tenements gives greater confidence in the predictions there.

It could be argued that a dual phase (water and gas) model would have been more appropriate for the CSG simulations, but we note that APLNG have accounted for this by gradually reducing hydraulic conductivity in the coal seams during the gas production phase.

The designation of boundary conditions by APLNG appears to be reasonable, apart from perhaps the setting of no-flow boundaries in layers 3 and beyond along the southern model boundary (the western boundary is not impacted because it is almost parallel to the regional groundwater flow lines). In reality, the southern boundary is more or less orthogonal to flow lines in the deeper aquifers and should be specified as groundwater flux (Neuman) boundary conditions. However, we acknowledge that these elements are so far removed from the main area of interest (the tenements) that this criticism is academic.

Like most models, the APLNG finite element model suffers from the assignation of bulk hydraulic parameters for all layers except the coal seams. In reality, there is significant variation in these parameters in all layers across the model domain, particularly in the Evergreen Formation. Of particular concern is the lack of knowledge of storativity values of aquifers and aquitards, with a uniform storativity derived from a single pump test being applied across the model domain. This is not a concern for steady state calibration (as in this case) but would result in large and unquantifiable uncertainties if the model was extended to transient conditions.

The model handles depressurisation of the Walloon Coal Measures by specifying constant head cells 35 m above the top of the WCM. In our opinion, it would have been preferable to configure these as active elements with specified pumping rates. However, we acknowledge the large uncertainties associated with specifying future CSG pumping rates.

Calibration

The model was calibrated against observed pressure measurements over all layers. Head measurements away from the tenements were taken from the DERM groundwater database, across various times and containing lithological interpretation uncertainties. A fundamental flaw in this methodology is the underlying assumption that all the aquifers and aquitards in the Queensland Surat Basin are in steady state equilibrium.

The overall residual mean error for the model was 2% which appears to represent an acceptable model calibration, but some of the residual standard deviations are high (25% in the Precipice Sandstone, 23% in the Westbourne Formation, 19% in the Walloon Coal Measures and 15-16% in the Springbok and Gubberamunda Sandstones).

Prediction

Predicted drawdowns in the major aquifers above and below the Walloon Coal Measures appear to be intuitively as expected and reasonable. However, a possible exception is the near-zero drawdown predicted for the Precipice Sandstone. It seems that the model developers assumed a tight seal for the Evergreen Formation aquitard (between the Hutton and Precipice Sandstones). We have no way of assessing this because Kh and Kv values for the aquitards were not documented in the EIS or in any subsequent APLNG reports. In this regard, it is pertinent to note that drill stem tests in the nearby petroleum well SDA Paddy Creek South #1 (Hodgkinson et al. 2010) show hydraulic continuity between the Hutton and Precipice Sandstones (i.e. the Evergreen Formation is leaky at this location).

The presentation of predicted drawdowns could be improved in the APLNG reports. The colour coding used has too wide a range – it would have been better to use labelled contours. In the particular case of the Gubberamunda Sandstone, it would have been more informative to show the lateral extent of the 2 m drawdown contour, rather than the >5 m contour. This is important because the Gubberamunda Sandstone aquifer has been targeted extensively and at great public and private investment for pressure restoration works under the GABSI Phase 1 and 2 programs. Bore capping has been done in many bores intersecting this aquifer 100 km down gradient and it would be useful to know whether the 2 m drawdown cone of depression propagates this far.

The magnitude of drawdown in the cumulative and stand-alone models is remarkably similar. This result is somewhat counter-intuitive considering a three fold difference in extraction rates between the two models and implies the model may be insensitive to pumping rate.

Sensitivity/Uncertainty Analysis

There is an inherent uncertainty in this and all other CGS proponent models related to the capacity of the model to predict the system response to large drawdowns of the order of several hundreds of metres that will be generated in the Walloon Coal Measures. Groundwater models have been developed primarily to predict the system response to perturbations, but the fundamental question we must ask is: are such large drawdowns beyond the solution space of the model to predict impacts satisfactorily? Is such a large perturbation beyond the scope of the model? It is therefore essential that a post-audit of the model be made after, say, the first 5 years and thereafter at 5 yearly intervals to check what actually happened. It may well be that the greatest uncertainties lie in the water production volumes, not in the estimation of aquifer parameters. Note that the post-audit review is a recommended final step in the MDBC Best Practice Guidelines for medium and high complexity models.

Whilst it is not clear whether a formal sensitivity analysis was carried out on the APLNG model (i.e. Assessing model sensitivity to doubling and halving *Kh*, etc), we note the developers produced a 'best estimate' (calibrated) model, a 'potential minimum impact' model and a 'potential maximum impact' model. These best and worst case scenarios are a surrogate for a formal sensitivity analysis.

Adequacy of Model for Estimating Impacts

Notwithstanding the shortcomings identified above, we are of the opinion that the APLNG groundwater model is adequate to estimate potential hydrogeological impacts from CSG production. As far as practicable, the model developers have followed MDBC best practice guidelines. However, it needs to be acknowledged that the model has only been calibrated against steady state (and variable quality) data, and that better constraints for aquifer storage values would be needed before the model could be extended to transient conditions. The model could also be improved by varying hydraulic parameters across the domain as these data become available. The fundamental question regarding the capacity of the model to handle very large drawdowns in the Walloon Coal Measures will only be answered when production ramps up.

b. Potential impacts of groundwater extraction on aquifer interaction (e.g. water flow, cross contamination), vertical recharge, structural integrity and artesian pressure as a result of the CSG activities. This applies to both quantity and quality of groundwater.

APLNG CSG developments are located between Millmerran and Roma – Wandoan, in an area where most waterbores tap the aquifers of the Bungil Formation, Gubberamunda Sandstone, Walloon Coal Measures, Hutton Sandstone and Precipice Sandstone (APLNG Volume 2, Chapter 10, Figures 10.9 and 10.10). Predictions of the drawdown in these aquifers resulting from CSG groundwater extraction have been made using numerical groundwater simulation models and the results are shown in APLNG Volume 2, Chapter 10, Figures 10.11 to 10.16.

Groundwater extraction from bores causes drawdown of the potentiometric surface of the aquifer from which the groundwater is pumped. A cone of depression will develop, which will expand laterally and vertically over time. Cones of depression of adjoining bores will overlap and the result is interference and accumulation of the cones of depression. Significant lowering of the potentiometric surfaces of the most commonly exploited aquifers in the Great Artesian Basin has taken place since the start of development of the GAB in 1878.

The modelling results indicate that this historical drawdown is likely to be exacerbated by extraction of the volumes of groundwater extracted through coal seam gas developments in the Surat Basin. The considerable volumes of groundwater will be extracted over a period of several decades from the Walloon Coal Measures will depressurise this geological unit to allow coal seam gas to desorb and be produced. As a result, vertical leakage is likely to take place from the overlying and underlying aquifers of the Springbok Sandstone, Hutton Sandstone and Precipice Sandstone, and to a lesser extent from the Gubberamunda Sandstone, into the Walloon Coal Measures and cause drawdown of the potentiometric surface of these aquifers.

We assess that drawdown beyond the CSG tenements is relatively small compared to the drawdowns from a relatively large concentration of bores to the southwest of the tenements. Bores in the latter area are currently showing a slight increase in aquifer potentiometric surfaces as a result of continuing GABSI rehabilitation. Any drawdown effect from the CSG activities will be compensated by the increase due to the GABSI program, therefore it will be difficult to differentiate the opposing changes. A small number of bores in the southwestern part of the northern APLNG tenement and the southern part of the SANTOS Roma tenements are still artesian, with all other bores within and beyond the tenements being now sub-artesian (Figure 2.1-1). Most of the present sub-artesian bores were artesian during the early part of last century, but as a result of large scale drawdown by all bores in the region, they have become sub-artesian. Any reduction in artesian pressure caused by the CSG activities will only have a limited effect on bores in the immediate surroundings of the CSG tenements.

The degree to which artesian pressures will be affected will not be known until either further vertical hydraulic conductivity data is collected, allowing more accurate drawdown predictions, or a monitoring of multiple aquifers within existing fields verifies the magnitude of hydraulic connection between aquifers adjacent to the coal measures. As a surrogate regional pressure data provided by APLNG for the Springbok, Precipice, Hutton Sandstones and the WCM was assessed to obtain an indication of the degree of connection with the groundwater system.

Pressure values for the Springbok, Precipice, Hutton Sandstones and the WCM generally lie on a similar pressure gradient. A plot of hydraulically connected aquifer pressures would show a similar trend, but this does not necessarily prove connectivity between individual aquifers. Further data such as aquifer chemistry, long-term pumping tests or pressure data from adjacent aquifers during production of water from WCM would be required in order to fully assess connectivity of the system. However, pressure data from within the WCM provided by APLNG and QGC, from the Talinga and Berwyndale South fields respectively, indicates that there is poor vertical interconnection within some areas of the WCM. This agrees with the proposition from the proponents that vertical flow is likely to be low due to the low permeability of the interburden within the WCM and may reduce the amount of induced leakage likely to occur from adjacent aquifers to that which numerical simulation modelling predicts. APLNG are currently installing nested piezometers to monitor pressure variations within over and underlying aquifers in their producing CSG field. (pers. comm. A. Moser 1/9/10).

Cross-contamination is considered a minor issue, as the physical characteristics and groundwater chemistry of the groundwater in the aquifers is similar and within acceptable ranges for water supply purposes. The exception is the groundwater from the Walloon Coal Measures, which is more saline and has a different chemistry compared to the other Jurassic aquifers. However, the groundwater from the Walloon Coal Measures is pumped to the ground surface as associated water during coal seam gas production and disposed of or re-injected following desalination processes. Vertical leakage of better quality groundwater from the other Jurassic aquifers is likely to take place into the Walloon Coal Measures.

We consider that structural integrity of the coal seams and aquifers of the Walloon Coal Measures has the potential to be affected by groundwater extraction. Coal seam gas extraction involves reducing the hydrostatic pressure in the coal seams to allow gas production by desorption of methane from the coal. This depressurisation results in a large drawdown cone (up to 600 m) in the potentiometric surface of the Walloon Coal Measures, which spreads out from the coal seam gas field production area. The drawdown of the groundwater levels propagates vertically through the over- and underlying aquitards or confining beds into the over- and underlying aquifers. As a result, vertical leakage from these aquifers takes place towards the Walloon Coal Measures and drawdown cones develop in the potentiometric surfaces of the Gubberamunda, Springbok, Hutton and Precipice sandstone aquifers, although at a smaller scale than in the Walloon Coal Measures. We consider that the depressurisation of these other aquifers will generally be too limited to affect the integrity of the aquifer rock structure, as drawdowns in those aquifers are only of the order of several metres.

c. Potential impacts of groundwater extraction on the EPBC Act listed endangered ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin'.

Risk Identification and Assessment

DEWHA (2001) stipulates that an assessment of each individual natural discharge of groundwater (spring) is required to determine its origin (i.e. whether it is a "discharge" or "recharge" spring) and in turn, whether it is associated with the EPBC listed ecological community (APLNG Vol. 5, Attach. 21, p. 58). It is our understanding that the main sources for spring data in Queensland - the Queensland Herbarium database and the Spring Register in the Queensland Water Resources (Great Artesian Basin) Plan 2006 - are not complete and that not all springs have been investigated, assessed and classified. This could lead to "recharge" springs as well as "discharge" springs being excluded from the EPBC listing, as well as springs being excluded simply because they are located in the recharge areas of the Great Artesian Basin ("recharge" springs are excluded as shown in DEWHA, 2001). This could also mean that the impacts of drawdown of groundwater levels caused by groundwater extraction may not be considered for communities assessed as being "recharge" springs purely on the basis of floristic composition.

The location and EPBC classification (i.e. "discharge" versus "recharge") of known springs in proximity to the APLNG development area is illustrated in Figure 2.1-2.

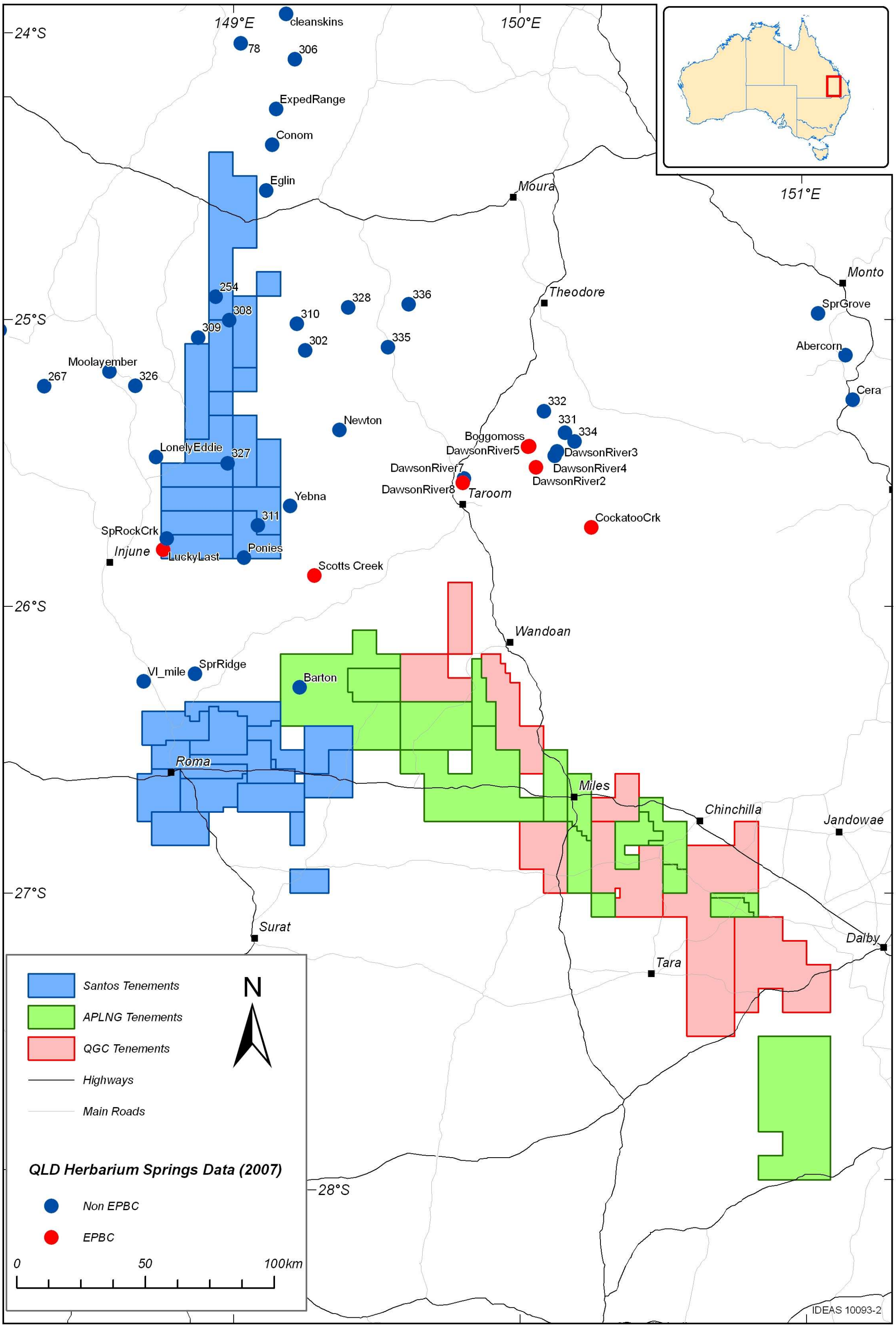

Figure 2.1-2. Location of natural groundwater discharge sites (springs) with respect to coal seam gas tenements considered in the current assessment.

Only one registered "recharge" spring was identified within APLNG leases, in the western corner of the Pine Hills development area (Fig. 2.1-2). The spring is included on the Qld GAB WRP Springs Register and the Qld Herbarium database, but does not appear in the DEWHA mapping of Threatened Ecological Community - The Community of Native Species Dependent on Natural Discharge of Groundwater from the Great Artesian Basins. The spring is listed as 'RJF Site No NV333' and classified as active but not visited. APLNG hydrogeologists visited the site in July 2010 and reported no surface hydrological expression or vegetation indicative of a spring or GDE. The feature was reported as a possible seepage relating to an incised erosional feature at base of deep soil profile after significant rainfall (APLNG response to Geoscience Australia questions – 23 August 2010, p. 29).

APLNG identify numerous high value "recharge" and "discharge" spring complexes associated with the Hutton Sandstone and Precipice Sandstone units. These are located proximal to the Taroom and Injune townships, at least 50 km north and north-west of the northernmost APLNG development areas (DNR 2005). The "discharge" spring complexes located near Taroom are supplied by artesian flow from the Precipice Sandstone, rising to the surface through joints and fractures in that unit. These complexes are known locally as 'boggomosses', and provide a wetland habitat in an area that experiences prolonged below average rainfall conditions (DEWHA 2001) (APLNG Vol. 2, Ch. 10, p. 17).

Recharge springs with high conservation values occur approximately 25 km north and northeast of Roma (Fig. 2.1-1), within outcropping areas of the Gubberamunda Sandstone (DNRM 2005). APLNG report having consulted with s. 47F(1) (DERM) on 18 February 2010 regarding the condition and source of the spring complexes located 25 km to the north of Roma. s. 47F(1) apparently confirmed that these springs are "recharge" springs, which emanate from the Gubberamunda Sandstone and that they have all been substantially damaged by damming and excavation. Water chemistry data provided by s. 47F(1) indicate that the water associated with these springs is of good quality, with near neutral pH, low mineralisation (as mg/L TDS) and an ionic composition similar to shallow groundwater and surface waters in the region. This supports the interpretation that the springs are derived from shallow, short flow systems (related to the outcropping Gubberamunda Sandstone), rather than being "discharge" springs associated with the deeper Great Artesian Basin aquifers (APLNG Vol. 5, Attach. 17, Table 5-1, p. 112).

It is noted that there is some ambiguity in the definition of "discharge" springs. Some definitions of natural discharge of groundwater sites are based on floristic composition rather than hydrogeological characteristics.

The proposed gas transmission pipeline corridor crossing Cockatoo Creek (east of Taroom) is known to be associated with GAB spring communities. No EPBC listed communities were recorded during the dry season survey conducted on behalf of APLNG, although the consultant reports that communities could be present where suitable habitats (i.e. actively flowing springs) exist. The EPBC listed *Myriophyllum artesium* (Artesian milfoil) and *Eriocaulon carsonii* (Salt pipewort) are known to occur in Cockatoo Creek (APLNG Vol. 5, Attach. 18, p. 99). The main activities that could impact artesian spring communities on Cockatoo Creek are identified as direct excavation and/or sediment delivery from road and pipeline construction, rather than effects from groundwater extraction (APLNG Vol. 5, Attach. 18, p. 94). Based on the current location of the pipeline corridor, the likelihood of impacts occurring would be minimal according to APLNG (Vol. 5, Attach. 17, Table 5-1, p. 108).

The groundwater model predicted drawdown cone of depression associated with the CSG extraction of groundwater has the potential to impact on the aquifer pressure of and groundwater flows from artesian springs that are within the cone of depression from CSG activities. For a period of time post-CSG production, during the recovery phase, the groundwater level drawdown cones in the affected GAB aquifers, whilst reducing in magnitude, are projected to broaden beyond the boundaries of the CSG development areas. APLNG's groundwater modelling (APLNG Vol. 2, Ch. 10) suggests that there is a very low risk that groundwater levels will be affected post-operation (APLNG Vol. 2, Ch. 9, p. 25), but it is unclear whether this relates strictly to bore water levels, or whether spring levels are included in this assessment. According to their initial 'project case' and 'cumulative case' numerical groundwater simulation model projections, APLNG determine that associated water production may have the following implications for spring complexes (and their dependent ecosystems) post-CSG operations (APLNG Vol. 5, Attach. 21, p. 81):

- High-value spring complexes and their associated ecosystems that occur east of the town of Injune - low risk that groundwater levels (and potentially the rate of vertical groundwater flows) will be affected by the APLNG operations.
- High-value spring complexes and their associated ecosystems *("discharge"* spring complexes) located near Taroom - not considered by APLNG to be at risk of reduced groundwater levels or vertical flows as a consequence of APLNG operations.
- Spring complexes that occur 25 km north and northeast of Roma in outcropping areas of Gubberamunda Sandstone - not expected to be affected by any reduced groundwater levels that may occur in this area.
- Various spring complexes that may exist approximately 100 km west of Roma. These spring complexes are *"recharge"* springs (pers. comm. s. 47F(1) , 18 February 2010) and as such APLNG does not expect them to be affected by any reduced groundwater levels that may occur in this area.

GA and s. 47F(1) consider that the risk methodology applied by APLNG (Vol. 1, Ch. 4) is appropriate for assessing potential risk to EPBC listed communities. Against the criteria specified in their risk assessment documentation, we agree with APLNG's determination that there is a high risk of impact to EPBC communities as a result of pipeline and road construction in proximity to the Cockatoo Creek springs (APLNG Vol. 5, Attach. 17, Table 5-3, p. 119) and a low risk of potential impact associated with aquifer drawdown during the operation and decommissioning phases (APLNG Vol. 5, Attach. 17, Table 5-4, p. 121-122). These conclusions are based primarily on the relative proximity of CSG activities and modelled groundwater drawdown effects to known spring communities. However, it should be noted that any variation in the groundwater simulation model predicted lateral and vertical extent of groundwater drawdown could alter the potential impact and hence risk rankings.

On the basis of the available documentation, GA and s. 47F(1) consider that the majority of risks of significant impacts to the GAB and other affected surface and groundwater systems have been adequately identified and assessed. However, there are several identified spring communities for which the risk could be more thoroughly assessed. Acquisition of the data identified below would provide a mechanism for APLNG to reduce or eliminate these uncertainties.

Further Analysis

APLNG have already adopted the recommendation put forward by their consultant (Hydrobiology – APLNG Vol. 5, Attach. 17, p. 126) that they undertake field investigations to confirm the classification and condition (as well as location, type, source aquifer) of springs north of Roma (Six Mile, Spring Ridge). In addition, we recommend that APLNG undertake investigations of the springs east of Taroom (Cockatoo Creek) in order to inform a revised route for the pipeline. Despite being outside the APLNG tenements and modelled range of drawdown, it would also be pertinent to assess the spring (Scott's Creek) north of the Pine Hill's development. This site is known to host EPBC significant communities and to account for any variation in the modelling results which may alter the extent of drawdown influence it is recommended that this site be fully characterised for baseline purposes.

It is also suggested that for a minimum of 12 months prior to CSG development all spring sites within the APLNG tenements, plus those referred to above, be investigated and monitored at least quarterly (i.e. every 3 months) in order to identify any temporal or seasonal variation in the presence/absence of the EPBC Act communities of native species dependent on natural discharge of groundwater from the GAB. This recommendation is consistent with observations of large seasonal variability in the watercourses of the region, as reported by the consultant (Hydrobiology – APLNG Vol. 5, Attach. 17, p. III).

The completion of these investigations and monitoring results would provide a robust baseline data set against which to monitor any potential impacts of the CSG gas field and pipeline developments.

Adequacy of Mitigation Measures and Conditions

The monitoring and mitigation strategies proposed by APLNG are based on the principles of adaptive management. Adaptive management is a structured, iterative process of optimal decision-making in the face of uncertainty, with a focus on reducing uncertainty over time via system monitoring and knowledge enhancement. The main advantage of this approach is seen by APLNG to be the ability to utilise new groundwater quality and quantity knowledge generated in the region to update the conceptual hydrogeological model and associated numerical groundwater flow simulation model and adapt CSG operations and associated water management decisions accordingly (APLNG Vol. 5, Attach. 21, p. 29).

APLNG provide details of the location of their proposed monitoring bores and the aquifer targeted by each (APLNG Vol. 2, Ch. 10, Fig. 10.18). The presence of multiple monitoring bores in the Gubberamunda Sandstone to the west of the APLNG tenements is considered by GA and s. 22(1)(a)(ii)

s. 47F(1) to be a particularly appropriate decision with regards to monitoring any potential impact on springs to the north of Roma. Some additional monitoring bores in the Springbok Sandstone could be considered, particularly midway between Miles and Surat, where a major area of drawdown of the Springbok Sandstone aquifer will be located. Monitoring bores should have a frequency of groundwater level readings of at least quarterly from the start-up of CSG development, increasing to monthly or even weekly when groundwater levels start to show changes. Monitoring frequency of springs should be similar.

The potential implementation of monitoring bores concentrically outward from the CSG gas fields, in conjunction with indicative regional monitoring locations, to be developed in collaboration with other CSG proponents and government in accordance with the Queensland Government's Blueprint for the LNG Industry (APLNG Vol. 2, Ch. 10, p. 44), are also considered by GA and s. 47F(1) to be positive and appropriate decisions.

The monitoring measures proposed by APLNG (Vol. 5, Attach. 17, p. 126) are considered by GA and s. 47F(1) to require further explanation. While APLNG propose water quantity and quality indicators and trigger thresholds for changes in water level and water quality (APLNG Vol. 2, Ch. 10, Section 10.5.1), it is not clear how trigger levels will be acted upon with regards to mitigating changes to groundwater flow or quality in springs. Accordingly, GA and s. 47F(1) consider that the current mitigation measures require further elaboration to provide confidence that critical impacts on springs can be mitigated.

Proposed Measures or Requirements

- It is recommended that the proposed monitoring bore network be expanded to include bores monitoring the Precipice Sandstone between the APLNG tenements and both Taroom and Cockatoo Creek, in order to quantify any potential impact of drawdown on EPBC significant springs in that region.
- Although one monitoring bore in the Hutton Sandstone aquifer is already proposed immediately west of the westernmost (Pine Hills) APLNG CSG field, it is recommended that additional monitoring of the Hutton Sandstone to the north of Pine Hills be established to facilitate impact monitoring on the EPBC significant springs east of Injune (Scott's Creek).
- Additional monitoring bores in the Springbok Sandstone could be considered, particularly midway between Miles and Surat, where a major area of drawdown of the Springbok Sandstone aquifer is predicted.
- Monitoring measures proposed for adaptive management of spring communities in the region could be expanded to include those additional sites referred to previously. Springs in the areas west, northwest, north and northeast of Roma are not expected to be affected by the APLNG CSG activities, but some monitoring might be required, particular if the modelling predictions divert significantly from the actual drawdown conditions.
- The aquifer source of natural groundwater discharge sites (springs) needs to be established in all cases. In order to estimate the potential for impacts caused by CSG groundwater level drawdown, the elevation of the spring (vent) and the potentiometric surface elevation of the

source aquifer in the spring region should be determined (where not already known) prior to the onset of CSG groundwater extraction and be monitored throughout the production and recovery stages of the project.

Summary

On the basis of the available information, and subject to the adoption of recommendations proposed in earlier sections, GA and s. 47F(1) consider that APLNG have, in general, adequately identified and assessed the risk of significant impacts of groundwater extraction on the EPBC Act listed endangered ecological community *'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin'*. Exceptions have been noted and recommendations for further analysis to generate more robust baseline data sets are proposed. We agree with APLNG's assessment that the risks to EPBC communities resulting from both physical disturbance and groundwater drawdown are low, based primarily on the absence of any *"discharge"* springs from the CSG fields and the modelled zones of drawdown. However, we consider that the monitoring and mitigation measures proposed by APLNG could be strengthened, and we make a number of the proposed recommendations, including the expansion of the monitoring bore network.

d. Potential for recharge into the GAB to be impacted in these areas due to CSG activities and the likely long-term impact(s).

The potential for recharge into the GAB aquifers to be impacted due to CSG activities can be considered as three separate issues:

- Potential for infrastructure associated with CSG activities located on the GAB intake beds to reduce the amount of recharge due to soil compaction and a reduction in intake bed surface area due to infrastructure footprint.
- Potential for infiltrating recharge water to be contaminated prior to recharging the GAB aquifers.
- The effect on the GAB water balance caused by induced leakage from the GAB aquifers through extraction of associated water from the CSG formations.

It should be noted that a reduction in pressure due to water extraction down-gradient of the GAB aquifer intake beds will not affect the rate at which infiltrating water moves through the unsaturated zone into these aquifers. Hence the rate of recharge will not change. Recharge is a function of rainfall and rock permeability, which regulates the rate at which water can enter the rock matrix of the aquifer.

The risk that infrastructure located within the intake beds of the GAB will significantly reduce the amount of groundwater recharge is negligible and is not assessed further. For example, estimates of surface area covered by each production well drill pod, headworks and infrastructure are in the order of 0.005 km^2. As such, the total area impacted for the maximum 15,000 proposed CSG extraction wells will be in the order of 75 km^2. This area is insignificant considering that the GAB intake beds cover an area of several thousand square kilometres.

APLNG has identified shallow groundwater contamination as an issue; specifically contamination from associated water brine ponds and chemical and fuel storage sites associated with processing plants. APLNG state that Qld EPA guidelines will be adhered to in respect of the lining of brine ponds and on-site storage of chemicals and that these "best-practice" strategies will prevent on-site contamination.

GA and s. 47F(1) consider that the shallow groundwater monitoring strategies outlined in the APLNG EIS should be sufficient to address any potential shallow groundwater contamination issues.

Insufficient data was available in the EIS to enable an assessment of the impact of associated water production upon recharge in terms of the GAB water balance. To this end, data for the latest leakage estimates for aquifers adjoining the coal seams in each development area were requested from APLNG.

APLNG have been unable to provide the requested induced leakage data in the timeframe for delivery of this report. They have provided recharge estimates for the intake areas, used as input into numerical groundwater simulation model. These GAB aquifer recharge estimates are in general agreement with those of Kellett et al. (2003), as indicated by a comparison of the equivalent units in Table 2.1-1. However, at this stage a direct comparison of recharge against induced leakage from individual aquifers adjacent to the WCM is not possible, but a comparison of the bulk recharge of aquifers likely to be impacted, including the WCM with forecast average annual water production has been undertaken.

Table 2.1-1. Estimated recharge values for key hydrogeological units based on APLNG groundwater modelling.

Geological sub-unit	**Recharge (ML/yr) (APLNG data)**	**Surat Management Zone Recharge (ML/yr)(Kellett et al. 2003)**
Condamine Alluvium	9977	
Cainozoic Units/Rolling Downs Group	43572	
BMO/Gubberamunda Grouping	55827	60300 (Hooray Sst & Equivalents)
Springbok Sandstone	893	
Injune Creek Group	6885	
Hutton Sandstone	42439	54280
Evergreen Formation/Precipice Sandstone	119859	
Model Base	234	
Total	*279688 (279.7 GL/yr)*	

Based on water production forecasts and the recharge estimates provided by the proponents, average annual water production, over the life of the project, amounts to 15% of annual recharge for likely to be impacted aquifers adjacent to and including the WCM (Table 2.1-2).

Table 2.1-2. Estimated water production as a percentage of recharge.

Aquifer	Estimated annual recharge ML/yr	Forecast average annual water production (best case scenario) ML/yr	Forecast water production as % recharge
BMO/Gubberamunda Group + Springbok Sandstone + Injune Creek Group (WCM) + Hutton Sandstone	106045	15931	15

e. Potential impacts of fraccing on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes.

A series of risks associated with hydraulic fracturing ('fraccing') have been identified by APLNG that have the potential to impact the structural integrity and flow characteristics of surrounding aquifers. These risks include compromise of the integrity of the cement behind bore casings that could allow vertical fluid movement, fault reactivation, and the growth of induced fractures out of the intended zones into the surrounding aquifers and aquitards. Each risk is addressed in brief by the proponent who considers the overall risk of impact to be low.

The integrity of casing cement is confirmed through the use of cement bond logs and pressure testing of the casing. These are industry standard procedures (see API, 2009) and are considered adequate.

The risk of reactivation of existing faults is mitigated through the geological characterisation of the areas where fracture stimulation activities are carried out. In addition, design of the fraccing to generate multiple, smaller volume treatment zones also limits the extent of fracture growth.

Numerous steps and precautions are taken to mitigate the risk of induced fracture growth into surrounding aquifers and aquitards. These include the application of appropriate fracture monitoring techniques, maximising the distance between fracture zones and known aquifers, the use of a larger number of small stages of fracture fluid volume to limit fracture extent, and control of treating pressures to avoid extreme pressure. Mitigation measures have only been addressed briefly, but we believe they are adequately covered and are in line with industry standards, as are the remedial measures proposed.

As such, we consider that fraccing represents a low risk to the structural integrity of aquifers and aquitards, and on existing groundwater flow processes, so long as the proponent applies industry standards (e.g. API, 2009) and follows operating procedures as defined by the regulator.

f. Initial advice on the likelihood of materiality of subsidence as the result of the proposals.

APLNG identify the possibility of differential subsidence and assess it empirically. They determine a low risk ranking for the potential of both subsurface and land surface subsidence (APLNG Vol. 5, Attach. 21, pp. 91-92), despite providing an estimate of up to 0.5 m of subsidence. In the absence of appropriate data for the proponent to undertake a full geotechnical assessment of potential subsidence, we interpret the current information to suggest that the likelihood of subsidence is high. However, subsidence assessments for an existing CSG field in the Powder River Basin, USA, which represents a broadly similar geological setting to the Surat Basin, suggest that compression in the coal seams has not been transmitted to the surface due to the strength of materials above the coals. It is expected that such subsidence would be uniform over the area, and would not result in significant impact (Case et al. 2000).

APLNG propose baseline and ongoing regional groundwater level monitoring in areas at higher risk of CSG effects. They consider that early detection of potential land subsidence through groundwater monitoring would trigger mitigation measures, such as the injection of water into affected aquifers to counteract the effects. APLNG also state that groundwater level and quality monitoring may also assist in identifying any compromise to aquitard integrity through fracturing (and inter-aquifer flow); a possible consequence of geological deformation (APLNG Vol. 5, Attach. 21, p. 127).

GA and s. 47F(1) consider that the monitoring and mitigation measures proposed by APLNG are adequate to account for potential subsidence resulting from groundwater extraction and coal seam depressurisation.

Monitoring proposed by APLNG is restricted to the subsurface, and no consideration has been given to assessing change over time at the land surface. We suggest that the proponent, in conjunction with relevant State Government agencies and other proponents, establish baseline and ongoing geodetic monitoring programs to quantify deformation at the land surface. These should link from the tenement scale to the wider region across which groundwater extraction activities are occurring.

g. Initial advice on the likelihood and materiality of any impact on MDB groundwater or connected surface water resources.

APLNG have not provided information to enable assessment of the likelihood and materiality of any impact on MDB groundwater or connected surface water resources.

The GAB Water Resource Plan (DERM 2006) indicates that all identified baseflow reaches in the MDB are in the sub-artesian zone of the GAB, thus significantly limiting the possibility that base flow is derived from deep GAB aquifers. This assessment was based on a simplistic comparison of groundwater pressures and river bed elevations without consideration of the potential for connection between the aquifers and rivers. As a result, the identified potential for GAB sourced baseflow is likely to be a significant overestimation.

Although this broad assessment suggests that MDB surface water resources are not likely to be sourced from underlying GAB aquifers, there remains a minor possibility that the river sections may receive some baseflow from unconfined GAB sediments. To further assess this possibility, APLNG have commenced landowner surveys, remote sensing, field and stream gauging studies to re-assess potential GAB aquifer connected baseflow reaches. The hydrological and GDE significance of projected model drawdowns in any reaches with residual potential baseflow are planned be assessed through detailed investigation and monitoring (APLNG response to GA questions – August 2010, pp. 46-47).

On the basis of hydrograph analyses and water quality trends presented by Hillier (2010) there is an identified hydraulic connection between the Walloon Coal Measures (WCM) and Condamine River alluvium in the Cecil Plains area (southeast of Dalby). If the Walloon Coal Measures in this area are depressurised due to CSG activities, Hillier (2010) predicts that leakage could occur from the River and the alluvium into the Walloon Coal Measures. The Hillier (2010) report recommends that this potential leakage rate be quantified before approving any CSG activities in the Cecil Plains area. A small number of APLNG tenements intersect the Condamine River and its alluvium downstream of Chinchilla, but this area is unlikely to leak into the Walloon Coal Measures because there is no hydraulic connection between the Condamine alluvium and the WCM north west of Dalby.

On the basis of the available information, we thus consider that there is a limited likelihood of impact on MDB groundwater or connected surface water resources as a result of the proposed APLNG operations, and that APLNG are taking appropriate steps to better clarify the nature of any potential impact.

The following recommendations are made with regards to assessing potential impact on MDB groundwater or connected surface water resources:

- Data acquisition through drilling and pumping tests to quantify the connectivity between aquifers overlying the Walloon Coal Measures;
- Development of a regional scale, multi-layer model of the interaction between the Walloon Coal Measures and overlying aquifers to evaluate the long-term impacts of coal seam gas development on groundwater and connected surface waters in the MDB.

2.2 QUEENSLAND GAS COMPANY (QGC)

2.2.1 Project Summary

QGC propose to develop an area extending from around Wandoan southeast to Dalby, including areas west and south of Miles and Chinchilla (Fig. 2.2-1). The development areas target the Walloon Coal Measures of the Surat Basin.

The basis for the Project design is the delivery of 1,360 million standard cubic feet per day (MMscfd) of compressed CSG to the LNG Facility to be constructed at Gladstone. QGC plan to progressively establish approximately 6,000 gas production wells over the life of the project (20-30 years) with initially 1,000 to 1,500 wells across the gas field by mid-2014. The remaining wells will be phased in over the life of the project (20 to 30 years) to replace declining wells. Wells are drilled to a depth of between 200 m and 700 m, and have a typical life of between 15 and 20 years. Gas production is expected to ramp up from the current rate of 200 TJ/day to approximately 707 TJ/day (equivalent to 680 MMscfd), and ultimately to 1,415 TJ/day (1,360 MMscfd).

Cumulative groundwater production over the life of the project is expected to be approximately 1,200,000 ML (1200 GL). The volume of water generated is projected to peak at approximately 180 ML per day in 2013/2014, with average production in the order of 160 ML per day between 2015 and 2025. The estimated water volumes may vary by ± 50%.

The QGC tenements fall predominantly within the Surat Groundwater Management Area, with small areas in the Surat East, Surat North and Eastern Downs Management Areas, as defined in the Great Artesian Basin Water Resource Plan (DNRM 2005).

The Surat Management Area overlies the Jurassic to Lower Cretaceous sequence in the Surat Basin and the Upper Triassic sediments of the Bowen Basin in the west.

The Surat East Management Area covers the sediments of Kumbarilla Beds, Walloon Coal Measures, Hutton and Precipice Sandstones the within the Surat Basin and the Clematis Sandstone within the Bowen Basin.

The Surat North Management Area covers the sediments of the Westbourne Formation, Injune Creek Group, Hutton and Precipice Sandstones within the Surat Basin and the Clematis Sandstone within the Bowen Basin. This area has a large number of high value recharge and discharge springs within the outcrop areas of the major aquifer units.

The Eastern Downs Management Area covers western part of the Clarence Moreton Basin, extending from the Kumbarilla Ridge to the Great Dividing Range. The area includes the Jurassic sedimentary rocks of the Walloon Coal Measures, Marburg Sandstone and Helidon Sandstone, which are equivalent to sediments in the Surat Basin over the Kumbarilla Ridge.

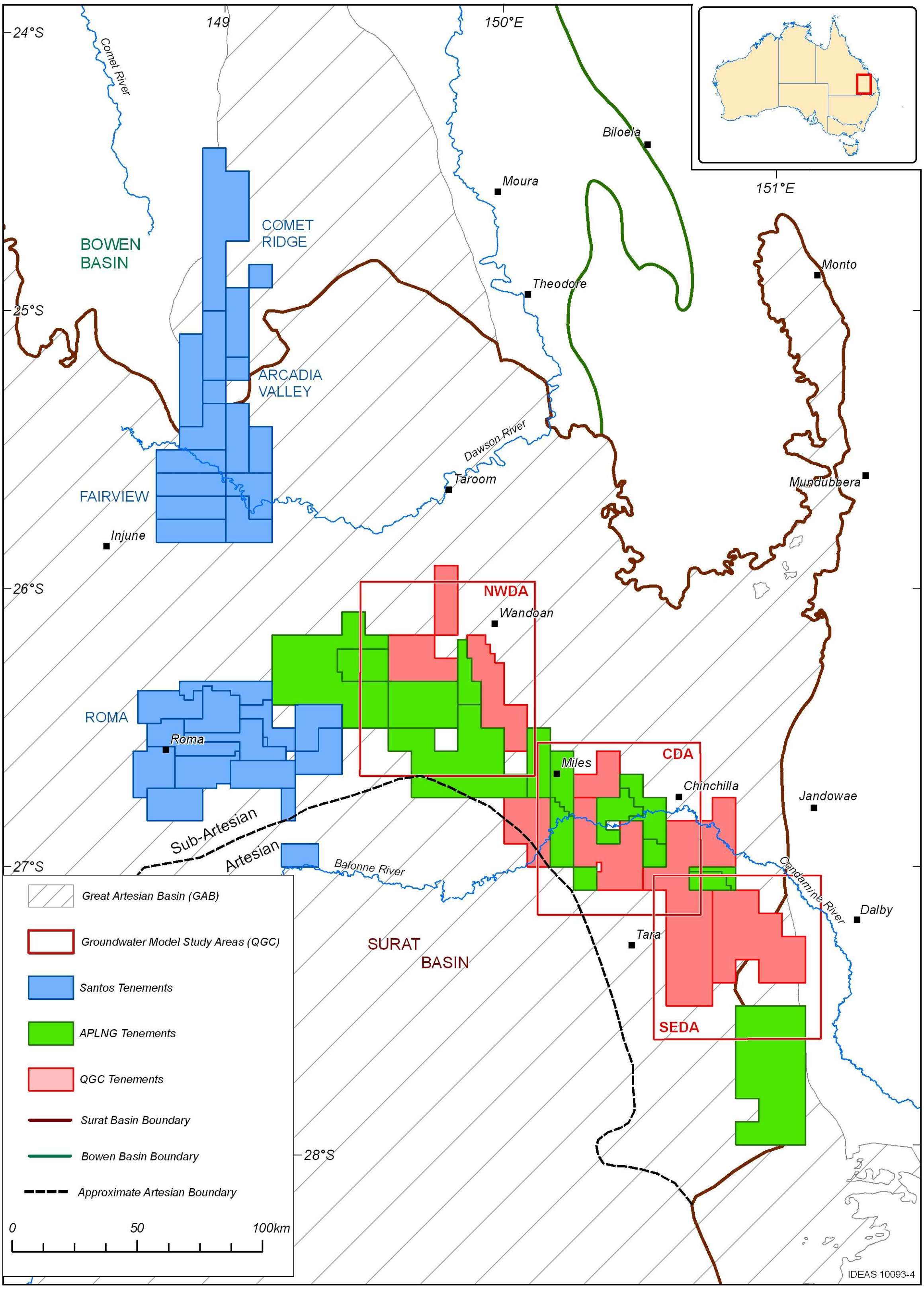

Figure 2.2-1. Location of coal seam gas tenements considered in the current assessment. The location of the artesian/sub-artesian divide, surface drainage and basin boundaries are also shown.

2.2.2 Summary of Assessment

The following summarises our assessment of the QGC proposed CSG development activities.

The adequacy of the proponents' hydrogeological models for estimating hydrogeological impacts on and within the Great Artesian Basin (GAB) and other affected surface and groundwater systems (this would include an initial assessment of the potential of one or more aquifers to depressurise and dewater and the likely impacts).

QGC present three numerical hydrogeological simulation models – using the modular finite-difference groundwater flow model (MODFLOW) computer code. The three model domains have been developed to encompass the location of the NWDA, CDA and SWDA - QGC CSG development areas. Each development area is considered geographically and geologically distinct and occupies an area of 17280 km^2. Based on the information provided by QGC in their EIS documents, and discussions with QGC, our assessment concludes that:

- Within the limitations of available data, the 'project-scale' groundwater models produced are suitable for estimating hydrogeological impacts on and within the GAB and other potentially affected surface and groundwater systems within the influence of the QGC operations. We have, however, noted a number of limitations in the modelling approaches taken.

- The modelling results reported by QGC require further work to fully establish the uncertainties and sensitivity of the models to the large predicted drawdowns that will occur in the coal measures, and hence does not provide a level of confidence in the model outputs and the conclusions drawn from them.

- The numerical groundwater simulation models were developed to produce drawdown predictions that could provide input into a risk management strategy, and the models are not designed to produce absolute and quantitative prediction of the magnitude of drawdown at specific locations

- The modelled occurrence, magnitude and extent of depressurisation in the Mooga Sandstone, Gubberamunda Sandstone and Springbok Sandstone, Hutton Sandstone and Precipice Sandstone aquifers is consistent with the proposed groundwater extraction operations, and is conservative in comparison with known impacts from existing CSG operations in the region.

Potential impacts of groundwater extraction on aquifer interaction (e.g. water flow, cross contamination), vertical recharge, structural integrity and artesian pressure as a result of the CSG activities. This applies to both quantity and quality of groundwater.

Potential impacts of groundwater extraction on aquifer interaction have, in general, been adequately addressed with, while there is scope for further elaboration regarding some aspects. Based upon consideration of the hydrogeological, geological and project development information provided, we conclude that:

- The modelled vertical recharge and artesian pressure changes resulting from coal seam depressurisation are realistic and likely to result in groundwater flow into the coal measures from adjacent aquifers. We consider that these changes are reversible over timeframes of decades to centuries, depending on the specific aquifer and the management strategies applied.

- Cross-contamination is likely to be of little consequence as the majority of inter-aquifer transfer will involve the migration of higher quality water from adjacent underlying and overlying sandstone aquifers into the Walloon Coal Measures.

- The structural integrity of aquifers in relation to groundwater transmission is unlikely to be significantly impacted by the proposed groundwater extraction. We note that groundwater extraction may cause some aquifer compaction that is likely to result in subsidence (as identified by the proponent and discussed below).

Potential impacts of groundwater extraction on the EPBC Act listed endangered ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.'

Based upon consideration of the hydrogeological, environmental and management information provided, we agree with QGC that the risk of impact from groundwater extraction to the EPBC Act listed endangered ecological community '*The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*' is low, based on the following:

- The location of documented and/or surveyed natural discharge sites (springs) from the CSG fields and the modelled zones of groundwater drawdown.

- Proposed monitoring programs enabling detection of potentially deleterious changes to groundwater level or quality and instigating mitigation measures.

- Proposed controls on the location and construction of infrastructure to avoid physical impacts on environments suitable for hosting EPBC Act listed communities.

- A small number of additional natural discharge sites proximal to the CSG fields may need to be investigated and assessed to determine their EPBC Act significance.

Uncertainties in the extent of modelled groundwater drawdown, however, lead to the conclusion that a small number of additional natural discharge sites proximal to the CSG fields may need to be investigated and assessed to determine their EPBC Act significance. We suggest that the outcomes of such investigations could provide input to the monitoring and management process proposed by QGC and ensure that the baseline datasets upon which monitoring and mitigation measures are based are both robust and complete.

Potential for recharge into the GAB to be impacted in these areas due to CSG activities and the likely long-term impact(s).

Consideration of a range of hydrogeological, geological and groundwater production data provided by QGC lead us to agree that their proposed CSG activities represent a low risk to recharge into the GAB. This is primarily because:

- The proposed extraction volumes are small in comparison to GAB intake bed recharge volumes, and;
- The majority of existing groundwater users and environmental values are located up-gradient of the proposed extraction activities.

Long-term impacts of the proposed CSG activities are possible, however, and would most likely manifest as a reduction in recharge volumes basinward of the CSG developments, which could result in reduced artesian pressures and potential impacts on EPBC Act significant spring communities much further afield north of the QGC tenements.

We are unaware of any existing data or modelling results that would be suitable for assessing the likelihood or potential timeframes for such impacts, although groundwater movement rates in deeper GAB aquifers.

Potential impacts of fraccing on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes.

Based upon the geological and technical information provided by QGC with regards to the potential impacts of hydraulic fracturing ('fraccing'), we consider that the potential risks posed by fraccing are low. We conclude that:

- The assessment completed by QGC identifies and assesses relevant factors and risks involved in the process.
- While the potential for fraccing activities to impact on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes, can never be completely eliminated, the competent application of industry standard technologies, techniques, and monitoring/mitigation measures proposed by QGC are considered appropriate for minimising the risk.

Initial advice on the likelihood and materiality of subsidence as the result of the proposals.

Based upon our assessment of the geological and geotechnical information provided, and relevant information from other sources, we agree with QGC that there is a likelihood of subsidence, and that this could result in several centimetres of surface subsidence.

However, based on the estimated magnitude of the subsidence (in the order or centimetres to tens of centimetres), and with reference to subsidence assessments for CSG activities in similar geological environments elsewhere, we consider that the risk of impacts to surface water and shallow groundwater systems are very low.

We suggest that the monitoring measures currently proposed by QGC, which assess both surface and sub-surface deformation and are considered appropriate, could be value-added by tying into a regional program of monitoring lead by the relevant State Government agency.

Initial advice on the likelihood and materiality of any impact on MDB groundwater or connected surface water resources.

On the basis of the available information, we consider that there is a limited likelihood of impact on MDB groundwater or connected surface water resources as a result of the proposed QGC operations.

This assessment is based primarily on information suggesting that the small number of QGC tenements proximal to the Condamine River and its alluvium are located in an area where there is no known hydraulic connection between the Walloon Coal Measures (which will undergo depressurisation) and alluvial aquifers of the Condamine Valley. QGC predicts that there will be no measurable reduction or loss of baseflow contribution to rivers or creeks as a result of the QGC CSG project operation.

2.2.3 Assessment of Proposed Development

a. The adequacy of the proponents' hydrogeological models for estimating hydrogeological impacts on and within the GAB and other affected surface and groundwater systems (this would include an initial assessment of the potential of one or more aquifers to depressurise and dewater and the likely impacts).

Model Description

QGC have developed three numerical groundwater simulation models using the modular finite-difference groundwater flow model (MODFLOW) computer code. The three model domains have been developed to encompass the location of the North-West, Central and South-East development areas. Each area is considered geographically and geologically distinct and occupies an area of 17,280 km^2. Each model has the same structure and consists of 18 layers corresponding to known aquifer and aquitards. The Walloon Coal Measures are represented by 2 aquifer layers within the model. The well field area is represented by 250 x 250 m cells. Model cells increase in width beyond the boundary of the well field. The respective well fields in each development area are represented as 50 x 10 km rectangular strips.

Model Parameters

A preliminary set of hydraulic parameters based mainly on published broad regional estimates has been used to provide a starting point for deriving a minimum and maximum set of parameters.

A minimum and maximum set of model hydraulic parameters have been arrived at by varying hydraulic conductivity, *Kv/Kh* ratios and storativity values ("within realistic ranges") in an attempt to match the model associated water volumes to upper and lower bound of a predicted associated water production forecasts that has an uncertainty of +-50%.

No recharge was used for the model to provide a level of conservatism in model outputs.

Model Boundary Conditions

To simulate the lateral extent of layers within the model beyond the model boundaries, constant head conditions were applied. The constant head boundaries used are 305 m AHD, 295 m AHD and 315 m AHD for the central, north-west and south-east development areas respectively.

Model Predictions

THE QGC EIS states that modelled drawdown in Gubberamunda Sandstone is minimal.

Drawdowns listed in Table 2.2-1 are for a point 1.8 km from the edge of the depressurised zone. No drawdown maps showing the areal extent of drawdown are provided in the EIS to allow an assessment of the distribution of groundwater drawdown within aquifers overlying and underlying the Walloon Coal Measures.

Table 2.2-1. Predicted drawdown at a point 1.8 km from the edge of modelled depressurisation zone (NWDA = North-West Development Area; CDA = Central Development Area; SEDA = South-East Development Area).

Aquifer	Drawdown (m) NWDA	Drawdown (m) CDA	Drawdown (m) SEDA
Springbok Sandstone	2 (max) 0 (min)	55 (max) ~5 (min)	23 (max) ~1 (min)
Hutton Sandstone	+0.1 (max) ~+0.8 (min)	2.5 (max) +0.25 (min)	~8 (max) ~1 (min)
Precipice Sandstone	+0.75 (max) + 0.001 (min)	1.8 (max) 0 (min)	~6 (max) 0 (min)

Adequacy of Model for Estimating Impacts

QGC state that their groundwater simulation model was developed to produce drawdown predictions that could provide input into a risk management strategy, and that the model is not designed to produce absolute and quantitative prediction of the magnitude of drawdown of the potentiometric surface at specific locations (at this stage). Further, the lack and quality of available data has influenced the level of sophistication of the model, resulting in a relatively simple model that has not been calibrated against measured groundwater levels.

However, QGC state that the conservatism built into the model provides high end estimates of aquifer leakage and drawdowns that are unlikely to be observed in reality. This assertion is based on their interpretation that extensive drilling within the Walloon Coal Measures suggests that the Walloon Coal Measures are hydraulically isolated from the adjacent aquifers. Furthermore, QGC state the high vertical hydraulic conductivity and low thickness values for the aquitard overlying the upper representative coal seam, and the lack of recharge into the model are evidence of the model's conservatism.

It is the opinion of GA and s. 47F(1) that, while the quantity and quality of available data may not permit a more sophisticated model to be constructed, the current QGC model provides only a rudimentary level assessment of hydrogeological impacts of associated water production on the GAB groundwater system.

b. Potential impacts of groundwater extraction on aquifer interaction (e.g. water flow, cross contamination), vertical recharge, structural integrity and artesian pressure as a result of the CSG activities. This applies to both quantity and quality of groundwater.

Coal seam gas developments proposed by QGC are located in a NW-SE oriented belt between Wandoan and Dalby, in an area where the majority of waterbores tap aquifers of the Bungil Formation, Mooga, Gubberamunda and Springbok Sandstones, and the Walloon Coal Measures (QGC Appendix 3.4, Report No. 9, pp. 89-92; DNRM 2005, pp. 29-31). Predictions of the drawdown in these aquifers by the CSG groundwater extraction have been made using numerical groundwater simulation models and the results are summarised in QGC Appendix 3.4, Report No. 11, pp. 105-109 and detailed in QGC Appendix 3.4, Report No. 13.

QGC model predictions indicate that CSG production will result in considerable volumes of groundwater being removed from the Walloon Coal Measures over a period of several decades. Consequently vertical leakage will take place from the overlying and underlying aquifers of the Springbok Sandstone, Hutton Sandstone and Precipice Sandstone, and to a lesser extent from the Gubberamunda Sandstone, into the Walloon Coal Measures causing drawdown of the potentiometric surface of these aquifers.

We assess that drawdown beyond the CSG tenements is relatively small compared to the drawdowns from a relatively large concentration of bores to the southwest of the tenements. Bores in the latter area are currently showing a slight increase in aquifer potentiometric surfaces as a result of continuing GABSI rehabilitation. Any drawdown effect from the CSG activities will be compensated by the increase due to the GABSI program, therefore it will be difficult to differentiate the opposing changes. A small number of bores in the southwestern part of the northern APLNG tenement and the southern part of the SANTOS Roma tenements are still artesian, with all other bores within and beyond the tenements being now sub-artesian (Figure 2.2-1). Most of the present sub-artesian bores were artesian during the early part of last century, but as a result of large scale drawdown by all bores in the region, they have become sub-artesian. Any reduction in artesian pressure caused by the CSG activities will only have a limited effect on bores in the immediate surroundings of the CSG tenements.

The degree to which artesian pressures will be affected will not be known until either further vertical hydraulic conductivity data is collected, allowing more accurate drawdown predictions, or a monitoring of multiple aquifers within existing fields verifies the magnitude of hydraulic connection between aquifers adjacent to the coal measures. As a surrogate regional pressure data provided by APLNG for the Springbok, Precipice, Hutton Sandstones and the WCM was assessed to obtain an indication of the degree of connection with the groundwater system.

Pressure values for the Springbok, Precipice, Hutton Sandstones and the WCM generally lie on a similar pressure gradient. A plot of hydraulically connected aquifer pressures would show a similar trend, but this does not necessarily prove connectivity between individual aquifers. Further data such as aquifer chemistry, long-term pumping tests or pressure data from adjacent aquifers during production of water from WCM would be required in order to fully assess connectivity of the system. However, pressure data from within the WCM provided by APLNG and QGC, from the Talinga and Berwyndale South fields respectively, indicates that there is poor vertical interconnection within some areas of the WCM. This agrees with the proposition from the proponents that vertical flow is likely to be low due to the low permeability of the interburden within the WCM and may reduce the amount of induced leakage likely to occur from adjacent aquifers to that which numerical simulation modelling predicts.

Cross-contamination is considered a minor issue, as the physical characteristics and groundwater chemistry of the groundwater in the aquifers is similar and within acceptable ranges for water supply purposes. The exception is the groundwater from the Walloon Coal Measures, which is more saline and has a different chemistry compared to the other Jurassic aquifers. However, the groundwater from the Walloon Coal Measures is pumped to the ground surface as associated water during coal seam gas production and disposed of or re-injected following desalination processes. Vertical leakage of better quality groundwater from the other Jurassic aquifers will take place into the Walloon Coal Measures.

Structural integrity of the coal seams and aquifers of the Walloon Coal Measures has the potential to be affected by groundwater extraction. Coal seam gas extraction involves reducing the hydrostatic pressure in the coal seams to allow gas production by desorption of methane from the coal. This depressurisation results in a large drawdown cone (up to 600 m) in the potentiometric surface of the Walloon Coal Measures, which spreads out from the coal seam gas field production area. The drawdown of the groundwater levels propagates vertically through the over- and underlying aquitards or confining beds into the over- and underlying aquifers. As a result, vertical leakage from these aquifers takes place towards the Walloon Coal Measures and drawdown cones develop in the potentiometric surfaces of the Gubberamunda, Springbok, Hutton and Precipice sandstone aquifers, although at a smaller scale than in the Walloon Coal Measures. The depressurisation of these other aquifers is considered to be generally too limited to affect the integrity of the aquifer rock structure, as drawdowns in those aquifers are only in the order of several metres.

c. Potential impacts of groundwater extraction on the EPBC Act listed endangered ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin'.

Risk Identification and Assessment

It is noted that there is some ambiguity in the definition of discharge springs. Some definitions of natural discharge sites are based on floristic composition rather than hydrogeological characteristics. DEWHA (2001) stipulates that an assessment of each individual natural discharge of groundwater site (spring) is required to determine its origin (i.e. whether it is a "discharge" or "recharge" spring) and in turn, whether it is associated with the listed ecological community (APLNG Vol. 5, Attach. 21, p. 58). It is our understanding that the main sources for spring data in Queensland - the Queensland Herbarium database and the Spring Register in the Queensland Water Resources (Great Artesian Basin) Plan 2006 - are not complete and that not all springs have been investigated, assessed and classified. This could lead to "recharge" springs as well as "discharge" springs being excluded from the EPBC listing, as well as springs being excluded simply because they are located in the recharge areas of the Great Artesian Basin ("recharge" springs are excluded as shown in DEWHA, 2001). This could also mean that the impacts of drawdown of groundwater levels caused by groundwater extraction may not be considered for communities assessed as being "recharge" springs purely on the basis of floristic composition.

The location and EPBC classification (i.e. "discharge" versus "recharge") of known springs in proximity to the QGC development area is illustrated in Figure 2.2-2.

QGC provide little information in their main EIS documents regarding the assessment, monitoring and mitigation of potential impacts of groundwater extraction on the EPBC Act listed endangered ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin'. Initial assessment of an insignificant impact is the stated reason for this information not being considered in their final reporting (QGC Response to Geoscience Australia initial Assessment – 13 August 2010, p. 10), owing largely to the absence of any listed springs within or in close proximity to their tenements. Based on a review of the Queensland Herbarium Springs of Queensland Dataset (Version 4.0), QGC identify and report that no "discharge" springs or EPBC Act threatened communities of 'native species dependent on the Great Artesian Basin' occur within the study area (QGC Vol. 3, Ch. 8, p. 5).

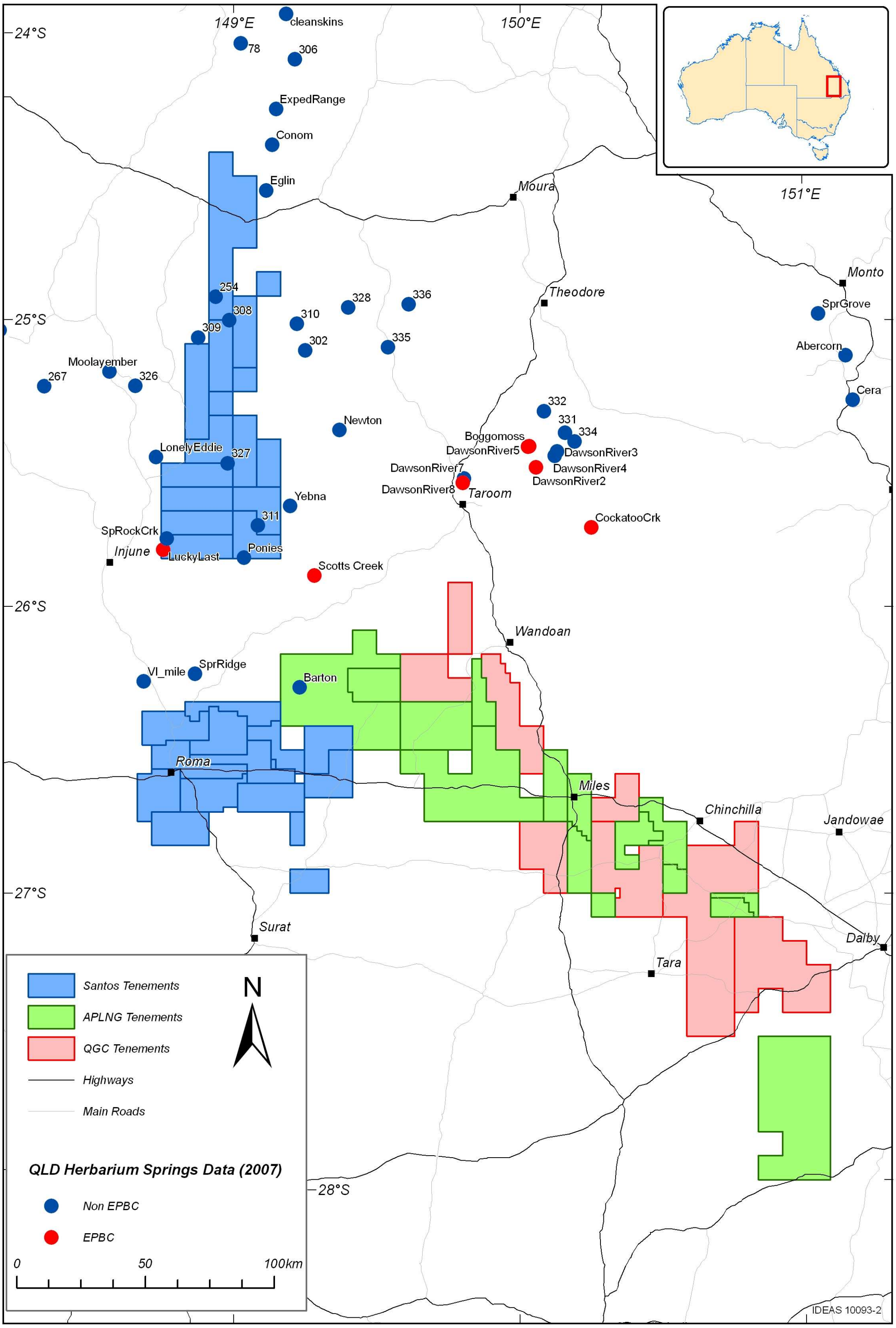

Figure 2.2-2. Location of natural groundwater discharge sites (springs) with respect to coal seam gas tenements considered in the current assessment.

GA and s. 47F(1) also identify no EPBC listed communities within the QGC tenements or within the QGC modelled zone of depressurisation. Some springs (type unspecified) are noted by QGC within 30 to 50 km of the CSG project area. At 30 to 50 km from the CSG fields QGC predict that drawdown in the Springbok Sandstone aquifer (Injune Creek Group), Hutton Sandstone and Precipice Sandstone aquifers will be negligible (QGC App. 3.4, Rep. 7, p. 72).

However, the springs within 50 km of the QGC tenements are noted by GA and s. 47F(1) to comprise of a number of EPBC Act significant springs, which include the Dawson River 8 springs immediately north of Taroom and the Scott's Creek springs to the northeast of Roma. The Cockatoo Creek springs, which are known to host the EPBC listed *Myriophyllum artesium* (Artesian milfoil) and *Eriocaulon carsonii* (Salt pipewort), are located east of Taroom and just over 50 km from the nearest QGC tenement. The QGC modelled potential drawdown extents for the Springbok Sandstone aquifer, and the cumulative impact case, show that radius of drawdown influence will be in very close proximity to springs near Taroom and Cockatoo Creek (QGC Impact Areas – Fig. 2).

While QGC have identified all major spring complexes in the region, and correctly reported that none are within their tenements or modelled drawdown zones, GA and s. 47F(1) consider that their assessment could be improved by considering potential impacts on springs of EPBC Act significance within 50 km of the QGC tenements, particularly given the uncertainty in the groundwater drawdown extents.

Further Analysis

QGC have committed to surveying and re-assessing springs within their tenements and within a 30 km radius of their proposed development areas (QGC Response to DEWHA 300810 – Attach. 1 – Springs Monitoring).

Adequacy of Mitigation Measures and Conditions

QGC's commitment to undertake further assessment and monitoring of springs within the region of their proposed development areas will improve on the initial level of assessment undertaken by QGC. However, the information available regarding the presence of EPBC significant communities in proximity to QGC modelled drawdown extents leads GA and s. 47F(1) consider that the QGC mandated 30 km survey radius will be inadequate to properly assess (and monitor) any potential impacts on these areas of EPBC significance. While the proposed 7 km radius imposed as the limit for ongoing monitoring may be helpful in assessing impacts to local surface water systems or shallow groundwater, it will not enable assessment or monitoring of any potential impacts on EPBC significant springs, which are located further afield. Accordingly it is recommended that the QGC radius of investigation of springs be extended to include at least the EPBC significant Dawson River 8 springs north of Taroom, the Cockatoo Creek springs east of Taroom, and the Scott's Creek springs northeast of Roma.

The current QGC monitoring proposal for the key aquifers in the region, namely the Springbok, Precipice, Hutton and Gubberamunda sandstones, should be reviewed in light of the need to assess potential impact on the springs identified above.

Trigger mechanisms using water quantity and quality criteria are specified (QGC Vol. 3, Ch. 10, pp. 6-7). However, despite putting in place provision for monitoring springs, QGC do not state how trigger levels will be acted upon with regards to mitigating changes to groundwater flow or quality in springs. Accordingly, GA and s. 47F(1) consider that the current mitigation measures require further elaboration.

Proposed Measures or Requirements

- QGC should be asked to detail what remedial action will be taken should groundwater drawdown be identified as impacting water quantity or quality in any springs, as all remedial measures currently proposed address only impacts on groundwater bores.
- The QGC radius of investigation of springs should be extended to include at least the EPBC significant Dawson River 8 springs north of Taroom, the Cockatoo Creek springs east of Taroom, and the Scott's Creek springs northeast of Roma.
- The current QGC monitoring proposal for the key aquifers in the region, namely the Springbok Sandstone, Precipice Sandstone, Hutton Sandstone and Gubberamunda Sandstone, should be reviewed in light of the need to assess potential impact on the springs identified above.
- In order to estimate the potential for impacts caused by groundwater level drawdown, and the appropriate application of trigger values, the elevation of the spring (vent) and the potentiometric surface elevation of the source aquifer in the spring region should be determined prior to the onset of CSG groundwater extraction and be monitored throughout the production and recovery stages of the project lifetime.

Summary

On the basis of the available information, and subject to the adoption of recommendations proposed in earlier sections, GA and s. 47F(1) consider that QGC have, in general, adequately identified and assessed the risk of significant impacts of groundwater extraction on the EPBC Act listed endangered ecological community '*The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*'. Exceptions have been noted and recommendations for further analysis to generate more robust baseline data sets are proposed. We agree with QGC's assessment that the risks to EPBC communities resulting from groundwater drawdown are low, based primarily on the absence of any "discharge" as well as "recharge" springs from the CSG fields and the modelled zones of drawdown. We consider that the monitoring and mitigation measures proposed by QGC are not yet adequate, and we make a number of recommendations with reference to the expansion of the monitoring bore network and the extent of the spring assessment.

d. Potential for recharge into the GAB to be impacted in these areas due to CSG activities and the likely long-term impact(s).

The potential for recharge into the GAB aquifers to be impacted due to CSG activities can be considered as three separate issues:

- Potential for infrastructure associated with CSG activities located on the GAB intake beds to reduce the amount of recharge due to soil compaction and a reduction in intake bed surface area due to infrastructure footprint.
- Potential for infiltrating recharge water to be contaminated prior to recharging the GAB aquifers.
- The effect on the GAB water balance caused by induced leakage from the GAB aquifers through extraction of associated water from the CSG formations.

It should be noted that a reduction in pressure due to water extraction down-gradient of the GAB aquifer intake beds will not affect the rate at which infiltrating water moves through the unsaturated zone into these aquifers. Hence the rate of recharge will not change. Recharge is a function of rainfall and rock permeability, which regulates the rate that water can enter the rock matrix of the aquifer.

The risk that infrastructure located within the intake beds of the GAB will significantly reduce the amount of groundwater recharge is negligible and is not assessed further. For example, estimates of surface area covered by each production well drill pod, headworks and infrastructure are in the order of 0.005 km2. As such, the total area impacted for the maximum 6000 proposed CSG extraction wells will be in the order of 30 km2. This area is insignificant considering that the GAB intake beds cover an area of several thousand square kilometres.

QGC has identified shallow groundwater contamination as an issue. Specifically contamination from associated water brine ponds and chemical and fuel storage sites associated with processing plants. QGC state that Qld EPA guidelines will be adhered to in respect of the lining of brine ponds and on-site storage of chemicals and that these “best-practice” strategies will prevent on-site contamination.

GA and s. 47F(1) consider that the shallow groundwater monitoring strategies outlined in the QGC EIS should be sufficient to address any potential shallow groundwater contamination issues.

To assess the impact of associated water production upon recharge in terms of the GAB water balance, data for the latest leakage estimates for aquifers adjoining the coal seams in each development area were requested from QGC.

Leakage estimates were provided by QGC (Table 2.2-2) for each of their three CSG development areas is based upon revised CSG gas and associated water production forecasts. Current estimates of total associated water production from the Walloon Coal Measures across the QGC gas fields is 829 GL over 40 years. We note that these water production forecasts are 45% lower than the figures used in the EIS (File Note: Groundwater Modelling – Aquifer Water Budget Estimates Rev. 1, 8 September 2010).

Table 2.2-2 Estimates of induced leakage from the QGC gas fields (NWDA = North-West Development Area; CDA = Central Development Area; SEDA = South-East Development Area).

Formation	Field	Average leakage during field operation (ML/day)	Cumulative leakage during field operation (~40 yrs) (ML)
Springbok Sandstone	NWDA	0.22	3212
Hutton Sandstone	NWDA	0.002	29.2
Precipice Sandstone	NWDA	0.0000	0
Springbok Sandstone	CDA	3.01	43946
Hutton Sandstone	CDA	0.008	116.8
Precipice Sandstone	CDA	0.0001	1.46
Springbok Sandstone	SEDA	0.57	8322
Hutton Sandstone	SEDA	0.018	262.8
Precipice Sandstone	SEDA	0.0002	2.92

A comparison of the predicted volumes of groundwater extracted following vertical leakage from the Springbok and Hutton Sandstones with groundwater recharge in the intake beds is summarised in Table 2.2-3. This comparison puts into perspective the likely impacts of QGC associated water extraction on the GAB water balance. Where sufficient information exists, a comparison has been made of the estimated groundwater recharge in the intake beds and the modelled induced leakage rates from overlying and underlying aquifers into the formations from which CSG associated water will be extracted.

It should be noted that the comparisons give an order of magnitude estimate only. Estimates of recharge are based on either chloride mass balance calculations undertaken by Kellett et al. (2003) or inferred recharge rates based on the proximity of intake beds to locations with existing chloride mass balance calculations. For the purpose of this comparison the intake area for each aquifer is the area of outcrop equal to the lateral extent of the field area plus a ~20 km buffer either side (a buffer of ~40 km was used for the Precipice Sandstone, Figure 2.2-3). It is recognised that the method used to define the intake bed areas for each field is relatively crude but is sufficiently precise to undertake an order of magnitude comparison. Additional further work would be required to increase the level of accuracy of the recharge rate estimates made in both the Springbok and Precipice Sandstones.

Table 2.2-3. Estimated induced leakage as a percentage of aquifer recharge for QGC CSG fields considered in the current assessment (NWDA = North-West Development Area; CDA = Central Development Area; SEDA = South-East Development Area).

CSG field	**Aquifer**	**Water Production Scenario**	**Estimated annual recharge (ML/yr) (Kellet et al. 2003)**	**Estimated induced leakage (ML/yr) (QGC)**	**Leakage as % of recharge**
NWDA	Springbok Sandstone	Average	1671	80	4.8
NWDA	Hutton Sandstone	Average	6662	0.73	0.01
CDA+ SEDA*	Hutton Sandstone	Average	12657	9.49	0.07

* Recharge into the Springbok Sandstone was not determined; intake bed area cannot be differentiated within the vicinity of CDA & SEDA.

QGC – North West Development Area (NWDA)

Within the NWDA (see Fig. 2.2-1 for location) the average annual induced leakage from the Springbok Sandstone is 4.8% of the annual recharge of the aquifer from the area up-gradient of the CSG field, while from the Hutton Sandstone the induced leakage is 0.001% of annual recharge.

The EIS states that water from the Springbok Sandstone is not generally used for human or livestock consumption within the vicinity of the development area due salinities ranging from 3,000-24,000 uS/cm. It is inferred from this statement that there are very few bores intersecting the Springbok Sandstone within the NWDA.

The majority of bores intersecting the Hutton Sandstone within the vicinity of the NWDA are to the east and north east and increase in number toward the outcrop area of the Hutton Sandstone. Due to the low amount of induced leakage predicted from the Hutton Sandstone, recharge into deeper parts of the basin is unlikely to be affected.

Induced leakage from the Precipice Sandstone is low and a more detailed assessment of the location of intake areas influencing the NWDA, CDA and SEDA would be required to determine actual recharge rates. For these reasons a comparison has not been made.

QGC – Central and South East Development Areas (CDA & SEDA)

The CDA and SEDA are directly adjacent to each other (see Fig. 2.2-1 for location) and induced leakage rates have been combined for ease of comparison with aquifer recharge rates. Within the vicinity of the CDA and SEDA the Springbok Sandstone is undifferentiated within the Kumbarrilla beds, and thus no estimate of recharge based on outcrop area is possible.

The annual average induced leakage rate from the Hutton Sandstone is 0.07% of annual recharge of the aquifer from the area up-gradient of the CSG fields.

The QGC EIS states that induced leakage of groundwater from the overlying and underlying water supply aquifers during CSG operations directly impacts the recharge to the CSG formation (coal measures), and hence may affect the sustainability of licensed water allocations in the affected aquifers further away from the recharge zone. However, the EIS also states that the likelihood of this occurring is considered negligible and that precautionary monitoring and management of the key aquifers will be implemented as part of a Groundwater Monitoring and Management Plan.

In contrast the "Groundwater Monitoring Strategy Risk Assessment Matrix" in the EIS indicates that the probability of "Loss of available water/loss of water column in bores" (i.e. drawdown caused by the extraction of associated water) within bores tapping the "Precipice & Hutton" and the "Springbok & WCM" is high, but that the risk of "Reduction in through flow to down-gradient aquifers" is low.

It is the opinion of GA and s. 47F(1) that the risk of reduction in through-flow to down-gradient aquifers is highly likely to occur but the magnitude of the reduction will only be known after production commences and monitoring information becomes available. Modelled drawdowns should be compared with the monitoring results and the numerical model adjusted and re-run with updated information. Based on the current analysis, however, the magnitude of the impact on GAB water balances is likely to be low.

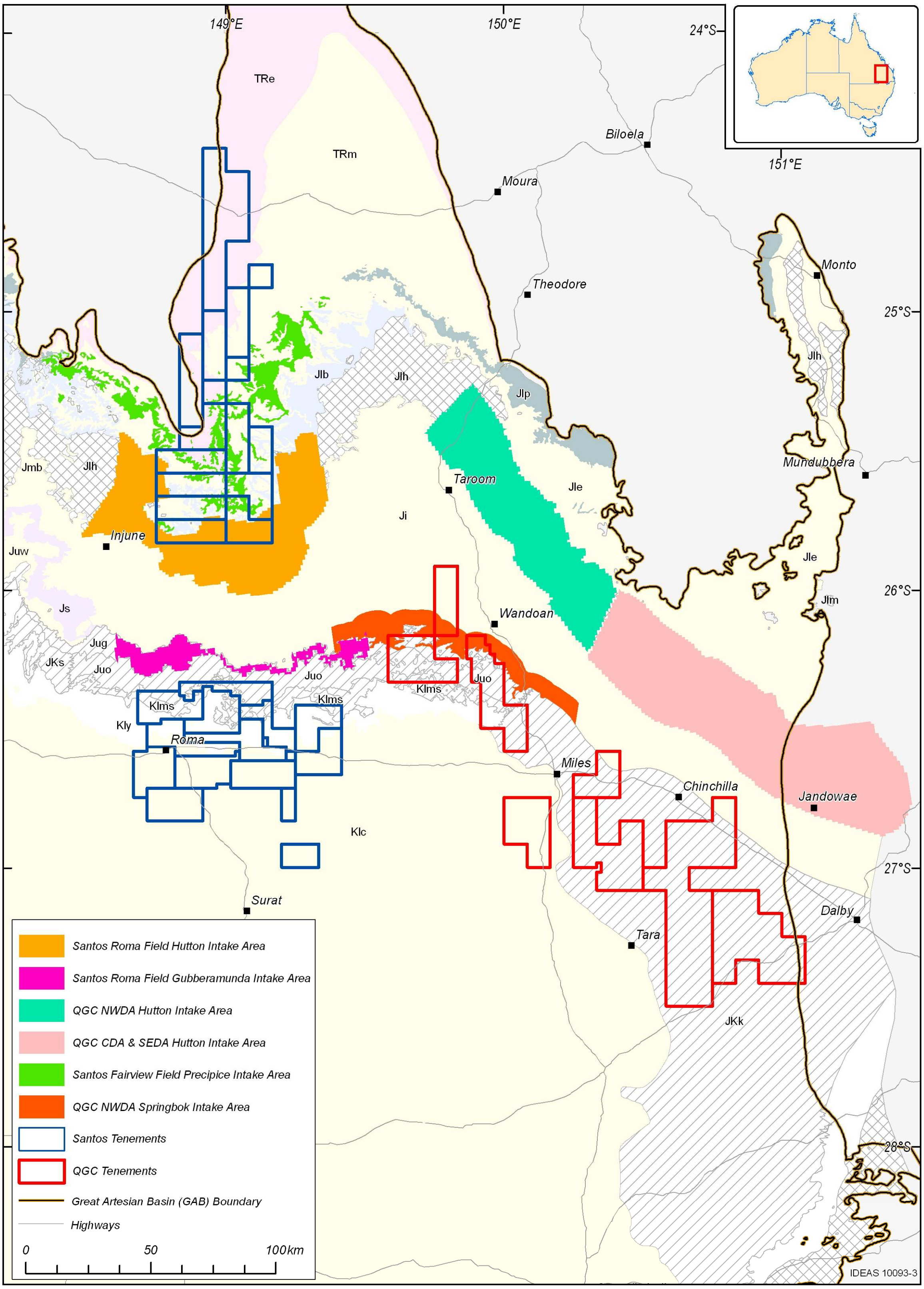

Figure 2.2-3. Location of QGC tenements shown relative to the defined areas of the GAB intake beds used for annual recharge calculations.

e. Potential impacts of fraccing on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes.

QGC indicates that any fracture resulting from hydraulic fracturing ('fraccing') should remain contained within the coal seams of the Walloon Coal Measures (WCM). QGC expect no impact from hydraulic fracturing on overlying aquifers above and including the Springbok Sandstone based on the occurrence of the low permeability Upper Walloon Measure, which separates the Springbok Sandstone from the Macalister Coal Seam. However, where the Springbok Sandstone has incised into the coal measures direct connection is possible.

QGC states that if such a breach were to occur, the limited volume of saline water in coal (cleats compose ~1% of total volume) and low permeability of the interburden would provide little opportunity for saline contamination of the Springbok Sandstone. As the hydraulic gradient would be from the Springbok into the WCM, the most likely impact would be a flux of low salinity water into the uppermost coal measures (i.e. from the Springbok into the WCM). QGC have not specified any potential for gas generated from the WCM to migrate into the overlying formation.

QGC indicates that increased drilling, ongoing improvements in understanding of the reservoir, geologic modelling and use of technical diagnostics can be employed to successfully manage and prevent or limit the occurrence of vertical fracturing. Interconnection would be recognised by monitoring pressure changes and would be effectively remediated by cementing any fractures that did exceed target dimensions.

According to the EIS documentation, fracture fluid will be injected through perforated holes in a casing and accurately located over the mid-point of the coal seam allowing the fraccing to occur in a very targeted way. Additionally, downhole pressure and fraccing fluid viscosity will be monitored during the process to identify any unexpected fracture propagation.

As identified in the fraccing risk assessment, fracture fluid is injected through perforated holes in a casing and accurately located over the mid-point of the coal seam allowing the fraccing to occur in a very targetted way. Additionally, downhole pressure and fraccing fluid viscosity are monitored during the process to identify any unexpected fracture propagation.

In conjunction with an adequate number of appropriately instrumented monitoring wells drilled into the adjacent aquifers and aquitards to monitor the changes in pressure and chemistry, these industry standard measures outlined above are considered to be appropriate for the proposed fraccing activities.

As such, we consider that fraccing represents a low risk to the structural integrity of aquifers and aquitards, and on existing groundwater flow processes, so long as the proponent applies industry standards (e.g. API, 2009) and follows operating procedures as defined by the regulator. We note that QGC are currently working with APPEA and the Queensland Government (DERM) to minimise any potential impacts of hydraulic fracturing on landholder groundwater bores in the vicinity of fraccing treatment areas.

f. Initial advice on the likelihood of materiality of subsidence as the result of the proposals.

QGC identified subsidence as a potential impact of coal seam depressurisation and commissioned an assessment of the potential. The conclusion of the QGC assessment is that predicted settlements would result in up to 0.18 m of subsidence at the land surface. In the absence of appropriate data for the proponent to undertake a full geotechnical assessment of potential subsidence, we interpret the current information to suggest that the likelihood of subsidence is high. However, subsidence assessments for an existing CSG field in the Powder River Basin, USA, which represents a broadly similar geological setting to the Surat Basin, suggest that compression in the coal seams has not been transmitted to the surface due to the strength of materials above the coals. It is expected that such subsidence would be uniform over the area, and would not result in significant impact (Case et al. 2000).

In addition to subsurface monitoring of the coal measures and key aquifers, QGC have committed to developing an industry acceptable monitoring program of the likely subsidence across their tenements (QGC Response to DEWHA 300810 – Attachment 3 – Geodetic Monitoring). In line with this, we consider that the proposed monitoring and mitigation measures are adequate with regards to the specific responsibilities of the proponent. We would encourage the proponent, in concert with the State Government and other companies in the area, to consider the development of an integrated and collaborative program of monitoring across the region to complement that undertaken at the tenement scale.

g. Initial advice on the likelihood and materiality of any impact on MDB groundwater or connected surface water resources.

QGC (QGC Volume 3 QGC Groundwater Study Surat Basin, Queensland prepared by Golder Associates) show the generalised sub-crop geology and provide maps showing the water level contours (potentiometric surfaces) and electrical conductivity values and contours obtained from bores in the area between Pittsworth-Chinchilla-Miles and Wallumbilla for the:

- Condamine River Alluvium,
- Shallow unit (Griman Creek Formation, Surat Siltstone and Wallumbilla Formation),
- Intermediate unit (Bungil Formation, Mooga Sandstone, Orallo Formation and Gubberamunda Sandstone),
- Walloon unit (Westbourne Formation, Springbok Sandstone, Walloon Coal Measures and Eurombah Formation),
- Hutton unit (Hutton Sandstone, Evergreen Formation, Marburg Sandstone), and
- Precipice Sandstone unit

Groundwater levels in the Condamine River Alluvium mimic topography towards the valley of the Condamine River. Most groundwater levels in the GAB aquifers are down dip and generally are in an east to west direction. It is suggested that in some areas a potential connection exists between the Walloon Coal Measures and the Hutton Sandstone.

Hydrographs of bores in the Condamine River Alluvium show longer term trends over approximately 28 years of declining groundwater levels (up to approximately 6 m) and also in a bore in the Walloon Coal Measures. Bores in the intermediate and Quaternary units shows small declines and other bores in the Walloon Coal Measures are static or show some declines across the area. No information has been provided in the report about possible leakage from the Condamine River Alluvium into the Walloon Coal Measures. No discussion is presented on the Murray-Darling Basin surface water aspects of the region, but it is predicted that there will be no measurable reduction or loss of baseflow contribution to rivers or creeks as a result of the QGC CSG project operation (p. 119).

A small number of QGC tenements intersect or are very close to the Condamine River and its alluvium downstream of Chinchilla, but this area is unlikely to leak into the Walloon Coal Measures because north west of Dalby there is no hydraulic connection between the Walloon Coal Measures and the river and its alluvium. Accordingly we consider that there is a limited likelihood of impact on MDB groundwater or connected surface water resources as a result of the proposed QGC operations.

2.3 SANTOS

2.3.1 Project Summary

Santos proposes to develop three CSG fields in an area extending from 50 km south of Roma northward to Rolleston. The project will deliver 5,300 petajoules (140 million m^3) to supply to the first stage of the LNG facility at Gladstone. This will involve the development of around 2,650 exploration and production wells. It is anticipated that about 1,200 wells will be established prior to 2015, with potential for 1,450 or more wells after 2015. The 'reasonably foreseeable development' (RFD) areas are comprised of tenements centred at Roma-Wallumbilla (Surat Basin) and Fairview and Arcadia Valley (Bowen Basin) north of Injune (Fig. 2.3-1). The total RFD area is 6,900 km^2 with a further 12,100 km^2 designated as 'future development areas'. The Roma field targets the Middle Jurassic Walloon Coal Measures for CSG development and the Fairview and Arcadia Valley fields target the Upper Permian Bandanna Formation. Santos anticipates drilling 1,200 production wells in the three fields up to 2014 and 1,450 wells after 2015.

Production of groundwater in the Fairview field is expected to increase from about ~8ML/day to a peak of about ~64 ML/day in 2012. Water production is expected to then steadily decline to about ~13ML/day in 2023, apart from a small increase to ~38ML/day in 2018.

Water production at Arcadia Valley is expected to commence in 2011 and rise to a maximum of ~13ML/day in 2013 and then to steadily decline to about ~8ML/day in 2023.

Production of water in the Roma field is expected to peak at ~3ML/day in 2012 and decline to about ~8ML/day by 2023.

The Santos Roma CSG field falls within the Surat Management Areas as defined in the Great Artesian Basin Water Resource Plan (DNRM 2005). This area overlies the full Jurassic to Lower Cretaceous sequence in the Surat Basin and the Upper Triassic sediments of the Bowen Basin in the west.

The Fairview CSG field fall predominantly within the Surat North Management Area. This covers the sediments of the Westbourne Formation, Injune Creek Group, Hutton and Precipice Sandstones within the Surat Basin and the Clematis Sandstone within the Bowen Basin. This area has a large number of high value recharge and discharge springs within the outcrop areas of the major aquifer units.

The northernmost Arcadia CSG field falls predominantly within the Mimosa Management Area. This covers the extent of the Triassic aged sediments of the Bowen Basin in the northern part of the Mimosa Syncline extending south to the Surat Basin in which the Clematis Sandstone is the only aquifer of significance.

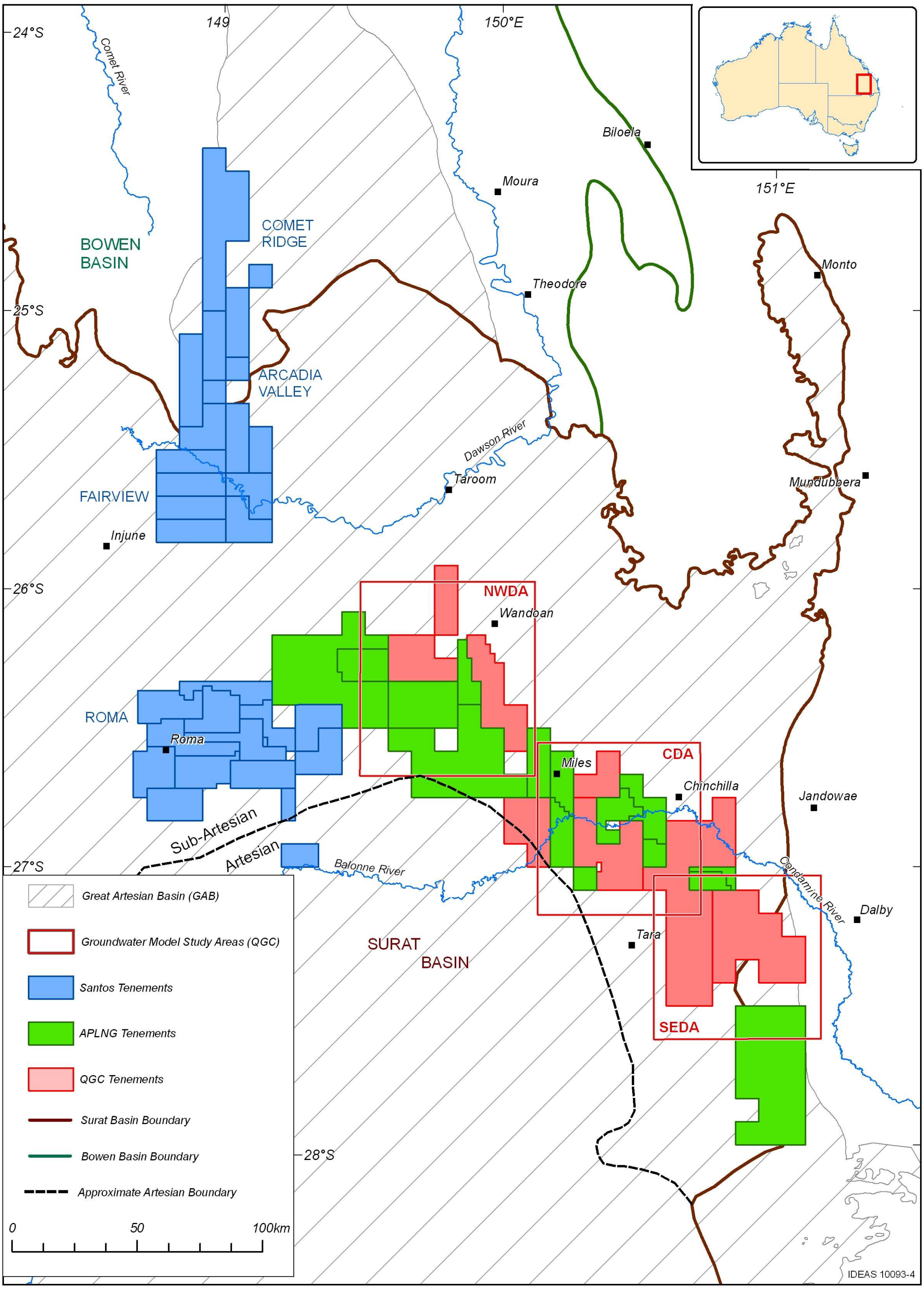

Figure 2.3-1. Location of coal seam gas tenements considered in the current assessment. The location of the artesian/sub-artesian divide, surface drainage and basin boundaries are also shown.

2.3.2 Summary of Assessment

The following summarises our assessment of the Santos proposed CSG development activities.

The adequacy of the proponents' hydrogeological models for estimating hydrogeological impacts on and within the Great Artesian Basin (GAB) and other affected surface and groundwater systems (this would include an initial assessment of the potential of one or more aquifers to depressurise and dewater and the likely impacts).

Santos present two hydrogeological simulation models – one 'project-scale' numerical groundwater simulation model based on MODFLOW, which predicts impacts for their proposed CSG operations in the Fairview and Arcadia CSG developments, and the other an analytical 'project-scale' model, which attempts to account for impacts resulting from CSG operations in the Roma region. Based on the information provided by Santos in their EIS documents, and discussions with Santos, our assessment concludes that:

- Within the limitations of available data, the 'project-scale' models produced are suitable for estimating hydrogeological impacts on and within the GAB and other potentially affected surface and groundwater systems within the influence of the Santos operations. We have, however, noted a number of shortfalls in the modelled occurrence, magnitude and extent of drawdown of the modelling approach taken, and we understand the proponent is in the process of developing a new model.

- The modelling results reported by Santos require further work to fully establish the uncertainties and sensitivity of the models to the large predicted drawdowns that will occur in the coal measures, and hence does not provide a level of confidence in the model outputs and the conclusions drawn from them.

- The modelled occurrence, magnitude and extent of drawdown potentiometric surfaces in the Gubberamunda Sandstone, Springbok Sandstone, Hutton Sandstone and Precipice Sandstone aquifers of the Roma area, Surat Basin, where the Walloon Coal Measures are depressurised and the modelled occurrence, magnitude and extent of drawdown of the potentiometric surfaces in the Hutton Sandstone, Precipice Sandstone and Clematis Sandstone aquifers of the Fairview and Arcadia area, Bowen Basin, where the Bandanna Formation is depressurised, are consistent with the proposed groundwater extraction operations, and are conservative in comparison with known impacts from existing Santos operations in the region.

- The models presented provide useful preliminary assessments of potential hydrogeological impacts resulting from a range of groundwater extraction activities. Santos is in the process of developing a new model, which will encompass the two areas and will underpin enhanced groundwater impact prediction and management.

Potential impacts of groundwater extraction on aquifer interaction (e.g. water flow, cross contamination), vertical recharge, structural integrity and artesian pressure as a result of the CSG activities. This applies to both quantity and quality of groundwater.

Potential impacts of groundwater extraction on aquifer interaction have, in general, been adequately addressed with, while there is scope for further elaboration regarding some aspects. Potential water quality impacts have been adequately identified and addressed. Based upon consideration of the hydrogeological, geological and project development information provided, we conclude that:

- The modelled vertical recharge and artesian pressure changes resulting from coal seam depressurisation are realistic and likely to result in groundwater flow into the coal measures from adjacent aquifers. We consider that these changes are reversible over timeframes of decades to centuries, depending on the specific aquifer and the management strategies applied.

- Cross-contamination is likely to be of little consequence as the majority of inter-aquifer transfer will involve the migration of higher quality water from adjacent underlying and overlying sandstone aquifers into the Walloon Coal Measures.

- The structural integrity of aquifers in relation to groundwater transmission is unlikely to be significantly impacted by the proposed groundwater extraction. We note that groundwater extraction may cause some aquifer compaction that is likely to result in subsidence (as identified by the proponent and discussed below).

Potential impacts of groundwater extraction on the EPBC Act listed endangered ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.'

Based upon consideration of the hydrogeological, environmental and management information provided, we do not agree with Santos that the risk of impact from groundwater extraction to the EPBC Act listed endangered ecological community '*The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*' is low, based on the following:

- The location of documented and/or surveyed natural discharge of groundwater sites (springs) from the CSG fields and the modelled zones of groundwater drawdown, with a significant number of surveyed and not-surveyed springs, including EPBC listed springs being located within the drawdown region of affected aquifers.

- Proposed monitoring programs do not state how trigger levels will be acted upon with regards to mitigating changes to groundwater flow or quality in springs.

Uncertainties in the extent of modelled groundwater drawdown, lead to the conclusion that monitoring and mitigation measures documented by Santos are inadequate. Monitoring of groundwater levels and quality are proposed, but there is insufficient acknowledgement of the uncertainty of modelled groundwater drawdown extents. It is suggested that Santos broaden the spatial extent of their spring survey, assessment and monitoring programs. Additional natural discharge of groundwater sites or springs proximal to the CSG fields may need to be investigated and assessed to determine their EPBC Act significance. We suggest that the outcomes of such investigations could provide input to the monitoring and management process proposed by Santos and ensure that the baseline datasets upon which monitoring and mitigation measures are based are both robust and complete.

Potential for recharge into the GAB to be impacted in these areas due to CSG activities and the likely long-term impact(s).

Consideration of a range of hydrogeological, geological and groundwater production data provided by the proponents lead us to conclude that there is currently insufficient information to understand the relative significance of the proposed CSG activities in proportion to GAB recharge. Our analysis of the relative volumes of induced leakage from adjacent aquifers in comparison to GAB intake bed recharge volumes has had ambiguous results.

- Estimates from modelled leakage volumes provided by Santos suggest that leakage from GAB aquifers as the result of CSG operations may be a relatively high proportion of recharge to the operations area, particularly to the Gubberamunda Sandstone.
- The majority of existing groundwater users and environmental values in the Hutton and Precipice Sandstone aquifers are located up-gradient of the proposed extraction activities.

Potential impacts of fraccing on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes.

Based upon the geological and technical information provided by APLNG with regards to the potential impacts of hydraulic fracturing ('fraccing'), we consider that the potential risks posed by fraccing are low. We conclude that:

- the fraccing risk assessments completed by Santos identify and assess relevant factors and risks involved in the process.
- while the potential exists for fraccing activities to impact on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes, the competent application of industry standard technologies, techniques, and monitoring/mitigation processes proposed are appropriate.
- Santos have adequately assessed any potential risks associated with fraccing activities and have proposed appropriate monitoring and mitigation measures.

Initial advice on the likelihood and materiality of subsidence as the result of the proposals.

Based upon our assessment of the geological and geotechnical information provided, and relevant information from other sources, we agree with Santos that there is a likelihood of subsidence, and that this could result in several centimetres of surface subsidence.

However, based on the estimated magnitude of the subsidence (in the order or centimetres to tens of centimetres), and with reference to subsidence assessments for CSG activities in similar geological environments elsewhere, we consider that the risk of impacts to surface water and shallow groundwater systems are very low.

We suggest that the monitoring measures currently proposed by Santos could be strengthened by assessing deformation at the land surface as well as in the aquifers and coal seams.

Initial advice on the likelihood and materiality of any impact on MDB groundwater or connected surface water resources.

On the basis of the available information, we consider that there is a limited likelihood of impact on MDB groundwater or connected surface water resources as a result of the proposed Santos operations.

This assessment is based primarily on the fact that most of the Santos CSG operations are located outside of the Murray-Darling Basin catchment area (Fairview and Arcadia tenements) and the Roma CSG tenements are high in the Murray-Darling Basin catchment area, with few major streams being present. Impacts of CSG induced drawdown in overlying and underlying aquifers will have little impact on the Murray-Darling Basin groundwater and surface water resources.

2.3.3 Assessment of Proposed Development

a. The adequacy of the proponents' hydrogeological models for estimating hydrogeological impacts on and within the GAB and other affected surface and groundwater systems (this would include an initial assessment of the potential of one or more aquifers to depressurise and dewater and the likely impacts).

Model Description

For the Arcadia and Fairview CSG fields, SANTOS have developed a finite difference numerical groundwater simulation model (MODFLOW – the industry standard) to predict changes in hydraulic head in the Bandanna Formation and overlying Precipice Sandstone aquifer in response to CSG depressurisation activities within their tenements. This model is referred to as the 'Comet Ridge ' model. The model domain occupies an area of 83,500 km^2. The model is partitioned into 3 layers representing the Precipice Sandstone, Triassic rocks (mainly the Rewan Formation) and Bandanna Formation (Bowen Basin – the source rock containing the gas). The overlying Hutton Sandstone, which outcrops over part of the Fairview tenements is not modelled. The model grid is aligned NNW, sub-parallel to the Hutton-Wallumbilla Fault, which is assumed to be an impermeable barrier to groundwater flow in the Bandanna Formation. The model cell size is variable with the minimum cell widths of 1,350 m, presumably within the tenements, but the sizes of the other cells are unknown. The model progressed in yearly stress periods, each with 5 time steps, from 2009 to 2028.

At Roma, an in-house analytical model developed by SANTOS consultants was used to predict the changes in hydraulic head in the Walloon Coal Measures due to CSG depressurisation. Details of the methodology are sketchy but by its very nature the analytical model would be simplistic and not as good as a numerical model in simulating the spatial variability of the system.

Both the Comet Ridge and Roma models have been superseded by a large scale finite element model but we have not received any documentation of the new model at the time of writing.

Model Parameters

For the Comet Ridge model, constant T values (the product of *Kh* and thickness) were applied to the layers representing the Precipice Sandstone and Triassic rocks. T values were distributed in layer 3 (Bandanna Formation) according to drill stem test results from individual wells in the tenements.

A uniform storativity value of 1×10^{-4} was assigned for layers 1 and 2 and 1.3×10^{-4} in layer 3. A specific yield value of 0.15 was adopted throughout. These values appear to reasonable estimates. Vertical leakage in layers 1 and 3 was set at $10^{-8} d^{-1}$ and $10^{-10}\ d^{-1}$ in layer 2.

Recharge in layer 1 was set at 15 mm/year in the Precipice Sandstone outcrop northwest of the Comet Ridge and recharge rates of 7 mm/year were specified in other areas of Precipice Sandstone outcrop.

Aquifer-stream bed (Dawson River) interaction was accomplished by specifying river cells with channel bed conductances in an area to the east of the CSG fields where the Dawson River and Hutton Creek incise the Precipice Sandstone.

In the Roma analytical model, all hydraulic parameters were assumed to be uniform across the entire CSG field.

Model Boundary Conditions (Comet Ridge model only)

No-flow boundaries were set in all layers where particular rock formations were absent and in the particular case of layer 3, to simulate the Hutton-Wallumbilla Fault. Head dependent outflow boundaries were set along the northern boundary of the Precipice Sandstone outcrop to simulate springs and seepages. General head boundaries were assigned to the western and southern boundaries of layer 1, and to the western boundary of layer 3.

Model Predictions

The Comet Ridge model predicts very large drawdowns to occur in the Bandanna Formation east of the Hutton-Wallumbilla Fault. Maximum drawdowns of 600 m are predicted in some places with large areas in excess of 300 m. Predicted drawdowns propagate steadily outwards from 2013 to 2028. Because of the relatively high transmissivity of the Bandanna Formation, the cone of depression is predicted to spread well beyond the boundary of the tenements.

A drawdown plume of >5 m is predicted to occur in the Precipice Sandstone. This plume is predicted to grow from a radius of influence of 50 km in 2013 to 100 km by 2028. The plume is centered about the Hutton-Wallumbilla Fault, an area where the Bandanna Formation directly underlies the Precipice Sandstone. The maximum drawdown of 65 m in the Precipice Sandstone is predicted to occur in 2028, collinear with the Hutton-Wallumbilla Fault south of Hutton Creek.

The Roma analytical model predicts large drawdowns to be generated in the Walloon Coal Measures between 2013 and 2028, up to 600 m in some places with significant acreage in excess of 500 m drawdown in the Wallumbilla area. The cone of depression is predicted not to spread much beyond the tenement boundaries because of the low transmissivity assigned to the coal measures in the model.

Drawdown in predicted to be minimal in the underlying Hutton Sandstone – about 3 m at the well-field perimeter after 20 years of operations. The radius of influence in the Hutton Sandstone is predicted to spread out to 54 km beyond the tenement boundaries after 20 years. This is an artefact of the high resistance to vertical flow imposed by the modellers at the top of the Walloon Coal Measures.

No predicted drawdowns are reported for the overlying Springbok Sandstone, which we consider to be an omission in the EIS. We also note the Roma model considers the SANTOS fields in isolation (unlike the Comet Ridge model which included the existing Spring Gully CSG operation). In reality there will be separate CSG operations in the Roma area concurrent with the proposed CSG depressurisation, so the drawdowns presented here will be the minimum case only.

Adequacy of Model for Estimating Impacts

SANTOS recognised that the Comet Ridge and Roma models were inadequate to predict drawdowns in the aquifers but they are probably applicable for predicting drawdowns in the coal measures. Accordingly they have replaced both models with a large scale finite element model comparable to that developed by APLNG. We are not in a position to comment on this model at present.

b. Potential impacts of groundwater extraction on aquifer interaction (e.g. water flow, cross contamination), vertical recharge, structural integrity and artesian pressure as a result of the CSG activities. This applies to both quantity and quality of groundwater.

Santos CSG developments in the Surat Basin are the Roma field, located within a ~50 km radius of Roma, and the Fairview field to the north-east of Injune. In the Bowen Basin the Arcadia field is located immediately north of the Fairview field (Fig. 2.3-1). In the vicinity of the Santos Surat Basin fields the majority of waterbores tap aquifers of the Bungil Formation, Mooga, Gubberamunda, Hutton and Precipice sandstones, with minimal extraction from the Walloon Coal Measures (Santos Appendix P2, p. 14). In the Bowen Basin the Hutton, Precipice and Clematis sandstones are the main aquifers utilised. Predictions of the drawdown in these aquifers for the respective CSG groundwater extraction projects have been made using numerical groundwater simulation models and the results showing impacts on the Precipice Sandstone (Bowen Basin) and Hutton Sandstone (Surat Basin) are presented in Santos Appendix P2 (summarised on page 67 of that document).

The modelling predicts that the volumes of groundwater pumped over a period of several decades from the Walloon Coal Measures will result in vertical leakage from the overlying and underlying aquifers of the Springbok Sandstone, Hutton Sandstone and Precipice Sandstone, and to a lesser extent from the Gubberamunda Sandstone, into the Walloon Coal Measures and cause drawdown of the potentiometric surface of these aquifers. A similar situation will occur in the Bowen Basin, with depressurisation of the Bandanna Formation (coal measures) resulting in drawdown in the Precipice Sandstone and transfer of groundwater into the Bandanna Formation.

Cross-contamination is considered a minor issue, as the physical characteristics and groundwater chemistry of the groundwater in the aquifers is similar and within acceptable ranges for water supply purposes. The exception is groundwater from both the Walloon Coal Measures and Bandanna Formation, which are more saline and have a different chemistry compared to the other Jurassic aquifers. However, the groundwater from the coal measures is pumped to the ground surface as associated water during coal seam gas production and disposed of or re-injected following desalination processes. Vertical leakage of better quality groundwater from the other Jurassic aquifers will take place into the Walloon Coal Measures and Bandanna Formation.

Structural integrity of the coal seams and aquifers of the Walloon Coal Measures and to a lesser extent the Bandanna Formation have the potential to be affected by groundwater extraction. Coal seam gas extraction involves the reduction of the hydrostatic pressure in the coal seams to allow gas production by desorption of methane from the coal. This depressurisation results in a large drawdown cone (up to 600 m) in the potentiometric surface of both the Walloon Coal Measures and Bandanna Formation, which spreads out from the coal seam gas field production area. The drawdown of the groundwater levels propagates vertically through the over- and underlying aquitards or confining beds into the over- and underlying aquifers. As a result, vertical leakage from these aquifers takes place towards the coal-bearing formations and drawdown cones develop in the potentiometric surfaces of the Gubberamunda, Springbok, Hutton and Precipice sandstone aquifers, though at a smaller scale than in the coal measures. The depressurisation of the other aquifers is generally too limited to affect the integrity of the aquifer rock structure, as drawdowns in those aquifers are only in the order of several metres.

c. Potential impacts of groundwater extraction on the EPBC Act listed endangered ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin'.

Risk Identification and Assessment

DEWHA (2001) stipulates that an assessment of each individual natural discharge of groundwater site (spring) is required to determine its origin (i.e. whether it is a "discharge" or "recharge" spring) and in turn, whether it is associated with the listed ecological community. It is our understanding that the main sources for spring data in Queensland - the Queensland Herbarium database and the Spring Register in the Queensland Water Resources (Great Artesian Basin) Plan 2006 - are not complete and that not all springs have been investigated, assessed and classified. This could lead to "recharge" springs as well as "discharge" springs being excluded from the EPBC listing, as well as springs being excluded simply because they are located in the recharge areas of the Great Artesian Basin ("recharge" springs are excluded as shown in DEWHA, 2001). This could also mean that the impacts of drawdown of groundwater levels caused by groundwater extraction may not be considered for communities assessed as being "recharge" springs purely on the basis of floristic composition.

The location and EPBC classification (i.e. "discharge" versus "recharge") of known springs in proximity to the Santos development areas is illustrated in Figure 2.3-2.

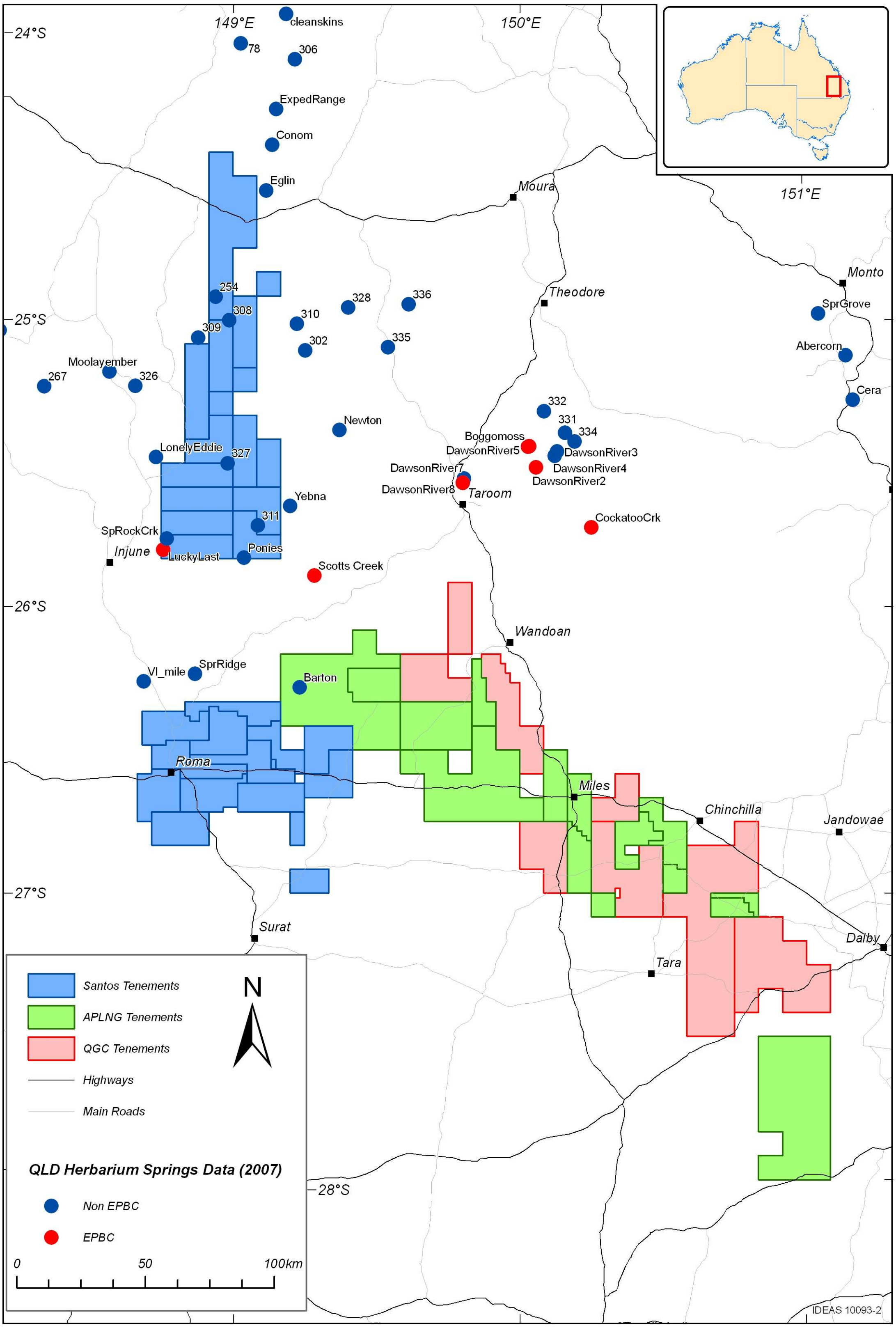

Figure 2.3-2. Location of natural groundwater discharge sites (springs) with respect to coal seam gas tenements considered in the current assessment.

Dry season field investigations (Santos Appendix N4) identify no rare or threatened aquatic species at active artesian spring sites in catchments adjacent to and containing the Santos CSG fields. In the Upper Dawson catchment the endangered (and EPBC Act listed) macrophyte salt pipewort (*Eriocaulon carsonii*) has been recorded at the Hutton Spring Group on Hutton Creek (Fensham and Fairfax 2004), and the consultant's report suggests that artesian springs elsewhere in the CSG fields may support similar communities, where comparable geomorphic and hydraulic conditions are present. Furthermore the consultant identifies the likely presence of the EPBC critically endangered Boggomoss Snail (*Adclarkia dawsonensis*) in one of the Santos leases to the west of Taroom, but not in any of the Fairview, Arcadia or Roma tenements.

Field investigations commissioned by Santos (Santos Suppl. Part 3, Attach. D5, App. A) identified numerous high value "recharge" and "discharge" spring complexes associated with the Gubberamunda Sandstone, Hutton Sandstone and Precipice Sandstone units. These springs are located near the Taroom and Injune townships and to the north of Roma. Several spring complexes are present within and in close proximity (<30 km) to the Santos development areas, including Lucky Last and Scott's Creek, two high EPBC value springs (see Fig. 2.3-2). Most of the "recharge" and "discharge" spring complexes in and near the Santos Fairview CSG field are artesian flows from the Hutton Sandstone and Precipice Sandstone aquifers. Some of the springs north of Roma are related to the Gubberamunda Sandstone aquifer.

According to Santos (Technical Memorandum, Golder Associates, 10 August 2010 – The impact from Santos CSG Fields on GAB Springs):

> "Two spring complexes located at the south western corner of Fairview and south west of Fairview have been assessed by Fensham and Fairfax for national environmental significance under the EPBC Act and have been classified following Fensham and Fairfax approach as discharge springs. Closer assessment of these springs shows that the spring located to the south western corner of Fairview CSG field is along the Hutton Creek drainage alignment, and at the same location that several GAB ROP recharge and watercourse springs. Additionally, the location corresponds to the outcrop of the Hutton Sandstone. Hence this spring may be of national environmental significance but is not a GAB discharge spring. The second spring, to the south east of Fairview is located at the outcrop of the Hutton Sandstone and should consequently be regarded as a GAB recharge spring. Santos CSG fields are located in what is considered the recharge beds area for the GAB. The GAB recharge area is commonly defined as the area where the GAB sandstone aquifer formations subcrop or outcrop on the eastern margins of the GAB."

The Taroom 1:250,000 Geological Map Sheet Explanatory Notes (Forbes et al. 1967) report that "The mound springs in the Hutton Creek area, north-east of Injune, are probably supplied by artesian water from the Precipice Sandstone, which rises to the surface through joints or small faults." If the latter is correct, then these springs are "discharge" springs, and should be considered under the EPBC Act.

“Recharge” springs with high conservation values occur approximately 30 km north and northeast of Roma, just north of the Santos Roma CSG development area (Fig. 2.3-2), within areas of the Gubberamunda Sandstone outcrop. Springs located within the Santos Arcadia CSG development area are related to the Clematis Sandstone aquifer and occur at the Clematis Sandstone and Moolayember Formation boundary in the Arcadia Valley.

The target formation for the Santos CSG development in the Comet Ridge fields (Fairview, Arcadia and Spring Gully) is the Bandanna Formation of the Bowen Basin, while the Roma CSG field targets the Walloon Coal Measures of the Surat Basin. Springs related to the Gubberamunda Sandstone, Hutton Sandstone and Precipice Sandstone are therefore potentially at risk of impact in the Santos Roma and Fairview CSG development areas and likewise springs associated with the Clematis Sandstone in the Arcadia CSG development area. In the Santos Comet Ridge (Fairview, Arcadia and Spring Gully) CSG fields springs related to the Hutton Sandstone, Precipice Sandstone and Clematis Sandstone are potentially at risk.

It is noted that there is some ambiguity in the definition of discharge springs. Some definitions of natural discharge sites are based on floristic composition rather than hydrogeological characteristics.

In all CSG development areas the radius of influence of groundwater drawdown is expected to extend beyond the boundaries of the CSG fields. Santos provide a predicted zero impact limit at around 250 km from the centre of the Santos Roma CSG development and a predicted zero impact limit at around 100 km from its Spring Gully and Fairview CSG fields (Technical Memorandum, Golder Associates, 10 August 2010 – The impact from Santos CSG Fields on GAB Springs). Drawdown in the Bandanna Formation is expected to result in the inter-aquifer transfer from the overlying Precipice Sandstone and Clematis Sandstone. Drawdown in the Walloon Coal Measures is expected to result in some inter-aquifer transfer from the overlying Gubberamunda Sandstone and Springbok Sandstone, and the underlying Hutton Sandstone and Precipice Sandstone aquifers, into the WCM.

Reduced artesian pressures caused by extraction of artesian groundwater from bores have been identified as a serious problem in the GAB, which have affected other bores and natural discharges, including springs (Habermehl, 1980, 2001, DEWHA 2001, Fensham et al. 2004). The EPBC listed Salt pipewort and Artesian milfoil are known to be associated with artesian springs within the vicinity of the CSG gas fields. Both species require actively flowing artesian water for survival.

Santos (Technical Memorandum, Golder Associates, 10 August 2010 – The impact from Santos CSG Fields on GAB Springs) states that:

- no GAB discharge springs (including mound springs) are located over the Santos tenements and within 100 km of the tenements including within the predicted impact zone;
- all springs located over and near Santos tenements are interpreted as GAB “recharge” springs and that no “discharge” springs are present. Santos concludes that its groundwater extraction activities are likely to have no impact on GAB mound springs and GAB fed GDE;
- in Fairview, there is a potential impact in the Precipice Sandstone limited to the vicinity of the contact zone between the Bandanna Formation and Precipice Sandstone (south

western corner of Fairview). The predicted impact is less than 3 m based on currently available modelling (expected case). Since the Santos gas field operations extract groundwater from the deep confined and the recharge springs derive their water supplies from the shallow perched aquifers (which are unconnected with the deep GAB aquifers), the recharge springs and their associated GDE will suffer no material impact from CSG production; and

- with regard to the EPBC Act, on the basis of this map and current interpretation, there is no evidence that Santos proposed CSG water production have anything but insignificant risk to matters of national environmental significance. Further details will be available in September in the groundwater impact report currently under preparation.

According to these Santos statements the "recharge" springs would not be affected by the lowering of groundwater levels as a result of CSG activities. The occurrence of perched GAB aquifers in the recharge areas is not elaborated on by Santos, nor is the issue of connection between GAB aquifers in the recharge areas and deeper in the GAB.

The drawdown cone of groundwater level depression associated with the extraction of CSG groundwater has the potential to impact on the aquifer pressure of and groundwater flows from artesian springs, which are within the cone of depression from CSG activities. Santos (Appendix P1 Groundwater Deep Aquifer Modelling - Matrixplus) suggests that most springs in the Taroom are a are associated with the boundaries between the Hutton Sandstone and its over- and underlying aquicludes. Santos also suggests that groundwater levels in the Hutton sandstone are unlikely to be affected by CSG operations. Baseflow to the Hutton Creek-Dawson River confluence in the Comet Ridge fields (Fairview, Arcadia and Spring Gully) from groundwater discharge sites and springs in the Precipice Sandstone outcrop area is most likely to be affected by groundwater drawdown in the Precipice Sandstone associated with CSG operations. Predicted drawdown at this locality will be less than 5 m (the 'trigger' value set by the Queensland Government to initiate 'make good' provisions under the Queensland Petroleum & Gas Act) in all cases and will be significantly less than the hydraulic head difference between the aquifer and the river according to Santos. Santos further suggests that, due to artesian conditions persisting in the Precipice Sandstone in this area, there is always positive flow according to their model predictions. However, Santos does not indicate the predicted drawdown, which is important, as even a drawdown of only a few metres may be sufficient to adversely affect the flow from springs. Santos expects that the contributions to the baseflow of the Dawson River and the discharge from springs near the Fairview CSG fields will not be significant as a result of the drawdown in the Precipice Sandstone aquifer. The potential for inter-aquifer transfer from the Gubberamunda Sandstone aquifer is considered to be small by Santos, but it recommends monitoring to validate this assumption.

The groundwater level drawdown cones in the affected GAB aquifers will, during the CSG production period and during the recovery phase, extend beyond the boundaries of the CSG development areas. Santos groundwater modelling indicates that there is a low risk that groundwater levels of springs will be affected. According to the initial 'project case' numerical groundwater simulation model projections, Santos determines that associated water production will have no implications for spring complexes (and their dependent ecosystems).

GA and s. 47F(1) consider that the risk methodology applied by Santos is appropriate for assessing potential risk to EPBC listed communities. Against the criteria specified in their risk assessment documentation, we suggest that there is a high risk of impact to any EPBC communities within the predicted groundwater drawdown areas. The risk is considered low if none of the springs maintain EPBC communities, however such springs, whether they be "discharge" or "recharge" springs, would still be impacted and the risk is to an environment with the potential to host such community rather than to a community *per se*.

On the basis of the available documentation, GA and s. 47F(1) consider that the majority of risks of significant impacts to the GAB and other affected surface and groundwater systems have been adequately identified and assessed. However, there are several identified springs (communities) within and in close proximity to their tenements for which the risk has been inadequately assessed. This includes the 'Lucky Last' spring complex in the southwest of the Fairview CSG field, whose classification as a "recharge" spring is considered questionable.

These conclusions, as with the risk assessments themselves, are based primarily on the relative proximity of CSG activities and modelled groundwater drawdown effects to possible spring communities. It should be noted that any variation in the groundwater simulation model predicted lateral and vertical extent of groundwater drawdown, resulting from uncertainties in the modelling, could alter the consequence and hence risk rankings.

Further Analysis

Santos state that a new numerical groundwater simulation model and accompanying report on impacts is currently under preparation and will be available in September (Technical Memorandum, Golder Associates – The impact from Santos CSG Fields on GAB Springs, p. 3). GA and s. 47F(1) have not had the opportunity to review this document, which was discussed by Santos during the meeting with GA and Dr M.A. Habermehl on 10 September 2010, but not tabled. As such we cannot provide any comment on the adequacy of any further assessment, monitoring or mitigation measures proposed by Santos.

Adequacy of Mitigation Measures and Conditions

Clearly defined monitoring information for the various types of environments (e.g. springs, groundwater bores, etc.) is presented by Santos including information regarding frequency and type of monitoring and analysis (Santos Suppl. Part 3, Attach. D2, pp. 107-110). Trigger mechanisms using water quantity and quality criteria are specified (Santos Suppl. Part 3, Attach. D2, pp. 110-112). However, despite putting in place provision for monitoring springs, Santos do not state how trigger levels will be acted upon with regards to mitigating changes to groundwater flow or quality in springs. Accordingly, GA and Dr M.A. Habermehl consider that the current mitigation measures need further elaboration.

Proposed Measures or Requirements

- Undertake detailed investigations of all springs within the groundwater model predicted drawdown extents. This would include detailed assessments of the EPBC significant Lucky Last and Scott's Creek springs in the vicinity of the Fairview CSG.

- Detail what remedial action might be taken should groundwater drawdown be identified as impacting water quantity or quality in any springs, as all remedial measures currently proposed address only impacts on groundwater bores.

- In order to estimate the potential for impacts caused by groundwater level drawdown, and the appropriate application of trigger values, the elevation of the spring (vent) and the potentiometric surface elevation of the source aquifer in the spring assessed should be determined prior to the onset of CSG groundwater extraction and be monitored throughout the production and recovery stages of the project lifetime.

Summary

On the basis of the available information, GA and s. 47F(1) consider that Santos have not adequately identified and assessed the risk of significant impacts of groundwater extraction on the EPBC Act listed endangered ecological community '*The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*'. On the basis of the current information we cannot agree with Santos' assessment that the risks to EPBC communities resulting from groundwater drawdown are low, as the monitoring and mitigation measures are inadequate. We understand a revised groundwater impact report is currently being prepared.

d. Potential for recharge into the GAB to be impacted in these areas due to CSG activities and the likely long-term impact(s).

The potential for recharge into the GAB aquifers to be impacted due to CSG activities can be considered as three separate issues:

- Potential for infrastructure associated with CSG activities located on the GAB intake beds to reduce the amount of recharge due to soil compaction and a reduction in intake bed surface area due to infrastructure footprint.

- Potential for infiltrating recharge water to be contaminated prior to recharging the GAB aquifers.

- The effect on the GAB water balance caused by induced leakage from the GAB aquifers through extraction of associated water from the CSG formations.

It should be noted that a reduction in pressure due to water extraction down-gradient of the GAB aquifer intake beds will not affect the rate at which infiltrating water moves through the unsaturated zone into these aquifers. Hence the rate of recharge will not change. Recharge is a function of rainfall and rock permeability, which regulates the rate that water can enter the rock matrix of the aquifer.

The risk that infrastructure located within the intake beds of the GAB will significantly reduce the amount of groundwater recharge is negligible and is not assessed further. For example, estimates of the surface area covered by each production well drill pod, headworks and infrastructure are in the order of 0.005 km^2. As such, the total area impacted for the maximum 2650 proposed CSG extraction wells will be in the order of 13 km^2. This area is insignificant considering that the GAB intake beds cover an area of several thousand kilometres.

Santos has identified shallow groundwater contamination as a potential issue; specifically contamination from associated water brine ponds and chemical and fuel storage sites associated with processing plants. Santos state that Qld EPA guidelines will be adhered to in respect of the lining of brine ponds and on-site storage of chemicals and that these “best-practice” strategies will prevent on-site contamination.

GA and s. 47F(1) consider that the shallow groundwater monitoring strategies outlined in the Santos EIS should be sufficient to address any potential shallow groundwater contamination issues.

To assess the impact of associated water production upon recharge in terms of the GAB water balance, data for the latest leakage estimates for aquifers adjoining the coal seams in each development area were requested from Santos.

Information provided by Santos is based upon revised FEFLOW numerical models that include:

- best estimates for coal seam water production;
- boundary conditions that are more representative (and less conservative) than the original EIS modelling;
- additional model layers resulting in better estimates of the time for impacts to occur;
- cumulative impacts (Sean Davidge, pers. comm., 8 September 2010).

It is noted that these revised Santos models have not been assessed by GA and s. 47F(1) .

The induced leakage estimates from the Santos Roma and Fairview/Arcadia (Comet Ridge) CSG fields are provided in Tables 2.3-1 and 2.3-2 respectively.

Table 2.3-1. Estimates of induced leakage for the Santos Roma CSG field based on Santos modelled water production scenarios.

Aquifer	Water Production Scenario	Leakage during field operation (ML/day)	Cumulative leakage during field operation (~25 yrs)	Cumulative leakage over total modelled period (~2700 yrs)
Gubberamunda Sandstone	Minimum	0.27	2.6 GL (~0.1 GL/yr)	132 GL (~0.05 GL/yr)
	Maximum	1.92	17.8 GL (~0.7 GL/yr)	738 GL (~0.3 GL/yr)
Hutton Sandstone	Minimum	0.82	7.8 GL (~0.3 GL/yr)	77 GL (~0.03 GL/yr)
	Maximum	4.9	45.3 GL (~1.8 GL/yr)	511 GL (~0.2 GL/yr)

Table 2.3-2. Estimates of induced leakage from the Santos Fairview and Arcadia (Comet Ridge) CSG field based on Santos modelled water production scenarios.

Aquifer	Water Production Scenario	Leakage during field operation (ML/day)	Cumulative leakage during field operation (~85 yrs)	Cumulative leakage over total modelled period (~2700 yrs)
Precipice Sandstone	Minimum	4.65	146 GL (~1.7 GL/yr)	373 GL (~0.14 GL/yr)
	Maximum	10.9	353 GL (~4.0 GL/yr)	491 GL (~0.18 GL/yr)

A comparison of the predicted volumes of groundwater extracted following vertical leakage from the GAB aquifers, including the Gubberamunda, Hutton and Precipice Sandstones with groundwater recharge in the intake beds is summarised in Table 2.3-3. This comparison puts into perspective the likely impacts of associated water extraction on the GAB water balance within the project area. Where sufficient information exists, a comparison has been made of the estimated groundwater recharge in the intake beds and the modelled induced leakage rates from overlying and underlying aquifers into the formations from which CSG associated water will be extracted.

Table 2.3-3. Estimated induced leakage as a percentage of aquifer recharge for Santos CSG fields considered in the current assessment.

CSG field	**Aquifer**	**Water Production Scenario**	**Est. annual recharge (ML/yr)**	**Est. induced leakage (ML/yr)**	**Leakage as % of recharge**
Comet Ridge	Precipice Sandstone	Minimum	5180	1700	33
		Maximum	5180	4000	77
Roma	Gubberamunda Sandstone	Minimum	626	100	16
		Maximum	626	700	111
	Hutton Sandstone	Minimum	8560	300	3.5
		Maximum	8560	1800	21

It should be noted that the comparisons give an order of magnitude estimate only. Estimates of recharge are based on either chloride mass balance calculations undertaken by Kellett et al. (2003) or inferred recharge rates based on the proximity of intake beds to locations with existing chloride mass balance calculations. For the purpose of this comparison the intake area for each aquifer is the area of outcrop equal to the lateral extent of the field area plus a ~20 km buffer either side (a buffer of ~40 km was used for the Precipice Sandstone, Figure 2.3-3). It is recognised that the method used to define the intake bed areas for each field is relatively crude but is sufficiently precise to undertake an order of magnitude comparison. Additional further work would be required to increase the level of accuracy of the recharge rate estimates made in both the Springbok and Precipice Sandstones.

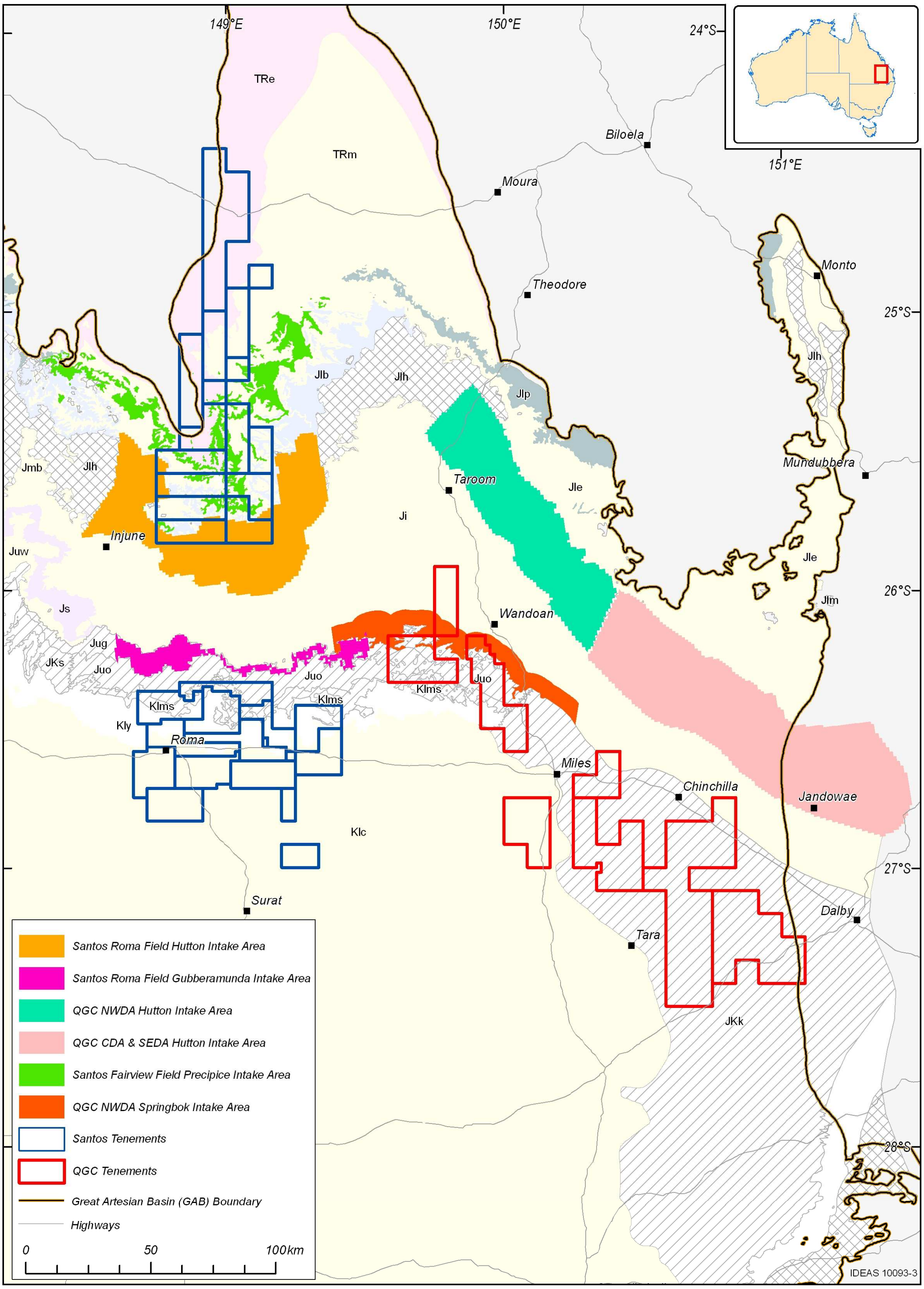

Figure 2.3-3. Location of QGC tenements shown relative to the defined areas of the GAB intake beds used for annual recharge calculations.

Santos – Fairview and Arcadia (Comet Ridge) CSG fields

Induced leakage from the Precipice Sandstone into the Bandanna Formation ranges from 33% to 77% of annual recharge of the aquifer from the area up-gradient of the CSG fields, based on the minimum and maximum (conservative) associated water production forecast scenarios respectively.

The induced leakage and the commensurate reduction in through-flow to hydraulically down-gradient parts of the aquifer is unlikely to significantly impact existing groundwater users within the vicinity of the Comet Ridge Field. Maps provided within the Santos EIS identify 41 registered bores intersecting the Precipice Sandstone, with most being situated hydraulically up-gradient of the modelled drawdown area. The Santos EIS identifies three privately registered bores and one DNRW bore, located in the area surrounding the proposed bore field as exhibiting drawdowns ranging from 7–25 m in the year 2028. However it should be noted that this map appears to omit bores intersecting the Precipice Sandstone located to the south of the Comet Ridge as shown in the Hydrogeological Framework Report for the Great Artesian Basin Water Resource Plan Area (Figure 4, DNRM 2005).

Santos - Roma CSG field

Within the vicinity of the Santos Roma CSG field, induced leakage from the overlying Gubberamunda Sandstone aquifer caused by the associated water production from the Walloon Coal Measures is estimated to be from 16% to 111% of annual recharge of the aquifer from the area up-gradient of the CSG field. This large range is due to differences in magnitude between forecast scenarios for minimum and maximum associated water production. However, Santos has indicated that ~10 ML/day (3650 ML/yr) of treated associated water will be reinjected (recharged) back into the Gubberamunda Sandstone. If this is the case there would in effect be an increase in the annual recharge rate to an estimated 4276 ML/yr, far in excess of the current predicted maximum induced leakage. In this situation an issue that has yet to be identified or addressed is the possibility of overpressurisation in the Gubberamunda Sandstone and additional induced leakage from the aquifer.

Induced leakage from the Hutton Sandstone ranges between 3.5% and 21% of annual recharge to the aquifer from the area up-gradient of the CSG field. Registered bores intersecting the Hutton Sandstone are concentrated to the north of the Santos Roma CSG field adjacent to the intake beds of the Hutton Sandstone. These bores are hydraulically up-gradient of the Roma CSG field and will not be impacted. However, as already identified and assessed by the proponent, a small number of bores are located within and to the south and southwest of the Roma field and are likely to be impacted resulting in drawdown of the groundwater levels.

e. Potential impacts of fraccing on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes.

Santos provides a comprehensive report and risk assessment on their hydraulic fracturing ('fraccing') process. The main physical risk is identified as the deviation of generated fractures out of the coal seam into the surrounding aquifers.

Santos provides several reasons to justify the assessed low risk of fracture deviation out of the coal seam. Firstly, a typical fracture radius is up to 20 m and within this radius there is very limited probability of a fracture intersecting aquifer units. Secondly, the elastic nature of overlying or underlying sedimentary rocks (in contrast to the brittle nature of coal) would be a barrier to fracture propagation even though it is possible for a breach to occur.

According to the EIS documentation, fracture fluid will be injected through perforated holes in a casing and accurately located over the mid-point of the coal seam allowing the fraccing to occur in a very targeted way. Additionally, downhole pressure and fraccing fluid viscosity will be monitored during the process to identify any unexpected fracture propagation.

In conjunction with an adequate number of appropriately instrumented monitoring wells installed in the aquifers and aquitards of interest to monitor the changes of pressure and chemical components, these industry standard monitoring measures are considered to be appropriate for the proposed fraccing activities.

As such, we consider that fraccing represents a low risk to the structural integrity of aquifers and aquitards, and on existing groundwater flow processes, so long as the proponent applies industry standards (e.g. API, 2009) and follows operating procedures as defined by the regulator.

f. Initial advice on the likelihood of materiality of subsidence as the result of the proposals.

Santos identified subsidence as a potential impact of coal seam depressurisation and commissioned an assessment of the potential. The conclusion of the Santos assessment is that predicted settlements would result in up to 0.2 m of subsidence at the land surface within the Roma tenements, and 0.045 m at their Arcadia and Fairview fields. In the absence of appropriate data for the proponent to undertake a full geotechnical assessment of potential subsidence, we interpret the current information to suggest that the likelihood of subsidence is high. However, subsidence assessments for an existing CSG field in the Powder River Basin, USA, which represents a broadly similar geological setting to the Surat Basin, suggest that compression in the coal seams has not been transmitted to the surface due to the strength of materials above the coals. It is expected that such subsidence would be uniform over the area, and would not result in significant impact (Case et al. 2000).

Santos proposes to monitor water pressure in aquifers in the units overlying the coal measures and to install extensometers in key locations to monitor compression of the coal measures. These measures are considered appropriate for assessment of subsurface subsidence associated with elastic deformation of the coal measures. However, we suggest that the proponent could improve their monitoring program by, in conjunction with relevant State Government agencies and other proponents, establishing baseline and ongoing geodetic monitoring to quantify deformation at the land surface. This should link from the tenement scale to the wider region across which groundwater extraction activities are occurring.

g. Initial advice on the likelihood and materiality of any impact on MDB groundwater or connected surface water resources.

There is no likelihood of impacts on MDB groundwater or connected surface water resources as a result of Santos CSG operations in the Roma area.

The Santos CSG operations in the Roma area are removed from the main river system of the Condamine River as they are located higher in the catchment, near the surface water divide of the Great Dividing Range. The Santos CSG Roma tenements overlie the Lower Cretaceous Coreena and Doncaster Members of the Wallumbilla Formation and the Upper Jurassic Bungil Formation, Mooga Sandstone and Orallo Formation outcrops and sub-crops. These areas are recharge areas for the aquifer sandstones in this region rather than discharge areas. According to their numerical groundwater simulation model predictions, Santos predict that their CSG activities will cause drawdown of the potentiometric surface of the Walloon Coal Measures and on a smaller scale cause drawdowns of the potentiometric surfaces of the Springbok Sandstone and possibly the Gubberamunda Sandstone, but not to any of the hydrostratigraphic units mentioned previously.

The Santos Fairview and Arcadia CGS fields are outside the Murray-Darling Basin, and as such cannot impact MDB groundwater or connected surface water resources.

2.4 COMMENT ON CUMULATIVE IMPACT ASSESSMENTS

The following section provides comment on the cumulative impact assessments of the proposed CSG developments. This was not explicitly requested in the scope of services detailed in the project contract between GA and DEWHA, but its potential significance necessitates some discussion of the extent to which the EISs have considered the issue of cumulative impacts.

All proponents have recognised that the potential impacts of CSG activities are not likely to be restricted to the tenements within which CSG and associated groundwater extraction takes place. APLNG and Santos have attempted to quantify these impacts, whilst QGC has provided a qualitative assessment of the likely impacts. The cumulative assessments focus primarily on the interaction and potential cumulative effects of other existing and proposed CSG operations in the local area. Non-CSG activities with a potential to impact on groundwater, such as underground coal gasification, mining, irrigation and power generation, have also been identified and considered.

APLNG based their cumulative assessment (APLNG Vol. 2, Ch. 25) on available public domain data as well as their own data. The APLNG assessment determined a medium impact on groundwater with generally low risk, with the exception of a high risk of reduced groundwater production rates in landholder bores. In this context, APLNG have proposed an adaptive groundwater monitoring program predicated on risk identification and management to be key in managing potential groundwater impacts, and propose the development of a regional monitoring network assisted by projections from their numerical groundwater flow model (APLNG Vol. 2, Ch. 25, p. 9).

A similar but less substantive assessment was completed by Santos (Santos Suppl. Part 3, Attach. J). The Santos cumulative impact assessment determined a medium impact on groundwater for the CSG fields. The Santos assessment concluded that their activities will require

- mitigation measures
- the application of specific management practices
- specific approval conditions
- and targeted monitoring programs.

Several of the proponents noted both the inability to access detailed data and modelling related to other existing or proposed (CSG) developments, and the inadequacy of publicly available data, as major impediments to providing meaningful assessments of cumulative impact (e.g. QGC Vol. 3, Ch. 10).

We consider that the APLNG and Santos ‘cumulative’ models represent useful preliminary assessments of potential regional hydrogeological impacts resulting from a range of groundwater extraction activities, and that the APLNG model in particular provides a good starting point for development of a regional model to underpin groundwater impact prediction and management. However, we consider that these cumulative impact assessments are unavoidably inadequate, due to the fact that they do not incorporate the best available information from a number of sources such as confidential drilling and production data from other companies. We recognise, however, that individual proponents are not in a position to access such data.

We consider that a robust cumulative impact assessment is fundamental to informing a risk assessment and the development of an adaptive management framework that includes a regional monitoring strategy. A critical requirement for such a robust cumulative impact assessment is access to data from across the region, and commercial interests dictate that any given company will have limited access to data produced by other companies. A cumulative impact assessment undertaken using only a subset of the existing data is not conducive to developing a robust understanding of the likely impacts of groundwater drawdown and its associated impacts across a region. Furthermore, a robust cumulative impact assessment requires accurate estimates of groundwater extraction, and we note that these are highly uncertain until CSG extraction is underway.

Vink et al's 2008 scoping study of the groundwater impacts of CSG development also identified significant data limitations relating to coal seams and surrounding aquifers, and considered that these must be dealt with to inform policy development in relation to multiple CSG developments. In particular, they reported on the significant variability in gas and water extraction relationships (Figure 2.4-1) between the Surat (Walloon) and Bowen basins (Bandanna, Baralaba and Moranbah). The results of the Vink et al. study accord with our consideration that, in order to assess cumulative impacts of groundwater extraction, predicting the quantity of water production from future CSG development is a necessary but complex issue.

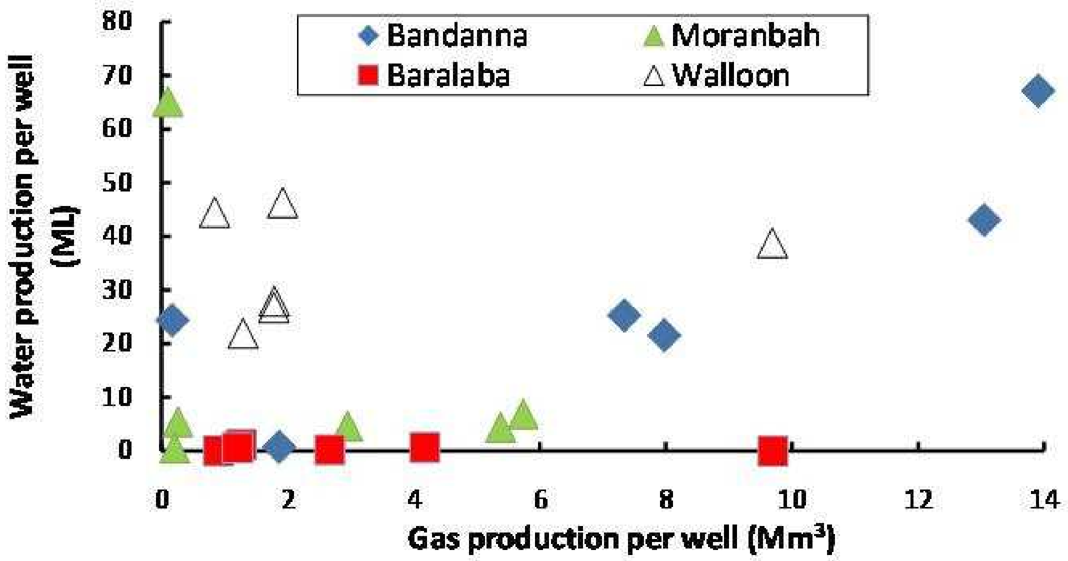

Figure 2.4-1. Gas and water production reported in 2007 from producing CSG tenements in the Bowen and Surat basins. Aggregate production values are reported every 6 months by companies for each tenement (from Vink et al. 2008).

The difficulties in accessing relevant data to complete a robust cumulative impact assessment suggest that governments may need to take a lead role in acquiring, compiling and assessing such data in a commercial-in-confidence setting. This would support the development of a robust cumulative impact assessment that maximised the utility of all existing data without compromising commercial sensitivity. Furthermore it is suggested that in the context of considerable uncertainties relating to the cumulative impacts of multiple CSG develops, an adaptive management framework be developed within which the data could be analysed and modelled, with the outputs informing the development of appropriate monitoring and mitigation measures and strategies. Vink et al. (2008) reach a similar conclusion regarding the need for an adaptive management approach, where new findings from a number of different lines of evidence can be incorporated into resource planning decisions as the information becomes available. With this in mind, we agree with the proponents that it is imperative that the regional numerical hydrogeological groundwater simulation modelling required to assess cumulative impact of the CGS activities be carried out by the relevant government regulatory authorities.

We note that the Queensland Government’s “Blueprint for Queensland's LNG Industry” (DEEDI 2009), and the attested commitment of the proponents and other CSG operators in the south central Queensland region, will promote collaboration to the development of an agreed approach to regional groundwater monitoring and cumulative effects groundwater modelling. The implementation and use of this approach to enable effective impact and risk mitigation will require high levels of collaboration with other project proponents and regulatory authorities over time. This is in agreement with Vink et al.’s (2008) conclusion that there is a critical need for involvement from stakeholders (particularly the CSG industry) in formulating and implementing a monitoring strategy.

2.5 Further Questions

Further questions that should be put to the proponents or QDERM concerning hydrological or water quality impacts on groundwater and surface water systems as would affect matters of National Environmental Significance.

A number of questions have already been put to Qld DERM and the proponents during the course of the assessment. No further questions are proposed at this time.

Questions that should be put to the proponents or QDERM concerning Murray-Darling Basin system impacts.

A number of questions have already been put to Qld DERM and the proponents during the course of the assessment. No further questions are proposed at this time.

2.6 Work Plan and Budget for Additional Work

Work plan and budget for undertaking additional work to fill the critical information gaps, taking into account synergies with the Great Artesian Water Resources Assessment being conducted jointly by GA and CSIRO.

We consider that a number of tasks are necessary for filling critical information gaps relating to the assessment of likely impacts of proposed and potential future CSG operations on matters. These are as follows:

- Undertake a detailed review of the validity of the new models developed by the proponents according to guidelines established in the Murray Darling Basin Commission Groundwater Modelling Guidelines (http://www2.mdbc.gov.au/data/page/127/model_guide.pdf). Without having access to the models to make a preliminary assessment of the magnitude of the work involved in this, we consider that this could be done within approximately 2 months of receiving the models, at a total cost of approximately $100,000.

- Undertake a comprehensive review of the available data relating to measured hydraulic characteristics of all hydrostratigraphic units (aquifers and aquitards), and use this to evaluate the appropriateness of the parameters used in the new models and inform the parameterisation of a regional scale model. Such a review of existing, public domain is planned to be undertaken by GA/CSIRO over the next 6 months as part of the GAB Water Resources Assessment. The scope of incorporating additional, private domain data is not clear without undertaking a scoping of the available data. Our very rough estimates of this task, in the absence of any scoping of the extent of this data, is that this could be done within approximately 3 months.

- Develop a regional scale 3D hydrostratigraphic framework for understanding the connectivity between hydrostratigraphic layers, and in which to set these current, and new EIS proposals. This work is planned to be undertaken to some extent over the next 6 months by GA/CSIRO as part of the GAB Water Resources Assessment, although this will not include the task of incorporating private domain data. Our very rough estimates of this additional task, in the absence of any scoping of the extent of this data, is that this could be undertaken within approximately 3 months additional to the 6 months of the GAB Water Resources Assessment.

- Assess the implications of petroleum and basin analysis work completed in the past few years should be assessed in order to develop a better understanding of the hydrogeology of the Bowen Basin and possible hydraulic connection to the Surat Basin. This exercise requires the acquisition of data identified in the previous tasks, and will take approximately 2 months.

- Undertake preliminary assessment of any new CSG proposals as requested by DEWHA. We consider that this will take approximately 3 months per proposal to enable adequate consideration of the presented information, consultation with proponents and regulators, and acquisition of additional information as required.

- Develop a regional scale, groundwater flow model that incorporates understanding of hydraulic connectivities between hydrostratigraphic layers, and enables the identification of short term and longer term cumulative impacts on groundwater from CSG operations in Qld and NSW (NOTE: We understand that this work is currently being planned by Qld and that discussions may have been initiated to this effect with NSW).

- Using the groundwater behaviour predicted by the regional scale model, develop a monitoring and management strategy that enables early identification of change before impacts on identified groundwater values occur (NOTE: We understand this work is currently being planned by Qld).

A very draft scoping of the first five of these tasks is summarised in Table 2-6-1 below. We consider that the scoping of the other tasks will require considerable consultation with other organisations and is not possible at this stage. We note that the information in this table is very approximate and would require more detailed scoping to confirm the timeframes and costs.

Table 2.6-1. Estimated induced leakage as a percentage of aquifer recharge for Santos CSG fields considered in the current assessment.

Task	Approximate timeframe	Approximate cost
1. Detailed review of the validity of the new and revised models	1 month	$50,000
2. Comprehensive review of the available data relating to measured hydraulic characteristics of all hydrostratigraphic units	3 months	$100,000
3. Regional scale 3D hydrostratigraphic framework	6 months (after completion of Task 2)	$200,000
4. Hydrogeology of the Bowen Basin	4 months (after completion of Task 2)	$150,000
5. Preliminary assessment of any new proposals for CSG	3 months (per proposal)	$100,000

3. Conclusions and Recommendations

We have reviewed the content of the Environmental Impact Statements and supporting documentation put forward by the three proponents, along with subsequent additional data and information, supplemented by discussions with the proponents. Based on this information, we consider that, while the Environmental Impact Statements relating to proposed and potential future CSG extraction activities in the Surat and Bowen Basins, Queensland identify and assess a number of potential local scale (project area) groundwater related impacts, there are some matters that require further consideration under the *Environment, Protection and Biodiversity Conservation (EPBC) Act 1999*.

3.1 Key Recommendations

Although we consider that a number of the issues requested by DEWHA have not been fully addressed by the material within the EISs, we note that in many cases the necessary information relating to the impacts of individual operations has either been developed since the submission of the EISs, or can be acquired in the course of subsequent development under an explicit adaptive management strategy. We have noted that the current groundwater modelling is inadequate in terms of scale and detail to address the impacts of multiple CSG developments on groundwater interactions in the GAB and hence on EPBC listed discharge springs communities in the GAB. However, if the following recommendations are implemented, it should be possible to manage the potential groundwater impacts of proposed and potential future CSG extraction activities in the Surat and Bowen Basin, and minimise the risk of unintentional outcomes for the Great Artesian Basin.

We thus make the following key recommendations for a staged process of adaptive management of CSG development.

1. Management of uncertainty

Given the resulting levels of uncertainty in relation to cumulative impacts at the regional scale of a number of CSG developments, a precautionary approach should be taken in relation to approving proposed and potential CSG developments, recognising the fundamental principle that excessive rates of groundwater extraction will have impacts on groundwater and connected surface water systems, and groundwater dependent values such as EPBC listed discharge springs communities in the GAB groundwater dependent ecosystems.

In the absence of sufficient evidence to characterise and quantify these potential impacts or to define excessive rates of extraction, we recommend that proposed and potential CSG development should be undertaken with an explicit requirement to minimise and mitigate any

impacts during production.

2. Refinement of existing models as an initial basis for development

We have noted a number of shortfalls in the models presented in the EISs, but consider that overall these models provide useful preliminary assessments of potential hydrogeological impacts resulting from a range of groundwater extraction activities.

We recommend that the predictions of these models could serve as a preliminary basis for informing initial decisions about the approval of the CSG developments, pending a positive assessment of the validity and implications of the new models we understand have been developed by the proponents since the submission of the EISs.

3. Modelling regional scale impacts of cumulative CSG developments

We consider that the proponents have, for the most part, proposed appropriate mitigation measures to address the short term, local scale impacts of groundwater extraction on groundwater users. However, it is not clear that the measures proposed in the individual proponents' proposals will be adequate to fully address regional scale impacts on EPBC values or aquifer interactions.

We recommend that a regional-scale, multi-state and multi-layer model of the cumulative effects of multiple developments, and a regional-scale monitoring and mitigation approach will be developed to assess and manage these impacts. Such a model could be used to set the parameters for an adaptive management framework in which monitoring and mitigation strategies can be developed that will be applicable at both the project and regional scale. We consider that concerted Commonwealth and State action will be necessary to develop such a model as a high priority.

4. Management of long-term water balance impacts

We emphasise that any groundwater model, no matter how well-parameterised, calibrated and validated, is an interpretation of a groundwater system, and therefore subject to uncertainty. Given that there are shortfalls in the parameterisation and calibration of the models presented in the EISs, we consider that there are high levels of uncertainty in the accuracy of the predicted impacts of CSG development on groundwater behaviour and on EPBC listed ecological communities dependent on discharge from the GAB.

For this reason, **we recommend that measures to mitigate the potential impacts of proposed operations on water balances, such as the re-injection of treated associated water back into appropriate permeable formation(s) to re-establish pre-development pressure levels, be explored as an option and considered as a condition for approval of any development activities.** This needs to be undertaken in conjunction with appropriate measures to forecast and proactively manage any short term impacts, and should enable the reversal of any medium to long term changes in artesian groundwater pressures before they could impact on EPBC listed discharge communities. The design of and volumes involved in these activities should be informed by a regional-scale groundwater model.

3.2 Additional Recommendations

The adequacy of the proponents' hydrogeological models for estimating hydrogeological impacts on and within the Great Artesian Basin (GAB) and other affected surface and groundwater systems (this would include an initial assessment of the potential of one or more aquifers to depressurise and dewater and the likely impacts).

- Adaptive monitoring, data collection, update of numerical groundwater simulation models and re-interpretation of results should be undertaken, with regular updates in quarterly and annual reporting to State and Commonwealth agencies.
- Effort should be aligned between the State and Commonwealth Governments to coordinate the necessary data collation, data collection and modelling efforts to develop such a regional scale model.
- Proponents should provide all data relating to the hydraulic connectivity between aquifers and aquitards to substantiate the model parameterisation.
- The groundwater simulation models should be calibrated against measured piezometer response in areas where CSG development has already commenced.
- The parameterisation and reporting of all numerical groundwater model outputs should conform to the recommendations in the Murray Darling Basin Commission Groundwater Modelling Guidelines.

Potential impacts of groundwater extraction on aquifer interaction (e.g. water flow, cross contamination), vertical recharge, structural integrity and artesian pressure as a result of the CSG activities. This applies to both quantity and quality of groundwater.

- Understanding of the hydrogeology of the Bowen Basin and possible hydraulic connection to the Surat Basin should be improved through the assessment of petroleum and basin analysis work completed in the past few years.
- Hydrogeological, hydrochemistry (including environmental isotopes) and temperature data sets for the Surat Basin should be reviewed and interpreted to characterise vertical and lateral groundwater movement. This data should be used to underpin prediction and assessment of the impacts of CSG development.

Potential impacts of groundwater extraction on the EPBC Act listed endangered ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.'

- Understanding of the connectivity between all springs and groundwater systems should be improved by surveying elevations of known springs and determining their source aquifers. The likely impacts of drawdown on springs can then be assessed using modelled potentiometric surfaces;

- The current risk assessment, monitoring and mitigation measures for springs within the GAB should be reviewed in light of the degree of uncertainty in the existing modelling results;

- Where spring sites are located within tenements or the modelled limits of aquifer drawdown, the proponents should undertake additional monitoring including quarterly ecological assessments for at least the first 12 months of operations in order to determine the seasonal presence/absence of EPBC Act listed communities;

- The definition of natural springs, as applied under the EPBC Act, should be reviewed by DEWHA with particular reference to the discrimination of 'discharge' versus 'recharge' springs. This will ensure that all natural groundwater discharge sites are adequately assessed in terms of their potential to host EPBC significant communities that can be impacted by changes to groundwater conditions. The hydrogeological processes associated with so-called "recharge" springs are not well understood (in particular, their connectivity with groundwater systems), and it is possible that these springs may be also affected by drawdown from CSG activities.

Potential for recharge into the GAB to be impacted in these areas due to CSG activities and the likely long-term impact(s).

- Further trials should be undertaken to establish the feasibility of large scale re-injection, including assessment of the hydraulic and hydrochemical implications of injecting treated associated water, to offset any potential impacts on GAB water balance.

Potential impacts of fraccing on the structural integrity of aquifers and aquitards, and on existing groundwater flow processes.

- The proponents should adhere to standard operating procedures as defined by the regulator.

Initial advice on the likelihood and materiality of subsidence as the result of the proposals.

- Baseline and ongoing geodetic monitoring programs should be established by proponents in consultation with State Government agencies (e.g. Qld DERM) to quantify deformation at the land surface. This should link from the tenement scale to the wider region across which groundwater extraction activities are occurring.

Initial advice on the likelihood and materiality of any impact on MDB groundwater or connected surface water resources.

- Data should be acquired through drilling and pumping tests to quantify the connectivity between aquifers overlying the Walloon Coal Measures;

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Appendix 1

Geology and Hydrogeology of Surat, Bowen and Great Artesian Basins

The following is a summary of existing geological and hydrogeological information for the Surat, Bowen and Great Artesian Basins within Queensland. This information provides a background to the environment and gives the reader a source of more detailed reference material with regards to some of the issues addressed in this document.

Bowen Basin

The main part of the Permo-Triassic Bowen Basin, which covers an area of 200,000 km^2, outcrops to the north of the younger Surat Basin, but its southern extension unconformably underlies the Surat Basin. The southern part of the Bowen Basin has an area of 50,000 km^2 and contains up to 9000 m of sedimentary rocks. In Early Permian time marine sediments were deposited followed in the Late Permian time by continental deposits including coals of the Bandanna Formation. The Permian sedimentary sequence is over 3500 m thick in places.

In Early Triassic time the Rewan Formation continental mudstones were laid down, followed by fluviatile sandstones of the Clematis Sandstones during the Lower to Middle Triassic, followed by the continental and deltaic mudstones of the Moolayember Formation in the Middle Triassic.

Surat Basin

The Jurassic-Cretaceous Surat Basin is an elongate sedimentary basin, which is part of the hydrogeological Great Artesian Basin and covers 300,000 km^2 in eastern Australia, most of it in Queensland and New South Wales. It contains up to 2500 m of virtually flat-lying sedimentary rocks and is connected across the Nebine Ridge with the Eromanga Basin and to the east across the Kumbarilla Ridge with Clarence-Moreton Basin (Fig. A1-1).

Deposition in the overlying Surat Basin started in the Lower Jurassic with fluviatile sandstones of the Precipice Sandstone. From the Lower Jurassic to the lowermost Cretaceous sediments are essentially terrestrial and cyclic, the sequence is up to 1700 m thick and each of the five cycles is hundreds of metres thick. Each cycle generally commenced with the deposition of coarse sand, grading up into finer sand and silt and ending with deposition of sand, silt, mud and organic material (ultimately coal). These cycles were deposited by streams, swamps, lakes, deltas and shallow seas. Late Jurassic uplift gave the basin its gross structural configuration.

The sequence (Fig. A1-2) consists of the Precipice Sandstone, followed by the mudstones of the Evergreen Formation, the Hutton Sandstone, the sandstones, silts, mudstones and coals of the Walloon Coal Measures, deposited in swamps, lakes and streams. This is overlain by the Springbok Sandstone, the mudstones of the Westbourne Formation, the Gubberamunda Sandstone, mudstones of the Orallo Formation, Lower Cretaceous Mooga Sandstone, and the sediments of the Bungil Formation, which include sandstones, silt and mudstones, deposited in streams, coastal plains and shallow marine environments. Marine sediments of the Rolling Downs Group were laid down, followed by shallow marine, beach and terrestrial sediments during Cretaceous times. The sequence of the Bungil Formation and the Rolling Downs Group is up to 1200 m thick. Erosion took place during the Late Cretaceous and Tertiary and deep-weathering profiles developed. Volcanics (basalts) erupted around the Surat Basin in the Oligo-Miocene and active tectonism at this time increased basinward tilt and exposed parts of the basin units along its eastern and northern margins. The basin's northern margin was subsequently eroded.

Great Artesian Basin

The hydrogeological Great Artesian Basin includes the Surat Basin (Fig. A1-1) and the uppermost part of the Bowen Basin sequence, i.e. the Clematis Sandstone and Rewan and Moolayember Formations. Most of the sandstone units are aquifers and the mudstones represent aquitards or confining beds. Aquifers in the Great Artesian Basin are present in the sandstones of the Clematis and Precipice Sandstones, Boxvale Sandstone Member and the Hutton, Springbok, Hooray, Gubberamunda and Mooga Sandstones and Kumbarilla Beds and Nullawurt Sandstone Member, with isolated aquifers in the Griman Creek Formation. The confining beds or aquitards in the Great Artesian Basin consist of the Rewan Group, Moolayember, Evergreen, Birkhead, Walloon Coal Measures, Westbourne and Orallo Formations, parts of the Bungil Formation, including the Kingull and Minmi Members, Wallumbilla Formation, including the Doncaster and Coreena Members, Griman Creek Formation and their equivalents. A summary stratigraphic column for the Surat Basin and underlying Bowen Basin is presented in Figure A1-2. Groundwater in the most widely exploited confined aquifers within the Lower Cretaceous-Jurassic sequence generally contains 500-1500 mg/L total dissolved solids. Artesian groundwater has pH values which are almost always between 7.5 and 8.5. The artesian groundwater is chemically of the Na-HCO3-Cl type, and these ions contribute more than 90 percent of the total ionic strength of solutes in the main basin area.

Recharge of the aquifers by infiltration of rainfall and through creeks and rivers into the outcropping aquifer sandstones and through unconsolidated sediments overlying the aquifers occurs mainly along the northern and eastern, elevated, margins of the basin, located on the western slope of the Great Dividing Range (Fig. A1-3).

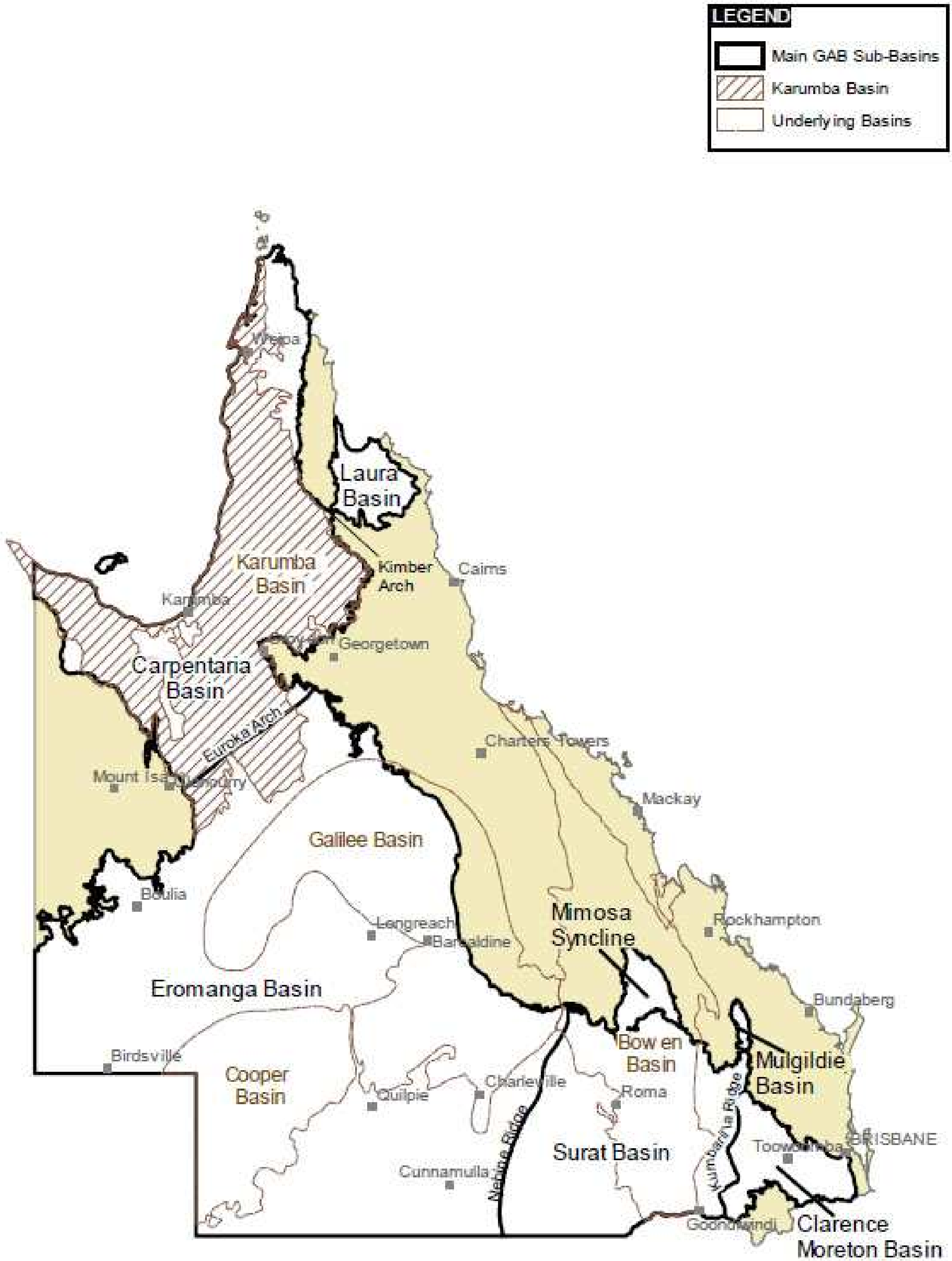

Figure A1-1. Map showing sub-basins of the Great Artesian Basin within Queensland, including the Surat and Bowen Basins, together with the eastern and western boundaries of the Surat Basin as defined by the Kumbarilla and Nebine Ridges (DNRM 2005).

Graphic	Litho-stratigraphy	Main Rock Types
	Condamine Alluvium	Unconsolidated sand, gravel and silt
	Tertiary Sediments	Unconsolidated sediments
	Griman Creek Formation	Sandstone, siltstone, mudstone conglomerate and coal
	Surat Siltstone	Interbedded carbonaceous siltstone, mudstone and lithic sandstone
	Wallumbilla Formation	Mudstone, siltstone, sandstone lenses with conglomerate and limestone
	Bungil Formation	Mudstone siltstone and lithic sandstone
	Mooga Sandstone	Fine to medium grained sandstone and shales
	Orallo Formation	Sandstone carbonaceous siltstone mudstone coal
	Gubberamunda Sandstone	Medium and coarse quartz sandstone
	Westbourne Formation	Shales, siltstones and fine grained sandstone
	Springbok Sandstone	Sublabile, lithic sandstone with calcareous cement
	Walloon Coal Measures	Shale, siltstone, labile argillaceous sandstone, coal, mudstone, limestone
	Hutton Sandstone*	Sandstone, siltstone, shale, conglomerate, coal, oolitic ironstone
	Evergreen Formation	Sandstone, siltstone, shale, mudstone (carbonaceous with minor coal), oolitic limestone
	Precipice Sandstone	Sandstone, pebbly sandstone, siltstone.
	Sedimentary sequences of the Bowen basin	Predominantly sandstone, siltstone, shale and mudstone with Coal measures

Figure A1-2. Simplified stratigraphy of the Surat Basin showing the unconformable relationship with the underlying Bowen Basin sequences (Hostetler, 2009).

Discharge from the Great Artesian Basin aquifers takes place as natural discharge from springs, by vertical leakage from the aquifers upwards to higher aquifers and the regional watertable, by subsurface outflow into neighbouring basins and as artificial discharge by means of free or controlled artesian flow and pumped abstraction from water bores drilled into the aquifers (Habermehl, 1980, 2001a, b). Concentrated outflow from springs occurs from a number of springs in the Surat Basin, where diffuse discharge from the artesian aquifers takes place through the confining beds towards the ground surface. Following development of the region since the 1880s, natural discharge has diminished. Abstraction by water bores and in particular the use by the pastoral industry of flowing artesian water bores caused large-scale lowering of the potentiometric surface and a steepening of the hydraulic gradients. A visible effect of this has been the reduction in flow from springs and in some areas springs have ceased to flow.

Regional groundwater movement in the aquifers in the Great Artesian Basin has been interpreted from the potentiometric surface maps of the aquifers in the Jurassic and Lower Cretaceous sequences (Habermehl, 1980, 2001a, Habermehl and Lau, 1997). In the southern and eastern parts of the GAB flow directions are generally towards the south and south-east. Groundwater movement is slow, and based on hydraulic data probably around 1–5 m/year, as hydraulic conductivities and gradients are low and porosities high (Habermehl, 1980). Groundwater flow rates based on carbon-14 and chlorine-36 studies range from less than 1 m/year to approximately 5 m/year (Calf and Habermehl, 1984; Bentley et al., 1986; Torgersen et al. 1991; Radke et al. 2000; Love et al. 2000; Mahara et al. 2000). Groundwater residence times determined from carbon-14 and chlorine-36 studies range from several thousands of years near the recharge areas to more than one million years near the centre of the Great Artesian Basin. Carbonate spring mound deposits in the Lake Eyre region have dated ages of up to 740,000 years, with some spring deposits probably being older (Prescott and Habermehl 2008).

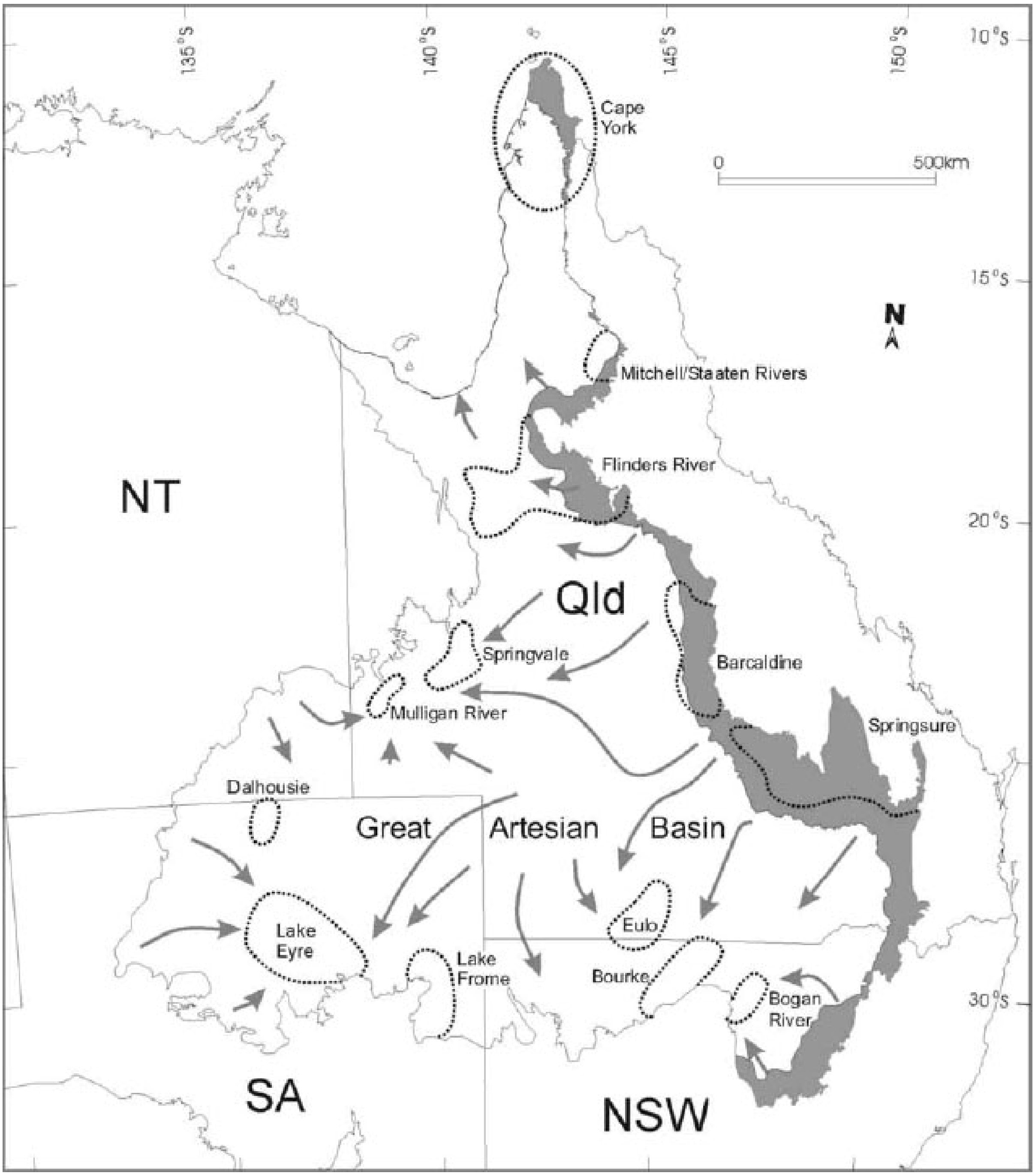

Figure A1-3. Recharge areas, generalised flow directions and spring groups of the Great Artesian Basin (Fensham 2006). Shaded patterns broadly represent the recharge area; arrows represent modelled flow lines after Welsh (2000); dashed lines represent spring groups (updated from Habermehl 1980, 1982).

Coal Seam Gas Production

Coal seam gas extraction in the Surat Basin is from the Walloon Coal Measures (see Fig. A1-2) in the north-eastern and northern parts of the Basin. The Walloon Coal Measures range in thickness from 50-500 m, and the unit consists mainly of siltstones, mudstones and sandstones that separate nine major coal intervals (Green, 1997). The coal seams are up to several metres thick, with maximum thicknesses of about 10 m. The overlying aquifers include the Springbok Sandstone and the Gubberamunda Sandstone, although the latter is separated from the Springbok Sandstone by the Westbourne Formation aquitard. The Walloon Coal Measures are underlain by the Hutton Sandstone and Precipice Sandstone aquifers, the latter being separated from the Hutton Sandstone aquifer by the Evergreen Formation, a regional aquitard.

Coal seam gas extraction involves the reduction of hydrostatic pressure in the coal seams to allow gas production by desorption of methane from the coal. This requires the extraction of groundwater from the coal seams by groundwater production bores. The large amount of groundwater produced, which in most cases is of poor quality, is called associated water. The process of groundwater extraction in the Surat Basin aims to lower the groundwater level to approximately 35 m above the upper coal seam. This is likely to result in a large drawdown in the potentiometric surface of the Walloon Coal Measures, which, over time, extends outside the bounds of the gas field production area. The drawdown of the groundwater levels will propagate vertically through the over- and underlying aquitards or confining beds into the over- and underlying aquifers. Following the cessation of CSG production and the extraction of groundwater after several decades, the groundwater level drawdown cones in the affected Great Artesian Basin aquifers, while reducing in magnitude, may still expand beyond the boundaries of the CSG development areas, and recovery of the drawdown in the affected aquifers may take a considerable time after cessation of CSG operations.

The significant volume of associated water produced by CSG extraction needs to be disposed of in a sustainable and environmentally acceptable manner. Suggested options by the proponents and the Queensland Government authorities include (a) re-injection of treated associated water into selected aquifers following water treatment to suitable water quality standards, (b) use of treated associated water in plantations and other agriculture enterprises, and (c) discharge of treated associated water into surface water or shallow groundwater systems.

Appendix 2

Environmental Impact Statements (EIS) and related documentation

The relevant information underpinning this advice is contained within the main Environmental Impact Statement report volumes of the APLNG, QGC and Santos EIS documents, several of the appendices, a range of technical supplements provided by the proponents, along with a number of other relevant publications. Contrary to the initial list of relevant documents provided by DEWHA, consideration of the issues raised requires reference to a significantly wider range of information. The list of documents below identifies the information sources which GA and s. 47F(1) have either identified or referred to in relation to this more detailed assessment.

<u>Australia Pacific LNG (APLNG) Environmental Impact Statements</u>

http://www.aplng.com.au/our-eis

* Not provided and not requested by DEWHA for original review

- Volume 2 – Gas Fields
  - Chapter 3* – Project Description (77 pages)
  - Chapter 9* – Water Quality & Aquatic Ecology (40 pages)
  - Chapter 10 – Groundwater (59 pages)
  - Chapter 11* – Surface Water (49 pages)
  - Chapter 12* – Adaptive Associated Water Management (23 pages)
  - Chapter 23* – Matters of National Environmental Significance (168 pages)
  - Chapter 24* – Environmental Management Plan (114 pages)
  - Chapter 25* – Cumulative Impact Assessment (25 pages)

- Volume 5 – Attachments
  - Attachment 17* – Aquatic Ecology, Water Quality and Geomorphology Impact Assessment – Gas Fields. Prepared by Hydrobiology for WorleyParsons. (195 pages)
  - Attachment 18* – Aquatic Ecology, Water Quality and Geomorphology Impact Assessment – Gas Transmission Pipeline. Prepared by Hydrobiology for WorleyParsons. (146 pages)

- Attachment 21 – Groundwater Technical Report - Gas Fields. Prepared by WorleyParsons for APLNG. (280 pages)
- Attachment 22* – Surface Water and Watercourses - Gas Fields. Prepared by WorleyParsons for APLNG. (238 pages)
- Attachment 23 – Conics IQQM Model [Hydrologic Modelling of Permeate
- Discharge to Condamine River]. Prepared by Conics for Origin Energy. (41 pages)
- Attachment 24 – Adaptive Associated Water Management - Gas Fields (83 pages)
- Attachment 25 – Water Resource Technical Report – Gas Transmission Pipeline. Undertaken by WorleyParsons. (41 pages)

- APLNG response to Geoscience Australia questions - August 2010. 52 p.

<u>Queensland Gas Company/British Gas (Queensland Curtis LNG project)</u>

Queensland Curtis LNG Draft and Supplementary Environmental Impact Statements

http://qclng.com.au/eis/draft-eis/

- Volume 2 – Project Description
  - Chapter 7 – Gas Field Component Operations + Supplement (48 pages)
- Volume 3 – Environmental Assessment of Gas Field Component
  - Chapter 8 – Aquatic (Freshwater) Ecology + Supplement (15 pages)
  - Chapter 9 – Surface Water + Supplement (21 pages)
  - Chapter 10 – Groundwater + Supplement. Overview of the potential impacts of the CSG field activities on groundwater. (35 pages)
  - Chapter 11 – Associated Water Management + Supplement (91 pages)
- Appendix 3.2 – Groundwater Study – Northwest Development Area. Prepared by Golder Associates for QGC. (184 pages)
- Appendix 3.4 – Gas Field Groundwater Report: Parts 01-13. Prepared by Golder Associates for QGC. (292 pages)
- *QGC Groundwater Study Surat Basin, Queensland. Prepared by Golder Associates for QGC (163 p. + 10 p.) + Groundwater Modelling for CSG Extraction – QGC. Prepared by Golder Associates

for QGC. (46 p.) + QGC Groundwater Quality Assessment. Prepared by Golder Associates for QGC. (33 p.)*

- QGC Environmental Authority Application: North West Development Area – Supporting Information. (165 pages)
- QGC Pipeline Licence Application – South East and Central Development Area Supporting Information (52 pages)
- QGC response to DEWHA request for further information related to Groundwater issues. (14 pages)
- Assessment of subsidence due to coal seam gas extraction. Prepared by Golder Associates for QGC, 20 August 2010. 5 pages.
- Response to DEWHA 300810 – Attachment 3 – Geodetic Monitoring. 1 page.

Santos (Gladstone LNG Project)

Gladstone LNG Environmental Impact Statement

(http://www.glng.com.au/Content.aspx?p=90)

- Section 3 – Project Description (98 pages)
- Section 6 – Coal Seam Gas Field Environmental Values and Management of Impacts
    - Section 6.1 – Assessment Methodology (2 pages)
    - Section 6.4 – Nature Conservation (62 pages)
    - Section 6.5 – Surface Water (21 pages)
    - Section 6.6 – Groundwater (75 pages)
    - Section 6.7 – Associated Water Management (27 pages)
- Appendix N4 – Aquatic Flora and Fauna. Prepared by frc environmental for URS. (299 pages)
- Appendix P1 – Shallow Groundwater. Prepared by URS for Santos. (178 pages)
- Appendix P2 – Deep Groundwater. Prepared by Matrixplus for Santos. (145 pages)

Gladstone LNG Supplementary Environmental Impact Statement (http://www.glng.com.au/Content.aspx?p=96)

EIS Response to Submissions

- Coal Seam Gas Field Environmental Values and Management of Impacts (83 pages)
- Appendix G – EPBC Act Report (13 pages)
- Appendix P – Groundwater (3 pages)
- Appendix Q – Associated Water Management Strategy (3 pages)

Supporting Documentation

- Attachment B1 – Coal Seam Gas Field Revised Environmental Management Plan. (46 pages)
- Attachment D2 – Groundwater and Associated Water Impact Management Plan. Prepared by Golder Associates for Santos. (208 pages)
- Attachment D3 – Associated Water Management Plan. (68 pages)
- Attachment D5 – Nature Conservation. Supplementary Assessment of Potential Impact to Ecological Values. Prepared by URS for Santos. (171 pages)
- Coal Seam Hydraulic Fracturing Fluid Environmental Risk Assessment: Response to the Coordinator General Requirements for Coal Seam Gas Operations in the Surat and Bowen Basins, Queensland. Prepared by Golder Associates for Santos. (424 pages)
- Technical Memorandum – The Matter of the Impact from Santos CSG Fields on the GAB Springs. Golder Associates, 10 August 2010. (3 pages)
- Assessment of subsidence due to coal seam gas extraction. Prepared by Golder Associates for Santos, 1 September 2010. 12 pages.

Assessment of impacts of the proposed coal seam gas operations on surface and groundwater systems in the Murray-Darling Basin.

Prepared by: Professor Chris Moran, Dr Sue Vink
Centre for Water in the Minerals Industry
Sustainable Minerals Institute
The University of Queensland

Commenced: 14 October 2010
Final report: 29 November 2010

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1 Executive Summary

Context and Scope

This report was commissioned by DSEWPAC on advice in a report by Geoscience Australia and Habermehl (2010) that the location and nature of current and proposed CSG activities in Queensland may trigger Section 255AA - Mitigation of unintended diversions - of the *Commonwealth Water Act 2007.* The scope of this study was to undertake a desktop study to determine the impacts of the proposed CSG operations on the connectivity of groundwater systems, surface water and groundwater flows and water quality in the Murray-Darling Basin.

Underlying the MDB, the primary target of CSG development are the seams of the Walloon Coal Measures located in the Surat/Clarence Morton Basins. In order to extract gas, the hydrostatic pressure must be reduced by pumping water from cleats in the coal seams so that gas is desorbed from the coal pores. This dewatering has been predicted to result in drawdown of water levels in overlying and underlying aquifers in the region during CSG production.

The scope of this study included rivers, streams and associated alluvial aquifers in the MDB. The spatial coverage defined as alluvium was supplied by the government and covers an area of 172,898 km^2. Assessment was restricted to CSG activities on this area. Although the Great Artesian Basin aquifers are not part of the MDB surface water management area, the impacts of dewatering of the Walloon Coal Measures on these aquifers may also impact alluvial aquifers, in particular the Condamine Alluvium. Given the spatial extent of CSG activities the primary focus of the report was the Condamine-Balonne River system and Central Condamine Alluvium. The Condamine River and the alluvium have been extensively used as water resource for agriculture. No data have been made available to examine the possible implications of hydrocarbons, eg, BTEX, in associated water. Engineering solutions for surface water storage, water treatment facilites and consequential brine management were not examined.

As of November 2010, there were 105 tenements in the MDB with a total area of 18,903 km^2. The area of alluvial extent within these tenements is 4,130 km^2. Arrow Energy and QGC have the highest proportion of alluvium in their tenements.

Assessment of impacts on MDB surface and groundwater systems

A conceptual diagram of flows and processes driving flows in the system was constructed. Imports, exports and hydraulic interactions between the system components were reviewed. Changes to the processes controlling water flows and interactions as a result of CSG activity were categorised according to the relative significance of change and/or local risk. Four interactions are identified as creating significant changes and/or local impacts. Three interactions are categorised as intermediate, six as minor and nine with no changes.

		To				
		Surface water	**Groundwater**			**Mixed S/G**
		Rivers	**Alluvium**	**WCM**	**GAB**	**Other uses**
From	**Rivers**		14. recharge from losing streams	15. recharge from losing streams into outcrop intake beds	16. recharge from losing streams into outcrop intake bed	12. crops, forestry, municipal
	Alluvium	17. discharge (gaining streams)	3. redistribution potentially with water quality change	7. redistribution potentially with water quality change	10. redistribution potentially with water quality change	12. crops, forestry, municipal
	WCM	1. discharge of associated water (with treatment if required)	2. reinjection of co-produced water via surface bores 5. redistribution potentially with water quality change	8. reinjection of co-produced water via surface bores	6. reinjection of co-produced water via surface bores	13. crops, forestry, municipal
	GAB	11. discharge (gaining streams)	9. redistribution potentially with water quality change	4. redistribution potentially with water quality change	redistribution potentially with water quality change	12. crops, forestry, municipal
	Other Uses	Discharge (Municipal effluent)	recharge (Drainage below root zone)		recharge (Drainage below root zone)	

Blue= significant and/or local risk; Green = intermediate changes; Yellow = minor changes; White = no change.

MDB Surface waters

The Upper Condamine River is a losing stream (water moves from the stream to recharge aquifers) under which groundwater is already significantly depleted and currently not connected to the stream. Flow is therefore unlikely to be changed by further drawdown of water level in the alluvium as a result of CSG extraction. Below the Chinchilla Weir, flow in the Condamine River may be increased by discharge of treated associated water (permeate). Modelling of stream flow by one proponent (APLNG, 2010) suggested that permeate discharge could be managed to meet environmental flow requirements and not significantly affect water quality. Permeate discharge proposed by APLNG could return on the order of 2-17% of pre-development flows to the River. QGC and Santos have investigated disposal of treated associated water to streams as an option, currently this is not the preferred option for Santos (QGC, 2010, Vol 3 Ch. 11; Santos, 2010, Appendix Q). If more than one proponent discharges to the Condamine River, an assessment will required to determine the cumulative impact of discharges from multiple proponents. This assessment will need to consider the physical and ecological implications of changes to water quantity and quality and account for the timing of discharge.

Mitigation strategies proposed by the proponents should minimise the risk of water quality compromise to surface waters due principally to potential sediment production from construction activities (APLNG, 2010, Vol 5 Att. 22; QGC, 2010, Vol. 3 Ch.9; Santos, 2010, Section 6.5).

Alluvial Aquifer

Hydraulic connectivity between the Central Condamine Alluvium and both the Walloon Coal Measures and some GAB aquifers has been demonstrated by analysis of bore water levels and water quality data (KCB, draft in review; Hillier, 2010). Current hydraulic relationships between the alluvium and the underlying units may be altered by dewatering of the coal measures. Loss of water availability from the Central Condamine Alluvium due to direct or indirect induced leakage caused by dewatering of the coal seams could not be separately assessed due to lack of sufficiently detailed numerical model outputs and measurements from current operations. Drawdown of the water table was predicted to be ~2 m on average by one of the proponents (APLNG, 2010, Vol. 5 Att. 21). The predicted drawdown area was not expected to extend appreciably beyond the current tenement boundaries. Thus only a small area of the Central Condamine Alluvium was predicted by proponents to be affected by CSG activities.

The area of maximum drawdown of the water table (5-7m) is restricted to a small area around Miles and immediately downstream of the Chinchilla Weir (APLNG, 2010, Vol. 5 Att. 21). One water bore user was identified as likely to be affected by water table drawdown in these areas (APLNG, 2010, Vol. 5 Att. 21).

Water quality in the Central Condamine Alluvium is most likely to be affected by redistribution of water within the alluvium in response to aquifer drawdown because net movement of water is into the coal measures as a result of dewatering. Water quality in the alluvium is heterogeneous and in some areas varies considerably between bores. While the movement of water within the alluvium will not likely change water quality over a wide spatial extent it may impact individual bore holders

Reinjection of treated associated water into aquifers may lessen the impact of drawdown created by dewatering of the coal seams. A significant amount of further technical work is required to determine appropriate reinjection targets, timing and water quality/treatment needs.

Subsidence effects due to aquifer compaction were predicted by all proponents to be minor (APLNG, 2010, Vol. 5 Att. 21; QGC, 2010, Vol 3 Ch. 10; Santos, 2010, Appendix P1). However, even small changes to the land surface due to subsidence may alter overland flow paths initiating new erosion features in susceptible areas. Additionally, subsidence may also change or cause fracturing in aquifers which may alter the hydraulic connectivity.

Current predicted drawdown of the Condamine Alluvium by CSG proponents suggest that the drawdown of the alluvial aquifer due to CSG activity is likely to be considerably smaller than the drawdown that has occurred over recent decades due to water extraction for agricultural purposes. None-the-less there are significant gaps in knowledge of the system and the numerical models currently being used to assess likely impacts.

Gaps

Localised drawdown effects are likely to be significantly different to the predicted regional average drawdown owing to the spatial variability in hydraulic connectivity between the coal measures and aquifers, rates of water movement, depth of the coal seam and the thickness confining layers. No proponents have considered the effect of faulting or fractures in their models. These preferential flow features can alter local drawdown. Data on hydraulic properties is scarce. More spatially explicit hydraulic data should be collected and incorporated into models on an on-going basis.

Targeted areas for monitoring and additional data on hydraulic properties should be prioritised. Ongoing validation of model predictions of drawdown and water production will provide insights into areas requiring better characterisation and/or additional monitoring. Water production data should also include water produced during exploration because this extraction will contribute to the water deficit of the system. It is not clear whether this is currently included in water production estimates and, if so, how.

Water quality analyses, including isotope tracers and dating of waters may aid in identification of changes to local hydraulic conditions. Changes in water types and salinity in the Central Condamine Alluvium in combination with analysis of water levels have been interpreted to be indicative of hydraulic exchange between the alluvium and underlying Walloon Coal Measures and sandstone aquifers. Incorporation of geochemical analysis into a monitoring program with water level monitoring may improve understanding of changes to aquifer interactions.

An adaptive management regime, supported by significant monitoring at the individual well level, with specific management actions stated upfront to cope with predictable localised effects should provide an acceptable mechanism for ongoing system control. Transparency of information and impact reporting provides a strong adjunct to adaptive management to assist community, government and industry to maximally benefit from the full range of resource uses available in the region.

2 Purpose

Professor C. J. Moran, on behalf of the Centre for Water in the Minerals Industry, was contracted by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) to conduct an independent expert study in relation to development of coal seam gas (CSG) industry in Queensland and potential for impacts on the Murray Darling Basin water flows. The need for this study was based on advice in a report by Geoscience Australia and Habermehl (2010) that the location and nature of current and proposed CSG activities in Queensland may trigger Section 255AA - Mitigation of unintended diversions - of the *Commonwealth Water Act 2007.*

Section 255AA of the Water Act 2007 states that:

"Prior to licences being granted for subsidence mining operations on floodplains that have underlying groundwater systems forming part of the Murray-Darling system inflows, an independent expert study must be undertaken to determine the impacts of the proposed mining operations on the connectivity of groundwater systems, surface water and groundwater flows and water quality".

2.1 Scope of work

The scope of this study was to determine the impacts of the proposed CSG operations on the connectivity of groundwater systems, surface water and groundwater flows and water quality in the Murray-Darling Basin. Terms of References for the study are given in Appendix 1.

The study scope did not include analysis of engineering structures or solutions such as storage pond design, well completion techniques or brine management strategies.

2.2 This report

This report is the final deliverable for the project. The information assessed in this report was predominantly obtained from the Environmental Impact Statement (EIS) documents of three CSG proponents (APLNG, Santos and QGC), as well as a report prepared by Geoscience Australia (GA) (GA and Habermehl, 2010). Published literature and reports obtained from Queensland Department of Environment and Resource Management (DERM) were also reviewed. Technical data and information was requested from the CSG proponents and science and data agencies within the Queensland and Commonwealth governments. To date, only data downloaded from the Queensland Government website (QPED) has been obtained. No information has been obtained from Arrow Energy Ltd.

Discussion of water quality is largely restricted in this report to consider salinity and major anion/cation composition. While there is a small amount of dissolved heavy metal and nutrient data reported in the proponent EIS documents it was not considered sufficiently spatially or temporally detailed to form an assessment. Analytical results for dissolved organic compounds (including BTEX) were not available for this report.

3 Background and Context

The preconditions for triggering the provisions of Section 255AA of the *Commonwealth Water Act (2007)* are that the activity must be:

- a subsidence mining operation;
- occur on a floodplain; and
- have potential to impact on Murray-Darling Basin (MDB) system inflows.

Based on advice in a report by Geoscience Australia (GA and Habermehl 2010), the location and nature of current proposed coal seam gas (CSG) developments in Queensland mean that the above preconditions may potentially be met and it is therefore prudent to commission an independent expert study in accordance with s255AA of the Water Act 2007 in order to inform government decision makers prior to approvals being granted. The independent expert sought advice from the Joint Liaison Committee for definition of the floodplain. A map of the extent of alluvial sediment in the Queensland Murray Darling Basin was supplied for this purpose.

Under the *Commonwealth Water ACT 2007* this study is restricted to analysis and evaluation of CSG activities that are physically occurring on the floodplain and therefore does not consider activities in CSG tenements that are not overlying alluvium. Figure 1 shows the extent of alluvium in the Murray Darling Basin and location of CSG tenements. The total area of alluvium shown in Figure 1 is 172,898 km^2. Production schedules, proposed well locations during development of the fields, estimates of water production for individual wells and detailed hydrological modelling were not available for this report. Consequently the smallest spatial unit available for the assessment presented in this report is the tenement. Thus if a tenement intersected the alluvial extent shown in Figure 1, it was considered to be part of this assessment.

Within the study region, there are 13 companies undertaking CSG activities (including exploration, extraction and processing activities). The majority of tenements are to be developed by four proponents: Santos, BG/QGC, APLNG and Arrow Energy. Both Santos and QGC have had their developments approved with a significant number of conditions imposed by both State and Commonwealth Governments. The APLNG Environmental Impact Statement is currently under review by the Queensland State Government. The number and area of tenements intersecting alluvium are summarised in Table 1. As of November 2010, there were 105 tenements in the MDB with a total area of 18,903 km^2. The area of alluvial extent within these tenements is 4,130 km^2. Arrow Energy and QGC have the highest proportion of alluvium in their tenements. There is 1,646 km^2 of the Condamine Alluvium under CSG tenement.

Within the study region, there are currently 1,272 CSG wells. Figure 2 shows the current distribution of CSG production wells in the study area (QPED, October 2010). It can be clearly seen that current production is concentrated in well defined areas. Each proponent is proposing that ~10,000 wells will be staged in operations over the lifetime of their projects (~ 40 years). Most CSG activity is occurring on the Northwestern – Western margin of the Condamine Alluvium (Figure 2).

The primary areas under consideration are: Santos tenements in the vicinity of Roma, the central and south-east development areas under development by QGC, all APLNG tenements and all Arrow Energy tenements. It should be noted that no information was available regarding Arrow Energy CSG developments.

In addition, only considering activities that occur on alluvium may represent a significant gap in this analysis. CSG activities located outside of the alluvium may indirectly impact on MDB alluvium and surface water flows by changing hydraulic conditions in surrounding aquifers which may change aquifer connectivity.

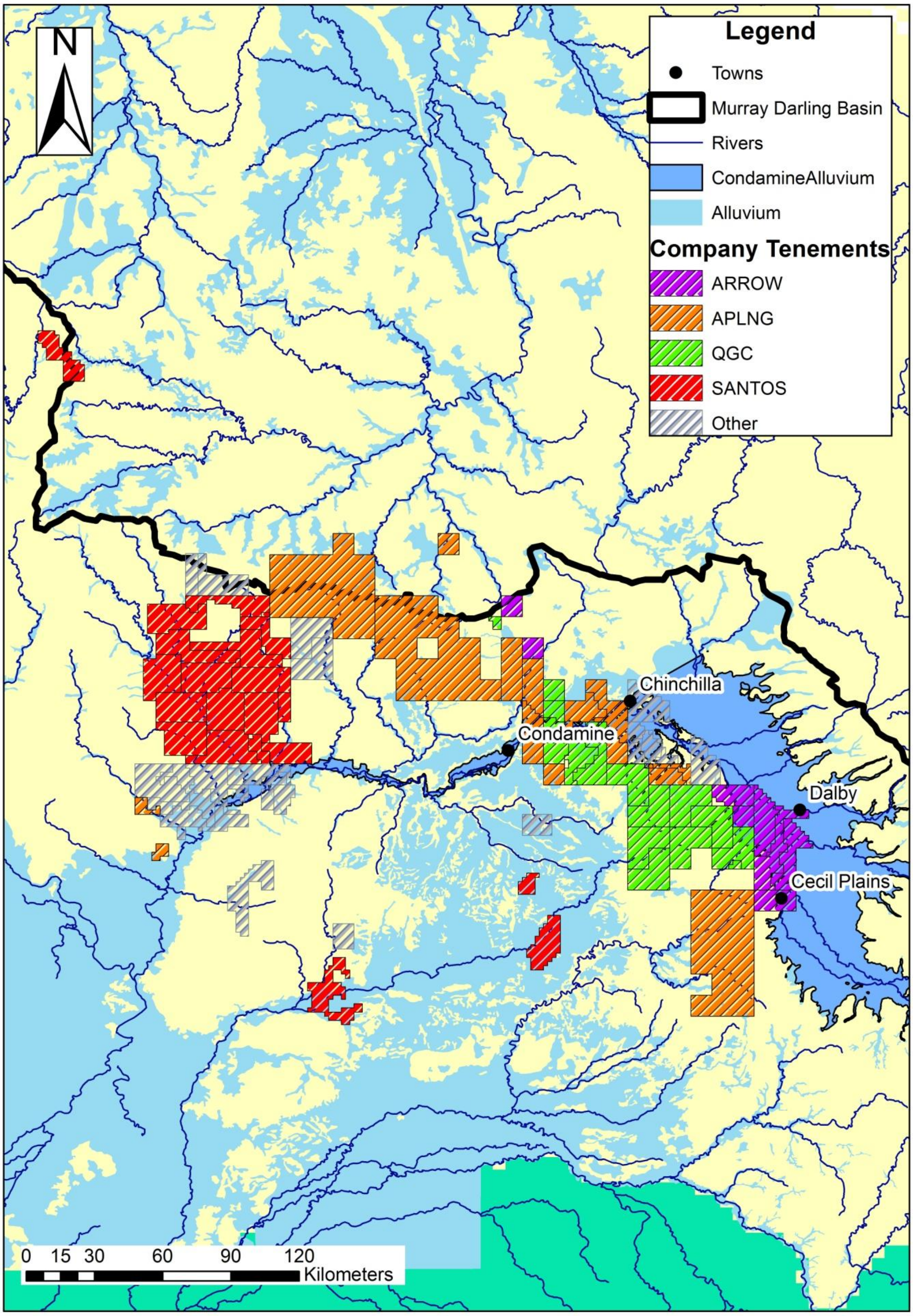

Figure 1. Alluvial extent and CSG tenements.

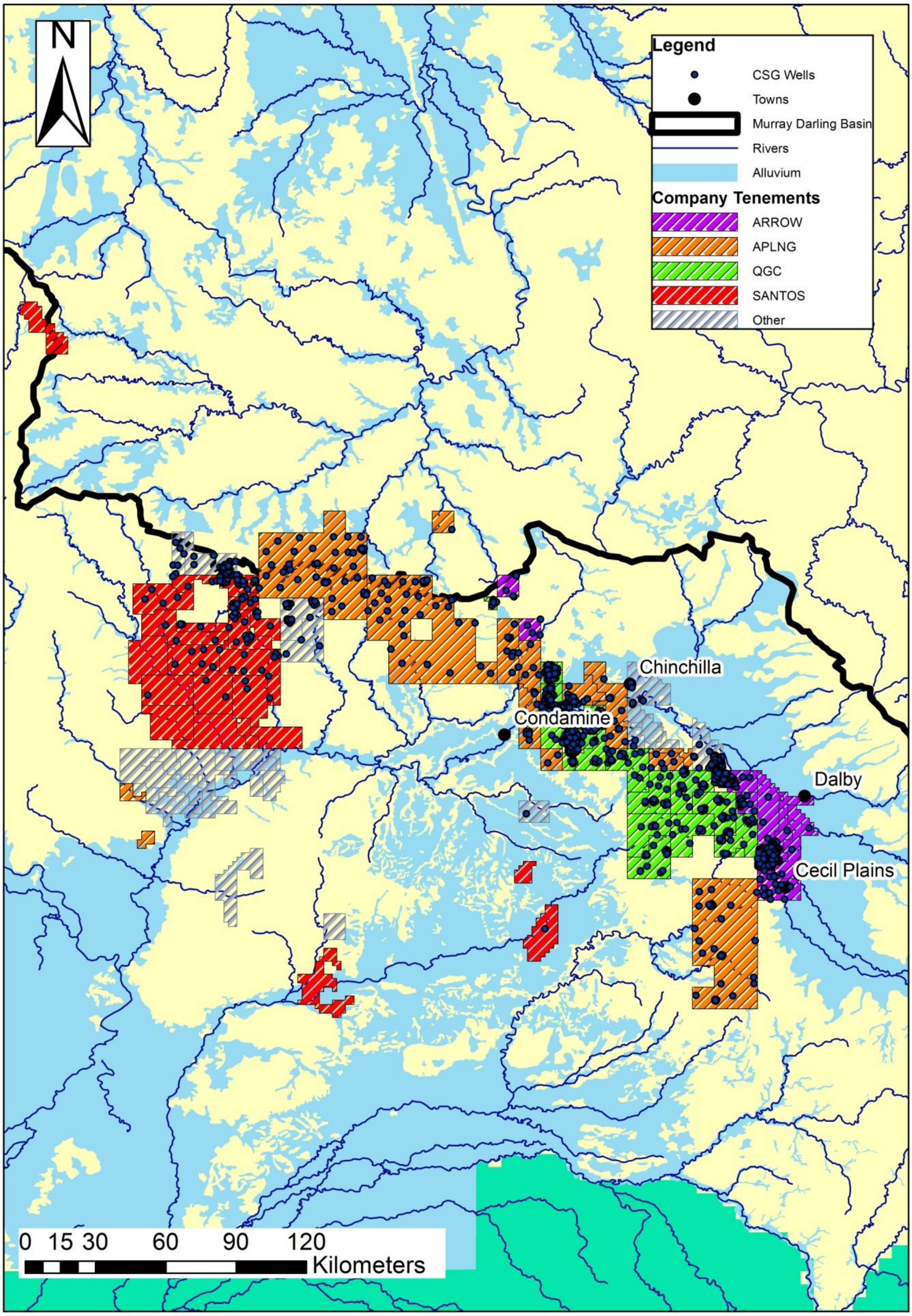

Figure 2. Location of CSG wells in the study area.

Table 1. Summary of CSG tenements within the boundary of the MBD and area of alluvium in the tenements.

Company	Number of Tenements	Area of Tenements (km^2)	Alluvium area in tenements (km^2)
ANGARI PTY LIMITED	2	153	16
ARROW ENERGY	8	1240	819
AUSTRALIA PACIFIC LNG PTY LTD	17	5802	863
AUSTRALIAN CBM PTY LTD	3	667	425
BNG (SURAT) PTY LTD	2	312	4
BRISBANE PETROLEUM LTD	3	357	0
BRONCO ENERGY PTY LIMITED	2	465	46
MOSAIC OIL NL	3	102	24
MOSAIC OIL QLD PTY LIMITED	8	874	30
OIL INVESTMENTS PTY LIMITED	9	1266	415
QGC PTY LIMITED	21	2786	651
SANTOS QNT PTY LTD	26	4771	752
SOUTHERN CROSS PETROLEUM & EXPLORATION PTY LTD	1	108	85
Total	105	18,903	4,130

3.1 Coal Seam Gas Development

Current approval of significant expansion of CSG development within the MDB has been given for two companies located in the Surat Basin. Further expansion is projected in order to supply gas to Liquefied Natural Gas (LNG) plants to be located in Gladstone. The primary target of CSG development are the seams of the Walloon Coal Measures located in the Surat/Clarence Morton Basins. The Walloon Coal Measures extend from surface outcrops to as deep as 1600 m below ground level, with the area being targeted for CSG primarily being where the coal is between 250m and 600m below ground level. The Walloon Coal Measures is composed of at least three coal seams (composed of 9 coal intervals) of variable thickness. In contrast to the relatively contiguous coal seams of the Bowen Basin, the seams of the Walloon Coal measures typically present as discontinuous relatively thin seams (Draper and Boreham, 2006). The coal seams are embedded in mudstone, siltstone and sandstones.

In order to extract gas, the hydrostatic pressure must be reduced by pumping water from cleats in the coal seams so that gas is desorbed from the coal pores. In the Surat Basin, CGS proponents typically reduce the hydraulic head to within 35 m of the upper coal seam. This groundwater drawdown has been predicted to result in drawdown from overlying and underlying aquifers in the region during CSG production. The spatial extent of the drawdown is expected to extend beyond the boundary of the gas field production area and recovery of the groundwater systems is expected to extend significantly beyond cessation of CSG operations.

Water quality in the Walloon Coal Measures is variable, reflecting the depositional environment, depth of burial and coal type. In general, waters are slightly brackish to brackish, although some bores in the Walloon Coal measures yield freshwater (i.e. Total Dissolved Solids (TDS) < 1000 mg/L). Salinity (measured as TDS) ranges between 950 -12,894 mg/L, with an average values across the Surat Basin of 4,494 mg/L. Average composition is compared to the only information available from the alluvium, specifically from the Central Condamine Alluvium, in Table 5.

Coal seam water from the Walloon Coal Measures is typically Na-Cl or Na-HCO3-Cl. Water type varies spatially. QGC state that saltier Na-Cl coal seam waters dominate in the north-west area of their tenements, while fresher Na-HCO3 waters occur in the Southeast area (QGC, 2010). Water samples from the Walloon Coal Measures in the area underlying the Central Condamine Alluvium also show spatial variation. KCB (draft in review) showed that Na-Cl type waters predominantly occur in the Walloon Coal Measures underlying the western margin of the alluvium, whereas Na-HCO3-Cl and to a lesser extent Na-Cl-HCO3 dominate to the east.

4 Murray Darling Basin

4.1 Setting

The MDB is the catchment for the Murray and Darling rivers and tributaries. The region has an approximate area of 1,060,000 km^2, occupying approximately 14% of Australia's total area, and spanning across the States of Queensland, New South Wales, Victoria, South Australia, and the Australian Capital Territory (Figure 5).

The region provides important economic, social and ecological values for the country. It is Australia's most important agricultural area, supporting 65% of Australia's irrigated agricultural land, it produces over one-third of Australia's food supply and generates 39% of the national income derived from agricultural production. The region is home to more than 2 million people and supports an additional 1.5 million people reliant on the MDB water resources. Important environmental assets of the region include wetlands of national significance (as listed under the Ramsar Convention) and other groundwater dependent ecosystems.

This scope of this study included rivers, streams and associated alluvial aquifers in the MDB. Although the Great Artesian Basin aquifers are not part of the MDB surface water management area, the impacts of dewatering of the Walloon Coal Measures on these aquifers may also impact surface waters and alluvial aquifers, in particular the Condamine River and Alluvium. The hydrogeology of the area, and particularly the Great Artesian Basin, has been described extensively and a simplified stratigraphic sequence is presented in Figure 3. In general the sandstone sequences are confined aquifers. The confining units (aquitards) are generally siltstone and mudstones and include the Walloon Coal Measures. The units considered at greatest risk from CSG development are the Hutton (the Hutton sandstone grades into the Marburg sandstone in the Clarence Moreton Basin) and Precipice Aquifers located below the Walloon Coal Measures and the Springbok and Gubberamunda Aquifers located above the coal measures. There is also considerable concern regarding possible impacts on the Condamine Alluvium.

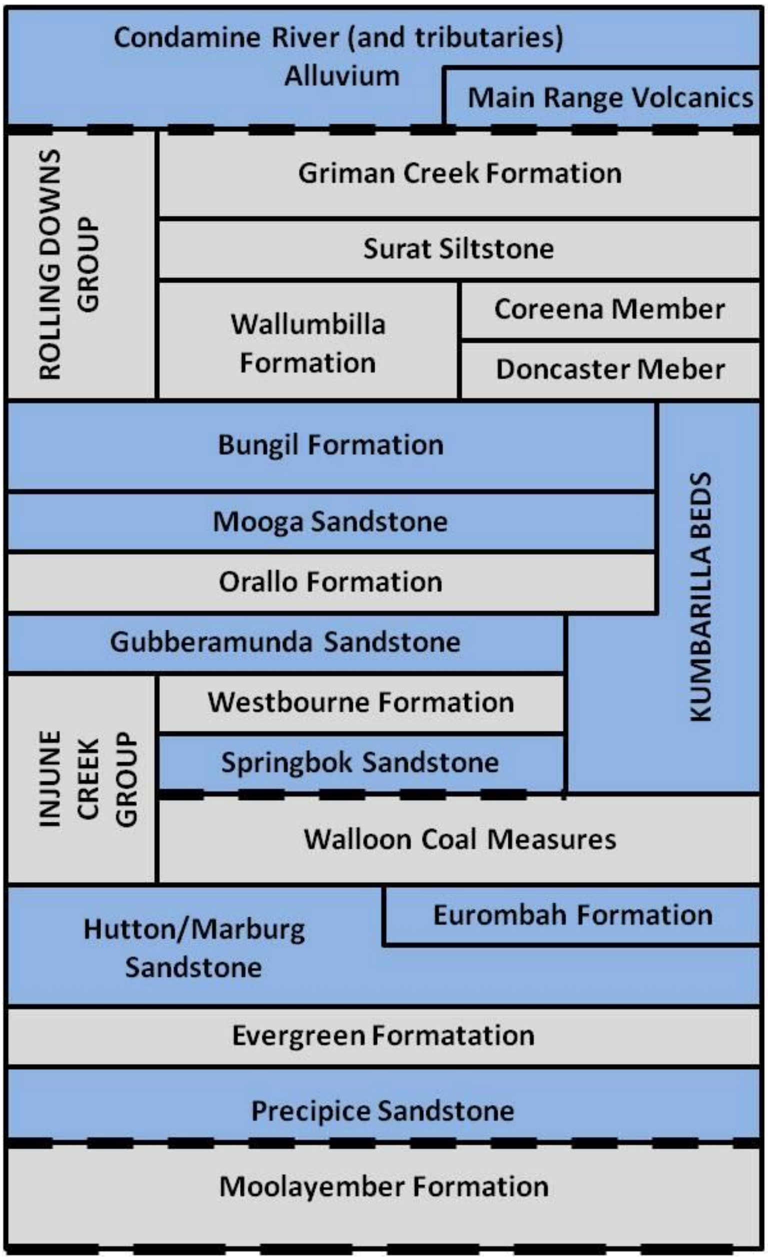

Figure 3. Simplified stratigraphic sequence and corresponding aquifers (blue) and confining units (grey) in the study area (after Radke et al., 2000; Draper and Boreham, 2006).

5 Conceptual model of flows and processes

Figure 4 is a conceptual model of the flows in the system. Exchanges between aquifers and surface waters are presented. At the top of the figure the pre-CSG flows are represented. Below, CSG direct drivers are shown. Water is extracted from the Walloons to reduce pressure to release gas from the coal. The water is drawn to the surface and then may be:

- Discharged to streams after treatment;
- Used in forestry, cropping, municipal and other beneficial purposes (with consequential redistribution of deep drainage and discharge of effluent); and
- Recharged into aquifers via reinjection bores.

Water can move between aquifers when a gradient of total potential (osmotic, pressure and capillary) exists. Pressure gradients exist where connected aquifers have different heads of water. This occurs because the water flows are more-or-less separate with respect to water sources into them. These pressures, and the hydraulic conductivity and juxtaposition of layers determines the actual water flows in space and time between strata. Water flows represented by the arrows may not be the same during dewatering and re-wetting. The term hysteresis[1] is used to describe this. Hysteresis is important in the design and optimisation of the relationship between water extraction and reinjection.

Water extracted outside the area of CSG extraction overlying the alluvium could be introduced to the alluvium by reinjection via bores and by regulated discharge to local waterways.

Figure 4 also indicates that each of the water system components has imports and exports. Exports from the Walloon coal measures resulting in additional beneficial use of water at the surface (with brine management) and potentially abstractions for licensed use are the only import/export fluxes affected by CSG. Table 2 is a tabulation of the conceptual model. Four categories of water movement process are used: Recharge, Discharge, Re-distribution and Other beneficial uses.

[1] Hysteresis is the term used to describe the well known phenomenon that porous materials do not wet and dry in the same way. There is evidence that dewatering can alter the pore structure of aquifers and coal potentially increasing the magnitude of hysteresis. Surface subsidence is one expression of loss of void space in the system.

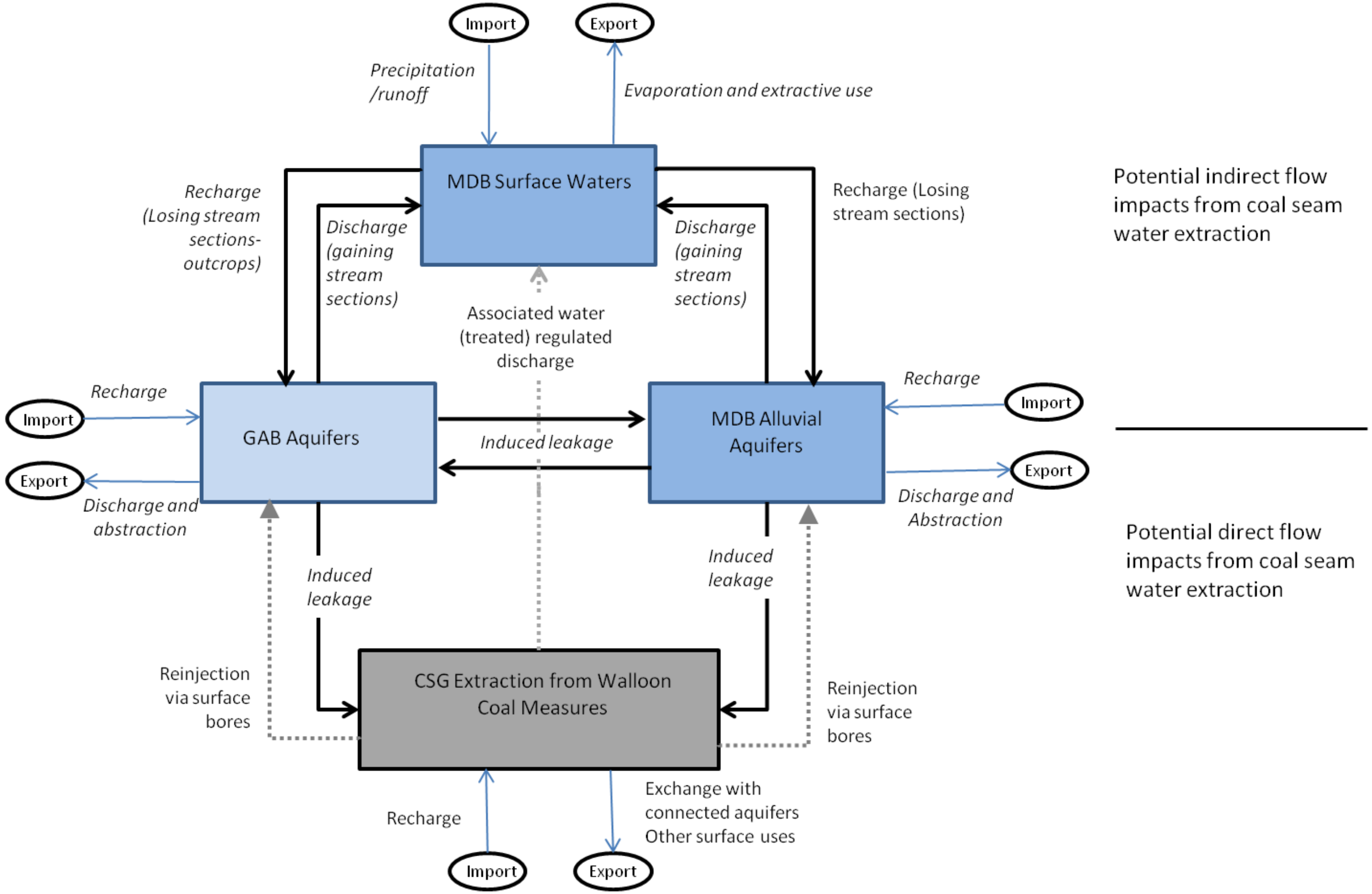

Figure 4. Conceptual diagram of the water balance for surface and groundwaters in the study. Arrows represent water fluxes. Dotted arrows represent input of treated coal seam water discharged to surface waters or re-injected into aquifers.

Table 2. Processes of water recharge, discharge and redistribution under pre- and post-CSG.

		To				
		Surface water	Groundwater			Mixed S/G
		Rivers	MDB Alluvium	WCM	GAB	Other Beneficial Uses
From	Rivers		recharge from losing streams	recharge from losing streams into outcrop intake beds	recharge from losing streams into outcrop intake beds	crops, forestry, municipal
	MDB Alluvium	discharge (gaining streams)	redistribution potentially with water quality change	redistribution potentially with water quality change	redistribution potentially with water quality change	crops, forestry, municipal
	WCM	discharge of associated water (with treatment if required)	reinjection of co-produced water via surface bores redistribution potentially with water quality change	reinjection of co-produced water via surface bores	reinjection of co-produced water via surface bores redistribution potentially with water quality change	crops, forestry, municipal
	GAB	discharge (gaining streams)	redistribution potentially with water quality change	redistribution potentially with water quality change	redistribution potentially with water quality change	crops, forestry, municipal
	Other Beneficial Uses	Discharge (Municipal effluent)	recharge (Drainage below root zone)		recharge (Drainage below root zone)	

5.1 MDB Surface waters

The major surface water systems of the Queensland MDB are the Condamine - Balonne River system and the Border Rivers (Figure 5). As can be seen in Figure 5, development of coal seam gas industry is predominantly occurring in the Condamine-Balonne Catchment with tenements distributed across the catchment. Six tenements intersect the headwaters of streams in the Border Rivers catchment.

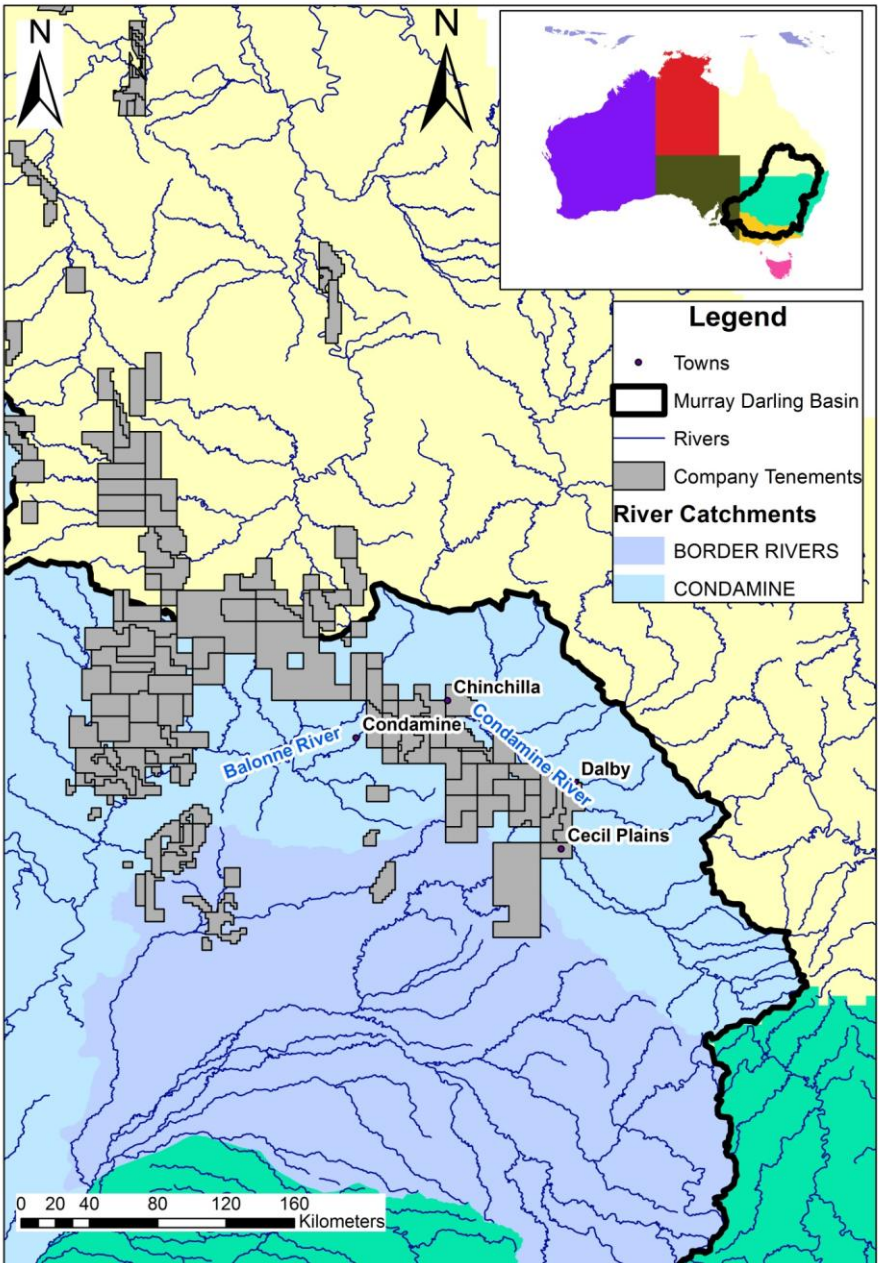

Figure 5. Location of the Murray Darling Basin (inset), major catchments and coal seam gas tenements.

All proponents have rivers or streams flowing through some tenements. APLNG, QGC and Arrow Energy all have tenements that intersect the Condamine River. Bungil Creek, Wallumbilla Creek and Yuleba Creek, within the Condamine-Balonne Catchment, flow across Santos tenements located near Roma.

5.1.1 Imports

Streams in the Condamine -Balonne catchment are ephemeral, with flow generally occurring during summer between December – February. Streamflow is rainfall/runoff dependent. Average annual rainfall is 514 mm (CSIRO, 2008) for the region with average annual rainfall of 635 mm and 634 mm at Miles and Dalby respectively. Annual stream flow is highly variable due to long term variations in rainfall.

5.1.2 Exports

Average annual evaporation is 2.5 - 3 times greater than average rainfall. Average annual evaporation at Miles is 1740 mm and Dalby is 1992 mm.

Total water entitlements for the Condamine – Balonne system is 729,000 ML/y. Water entitlements from the Condamine River, primarily for agriculture, are on the order of 240,000 ML/y or ~ 54% of the pre-development flow measured at the Chinchilla Weir (DERM, pers comm.).

5.1.3 Hydraulic Interactions with Groundwater

Surface water-groundwater interactions are often complex and difficult to quantify, particularly in areas where stream flow is ephemeral or intermittent. Where stream baseflow is derived from groundwater the stream is classified as a gaining stream and conversely where stream flow is lost to the groundwater the stream is classified as a losing stream. Connectivity between streams of the Condamine-Balonne and the alluvial aquifers is spatially and temporally variable.

5.1.3.1 Interactions with Alluvial Aquifer

CSIRO (2008) classified the Condamine River to be a high to medium losing stream upstream of Chinchilla Weir and as low - medium gaining stream downstream of the weir. KCB (draft in review) recently reviewed the conceptualisation of the Central Condamine Alluvium and also concluded that the Condamine River upstream of the Chinchilla Weir was a losing stream. These authors suggested that "the zone of hydraulic disconnection between surface water and groundwater (maximum rate of conceptual stream loss) is considered to extend further downstream than indicated by CSIRO (2008), with possible connectivity being apparent only downstream of the Tipton (bore) Line" (KCB, draft in review p 33). The Tipton bore line is in the vicinity of current CSG leases operated by Arrow Energy. In this upstream reach, stream loss during flow periods will be governed by the hydraulic conductivity of the stream bed and unsaturated zone of the aquifer rather than the difference in hydraulic head between the stream and groundwater. However, KCB (draft in review) stress that the mechanisms governing stream loss to the alluvium are complex and at least five processes may be occurring depending on river flow conditions. Preliminary modelling by QGC estimated that at most 17 % of flow in the Condamine River downstream of Dalby may be baseflow contributed by groundwater. This baseflow was only apparent during periods of heavy rainfall (QGC, 2010, Vol. 3 Ch. 10) and may be reflecting short-term storage in stream banks during high flows returning to the river during flow recession (KCB, draft in review).

The Condamine River, immediately downstream of the Chinchilla Weir was classified as a low gaining stream by CSIRO (2008) (Figure 6). Advice from the Queensland Government provided for this report is that there is unlikely to be any measureable baseflow contributed from groundwater in this reach due to the limited extent of the alluvium and evidence from IQQM stream flow modelling.

5.1.3.2 Connectivity to GAB Aquifers

AGE (2005) using depth to water table mapping for GAB aquifers and results from Kellett et al. (2003) determined that some river reaches in the area under CSG development could potentially receive baseflow from GAB aquifers. Of particular interest are reaches of the Condamine River (near Condamine), Dogwood Creek, Wambo Creek, Moonie River which were identified by Kellett et al., (2003) as being fed from the Hooray Sandstone equivalents (Gubberamunda and Mooga sandstone in the Surat Basin). Also, a reach of both the Weir River and Western Creek could be fed from the Kumbarilla Beds (AGE, 2005). No estimates of the baseflow contribution to these streams from GAB aquifers has been made.

Advice from the Queensland Government provided for this study is that there is no evidence of connectivity between surface waters and GAB aquifers in the study area.

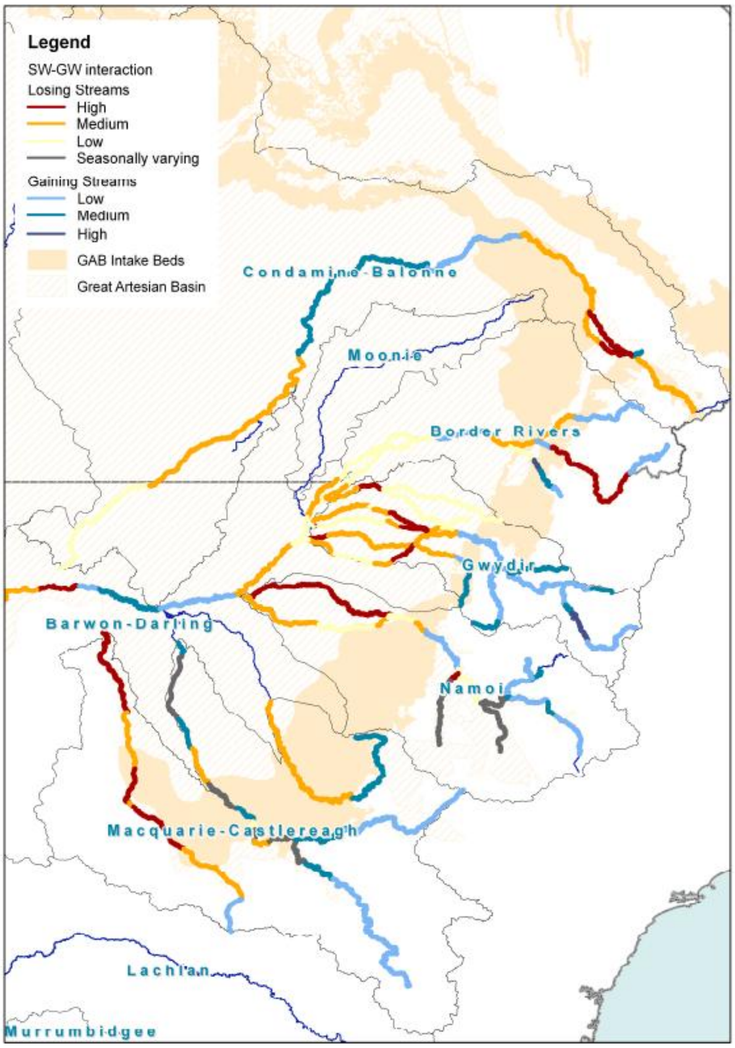

Figure 6. Gaining and losing stream reaches of the MDB. Taken from CSIRO (2008).

5.1.4 Water quality

Surface waters of the Condamine-Balonne system typically have low salinity, slightly alkaline pH and high turbidity. Statistics for stations on the upper Condamine River and four creeks in the Roma area are summarised in Table 3. The two Condamine River stations are located near Cecil Plains (station 422316A) and Dalby (Station 422333A) (ANRA, 2009; Santos, 2010; QGC, 2010; APLNG, 2010). Surface waters of the upper Condamine River have salinity between 200 – 1800 µS /cm. Median salinity is higher at the downstream station. Turbidity is highly variable. Surface waters downstream of Chinchilla are considered to be poor quality with high turbidity.

Water quality of surface water in the creeks near Roma are similarly variable although appear to have lower median salinities. Turbidity is also high and varies with rainfall and stream flow. Turbidity generally increases downstream (QMDC, 2010; Santos, 2010).

Table 3. Summary of water quality parameters for two stations located on the Condamine River and three stations in streams located in the Santos development near Roma (ANRA, 2010; QMDC, 2010; Santos, 2010; APLNG, 2010; QGC, 2010)

			Condamine River		Bungle Creek @Tabers	Yuleba Creek @Forestry	Balonne River@ Surat
			422316A	422333A			
Salinity	(µS/cm)	median	310	586	160	164	95
		min	188	226	66	72	74
		max	654	1350	1890	455	154
pH		median	7.72	7.78	7.5	7.4	6.9
		min	7.1	7.28	6.6	6.6	6.8
		max	8.6	9.2	8.5	7.9	7.2
Turbidity	(mg/L)	median	82.2	133	96.5	107	857
		min	0.9	0.5	5	10	148
		max	898	1390	1500	360	2810

5.2 MDB Alluvial Aquifers

The primary alluvial aquifer in the study area is the Central Condamine Alluvium and alluvium associated with tributaries of the Condamine-Balonne River system. The Central Condamine Alluvium extends across an area between Chinchilla, Dalby and Millmerran and is shown in Figure 1. The alluvium is heavily utilised as a water resource for agriculture and water abstraction has significantly impacted water levels in the alluvium. The conceptualisation and water balance of the Condamine alluvium was recently reviewed by KCB (draft in review). The alluvium is up to 100m thick in the thalweg located slightly to the east of the current river channel (KCB, draft in review). On average the alluvium is 20 - 30 m thick. Thick alluvial sediments are also associated with the Balonne River system. These alluvial sediments are Tertiary age and contain poor quality groundwater except in the area of the Maranoa and Balonne River junction.

The Central Condamine Alluvial basement sequences vary depending on how deeply the river channel eroded into the underlying sequences shown in Figure 3. In some areas the river cut through to the underlying Walloon Coal Measures providing opportunity for direct hydraulic connectivity between these units.

The water balance for the Central Condamine Alluvium presented in KCB (draft in review) is shown in Table 4.

5.2.1 Imports

Recharge of the alluvial aquifer is predominantly through rainfall and stream flow with smaller inflows to the Central Condamine Alluvium from bedrock and tributaries in the east (Table 4).

5.2.2 Exports

The largest outflow from the Alluvium is via groundwater abstraction. The current water deficit in the alluvium is estimated to be between 30,351 – 41,954 ML/y (KCB, draft in review). Groundwater flow in the alluvium is generally in the downstream direction (i.e. North-Westward). There has been significant drawdown of the watertable for agriculture in some areas (KCB draft in review). The area most affected by agricultural groundwater extraction is the area between Dalby and Macalister and to the east of Cecil Plains. Local internal groundwater flow developed in this area between 1990 – 2000 in response to groundwater abstraction resulting in drawdown of the aquifer water level by around 5-30 m (KCB, draft in review, p 40). This area lies adjacent to the current extent of CSG tenements located on the Western margin of the Central Condamine Alluvium.

5.2.3 Hydraulic interactions

5.2.3.1 Surface waters

Connectivity with surface waters was discussed above in Section 5.1.3.1. The alluvium is generally hydraulically disconnected from surface waters upstream of the Chinchilla Weir. Downstream of the weir there is not likely to be a measurable contribution of groundwater to Condamine River baseflow.

Table 4. Water balance for the Central Condamine Alluvium (from KCB, draft in review).

	Lane (1979)	Huxley (1982)	SKM (2002)	SKM (2008)	KCB (draft in review)
Area (km²):	4910	7700	3953	3953	4463
	ML/annum				
Imports:					
Streambed Recharge	12170 - 20810	19085-32634	15500 - 20239	11539	11158 - 22761
Bedrock contributions from the East	3610 - 3760	1130	1140	1604	1500
Bedrock contributions from the West		520	267	249	500
Tributary Alluvium Contributions from the East	280 - 410	1470	250	250	705
Flux into Alluvium from Upstream	760	-			316
Rainfall Recharge	-	-	1%[1]	0.10%[1]	10265
Irrigation Deep Drainage	-	-	-	-	446.3
Flood Recharge	-	-	-	-	-
Meander Channels Seepage	-	2000	2100	-	-
Exports:					
Groundwater abstraction (unmetered)	-	-	-	-	20200
Groundwater Abstraction	58903	61403	50000	50000	46400
Basement (bedrock) Leakage	8050	-	1649	0	0
Flux Out of Alluvium at Downstream	645	-	16467	12568	244.5
Evapo-transpiration	-	-	-	-	-

[1] presented as % rainfall.

5.2.3.2 Walloon Coal Measures and GAB Aquifers

The basement of the alluvium includes Marburg (Hutton) Sandstone, Walloon Coal Measures and the Springbok Sandstone. Historically, the Condamine River has incised valleys into the Springbok Sandstone (Kumbarilla Beds) and the Walloon Coal Measures (Hillier, 2010; KCB, draft in review). These valleys have subsequently been in-filled with what is today termed the Condamine Alluvium. Therefore water can move into and out of the alluvium depending on the hydraulic gradient. The details of the hydraulic conductivity and bedding of the alluvium also determines the rates and quantities of water movement. Given that these historical processes are highly spatially variable and the beds being incised were not homogeneous a great deal of local variation exists in both the connectivity and the potential for water exchange between strata across the alluvium. This explains why different studies in different parts of the Central Condamine Alluvium have reached what appear to be conflicting conclusions regarding water exchange. A brief summary follows.

Generally, water levels in the alluvium reflect basement topography. Discrete areas of basement highs have been mapped by KCB (draft in review) and were also noted by Huxley (1982) (Figure 7). Huxley (1982) interpreted the areas of basement highs to be intersection with the Walloon Coal Measures.

Hydraulic connection of the alluvium with the Walloon Coal Measures and other aquifers has been inferred from analysis of groundwater level records by Hillier (2010) and more recently by KCB (draft in review). KCB (draft in review) concluded that there was a general slight gradient driving water from the alluvium to Walloon Coal Measures. The strength of the gradient was variable, in the upstream section of the alluvium (the Southern area) there is a negligible or only slightly pressure gradient driving water from the alluvium in to the Walloons. Further north, around Dalby, water levels in the Walloon Coal Measures were similar to water levels in the alluvium implying little net water movement. There is evidence of variation around this general picture. KCB (draft in review) provided an example where water levels in the Walloon Coal Measures were up to 25 m lower than the alluvium. CSG dewatering of the Walloon Coal Measures will increase this gradient. Implications for water movement will depend on the hydraulic properties at the interface between the alluvium and Walloon Coal Measures. On the other hand, Hillier (2010) found alluvium water levels to be on the order of 10-15 m below the water level of bores in the Walloon Coal Measures in the area just south of Dalby and east to Oakey. Dewatering of the Walloon Coal Measures may neutralise or reverse this gradient. This is a possible driver for local re-distribution of water within the alluvium. For example water quality may be observed to change in bores from local re-distribution within the alluvium (see section 6.2.2).

Connectivity of the Condamine Alluvium with the Marburg sequence is similarly variable but generally there appears to be neutral to moderately upward hydraulic gradient (KCB, draft in review).

A detailed assessment of the sequences underlying the alluvium is currently being undertaken for DERM (Healthy Headwaters Program), results were not available for this report. Adaptive management will require this information to respond to local effects. For example, with this information it will be easier to target priority areas for reinjection into the Walloon Coal Measures to minimise the impact of dewatering on flows from the alluvium. This may be particularly important if action is taken to reduce abstraction to restore water levels in the alluvium.

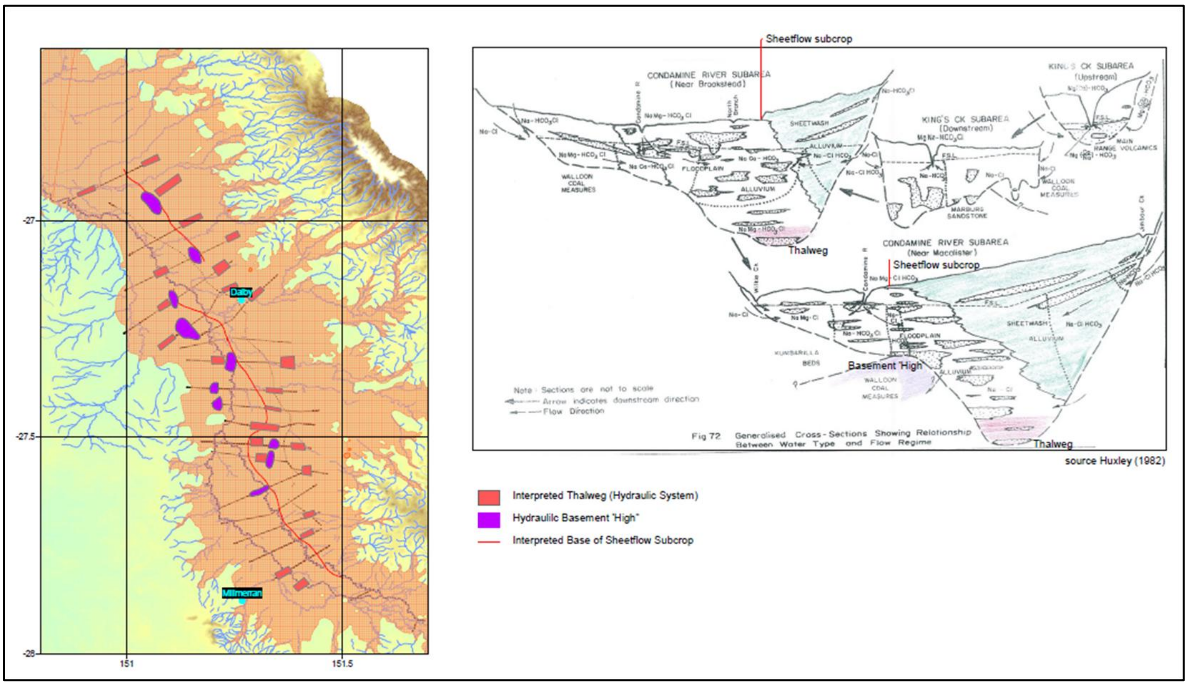

Figure 7. Location of thalweg and hydraulic basement highs in the Condamine Alluvium (from KCB, draft in review).

5.2.4 Water Quality

Water quality of the Condamine alluvium is spatially variable reflecting proximity to basin margins, tributary inflows and the Condamine River as well as variations in basement geology/water chemistry. Time-series of individual bore water quality data were not available for this report, consequently temporal changes in water type or water quality could not be determined. KCB (draft in review) reviewed groundwater chemistry and presented spatially contoured salinity maps. Their analysis suggested "that the spatial salinity distribution shows only minor variations over time, with changes in the continuity of individual sampling influencing these patterns. While minor changes occur, the overall trends in the dataset remain relatively constant" (KCB, draft in review, p 61). A summary of the findings of KCB (draft in review) water quality analysis is given below. It should be noted that the trends observed by KCB represent modal (most commonly occurring) or average changes in water chemistry throughout the alluvium. KCB (draft in review, p 64) note that for bores in proximity of Tipton, Westend, Oakey, Dalby, Yarrala and Pirrinuan "While broad trends associated with water chemistry and geology are inferred, the trend is not obvious, with different hydrochemical values often observed to occur in adjacent boreholes".

Salinity (as total dissolved solids) ranges between 103 – 24,473 mg/L. In general, salinity increases northward (i.e. downstream). Lower salinities are typically observed in the alluvium where bores are located close to the Condamine River and tributary inflows. Higher salinities are found in the northern area of the alluvium. Bores in this area tend to be drawing from deeper in the alluvium close to the basement contact. It is not clear whether these higher salinities are due to longer residence time (due to lower transmissivity), inflow from basement rocks or interaction with different parent material (KCB, draft in review). It is likely that all three processes may be influencing water quality.

Water type generally changes down the inferred groundwater gradient. The upper alluvial area waters are dominated by Na-Cl-HCO_3 as are waters from bores located close to the Condamine River. Deeper bores located in the upper Condamine located east of the river are Na-Mg-Ca-HCO_3. Margins of the alluvium are Na-Mg-Cl dominated which is thought to reflect the influence of Walloon Coal Measures and Main Range Volcanics, although there may also be some influence of lower recharge (KCB, draft in review). Downstream of Oakey

Creek alluvium water chemistry is Na-Cl-HCO_3 and Na-Cl. This change was consistent with change in water type of the underlying strata.

Table 5. Comparison of water quality of Central Condamine Alluvium, Walloon Coal Measures and Marburg Sandstone

		Central Condamine Alluvium	Walloon Coal Measures	Marburg Aquifer
Conductivity	average	2385	4305	1319
(µS/cm)	minimum	187	50	20
	maximum	30000	31000	39000
TDS	average	1437	2667	763
(mg/L)	minimum	103	30	12
	maximum	24473	21794	39819
pH	average	3.6	7.8	7.9
	minimum	7.9	3.8	2.3
	maximum	11	11.6	11

6 Assessment of Impacts on Surface and Groundwater in the MDB

Review of the fluxes presented in Figure 4 and Table 2 shows that CSG operations are not likely to affect a number of the fluxes. These fluxes are summarised in Table 7.

6.1 System Interactions: processes and significance

The water fluxes in the conceptual model (Section 5) will be influenced by CSG development to varying degrees. In this section, the flows between system components and the processes via which they occur are categorised in terms of significance. The category of main interest is where significant changes in flows are created by the introduction of CSG extraction. These changes include consideration of the management and technical challenges not just the magnitude of the changes to flows. For example, reinjection of water has significant engineering and sequencing challenges as well as difficult water quality issues including changes in mineral saturation status.

Flows were separately categorised into significant, intermediate and minor changes. Also, flows where no changes are expected are identified. Minor or no changes could be because of limited footprint of development and/or being dependent on factors not affected by CSG development (e.g. diffuse recharge dependent on flood frequency and hydraulic conductivity of alluvium).

Finally, flows that are part of realisation of other beneficial uses that may be enabled by the availability of associated water are identified. For example, water availability for agriculture and town supplies as well as surface water flows may be increased by availability of associated water.

The processes, interactions and their relative significance are summarised in Table 6. Four interactions are identified as creating significant changes and/or local impacts. Three interactions are categorised as intermediate, six as minor and nine with no changes.

Table 6. Processes of water recharge, discharge and redistribution post-CSG. White = no significant changes; yellow = minor changes ; green = intermediate changes; blue= significant changes and/or local risk

		To				
		Surface water	Groundwater			Mixed S/G
		Rivers	Alluvium	WCM	GAB	Other uses
From	Rivers		14. recharge from losing streams	15. recharge from losing streams into outcrop intake beds	16. recharge from losing streams into outcrop intake bed	12. crops, forestry, municipal
	Alluvium	17. discharge (gaining streams)	3. redistribution potentially with water quality change	7. redistribution potentially with water quality change	10. redistribution potentially with water quality change	12. crops, forestry, municipal
	WCM	1. discharge of associated water (with treatment if required)	2. reinjection of co-produced water via surface bores 5. redistribution potentially with water quality change	8. reinjection of co-produced water via surface bores	6. reinjection of co-produced water via surface bores	13. crops, forestry, municipal
	GAB	11. discharge (gaining streams)	9. redistribution potentially with water quality change	4. redistribution potentially with water quality change	redistribution potentially with water quality change	12. crops, forestry, municipal
	Other Uses	Discharge (Municipal effluent)	recharge (Drainage below root zone)		recharge (Drainage below root zone)	

6.1.1 Significant Changes and/or local impact

1. *Discharge of associated water from Walloon Coal Measures to Rivers*
    - Proponents have identified discharge of treated associated water to MDB streams as a water management option. Discharge of treated associated water could supplement streamflow.
    - APLNG have modelled potential permeate discharge between 20 - 100 ML/d (APLNG, 2010 Vol 5 att 23). This discharge volume represents 3 - 15 % of the volume currently being extracted from the Condamine River, upstream of Chinchilla Weir, under water entitlements (240, 000 ML/y, DERM).
    - QGC estimate total peak water production to be 190 ML/d and average production to be ~165 ML/d between 2015 – 2025 (QGC Vol 3, Chapt 11). If all associated water was treated and discharged this would represent ~25 % of the volume currently being extracted from the Condamine River, upstream of Chinchilla Weir, under water entitlements.
    - Santos stated that stream discharge is not a preferred option for the Roma development (Santos, 2010; Appendix Q).
    - Timing of discharge will be critical to ensure natural flow regimes are maintained and environmental flow objectives are met.
    - Where more than one operator is discharging associated water to streams, stream flow modelling will need to be conducted to determine the cumulative impact of multiple discharges.
    - Brine management will need to be carefully considered where associated water is treated.
2. *Reinjection (of associated water via surface bores) from Walloon Coal Measures to Alluvium*
    - Options for direct re-injection of associated water to the Central Condamine Alluvium is currently being investigated in Healthy Headwaters Program.
3. *Redistribution (potentially with water quality change) within the Alluvium*
    - Local redistribution of water in the alluvium in response to water table drawdown may result in water quality compromise of some water bores (Section 6.2.1,

6.2.2). Significant differences in bore water chemistry have been noted in some areas of the Central Condamine Alluvium (Section 5.2.4).

- During water table drawdown, water in the alluvium may be redistributed so that in some cases low quality water may flow to areas where water quality was previously high. This local (individual water bores) change to water quality may be significant, but the number of bores likely to be affected and the locations cannot currently be predicted or the magnitude of change estimated.

4. *Redistribution (potentially with water quality change) from GAB to Walloon Coal Measures*
   - Even though this process is from one non-MDB water component to another, it represents a change to system flows.
   - It is possible that water that has redistributed from other aquifers to the Walloon Coal Measures is subsequently extracted as associated water. Therefore, if this is licensed for other beneficial uses, it may actually be a re-allocation of entitlement from the source aquifer. Therefore, overall, entitlements may be increased if this is not monitored and appropriate corrections made. It is likely that this water will have been the subject of make good provisions if it was previously allocated to an entitlement holder.
   - GA and Habermehl (2010) presented an order of magnitude comparison between estimated aquifer recharge and estimated leakage from various GAB aquifers induced by dewatering of the Walloon Coal Measures. This analysis was only possible for QGC and Santos development areas. Depending on associated water production scenarios, development area and affected aquifer, these induced leakage was estimated to range between 0.07 – 111 % of recharge.
   - Reinjection of associated water to GAB aquifers may mitigate the induced leakage from GAB.

6.1.2 Intermediate Changes

5. *Redistribution (potentially with water quality change) from Walloon Coal Measures to Alluvium*

- For areas where Walloon Coal Measures is currently hydraulically connected to the alluvium and flow is from Walloons to the Alluvium (Section 5.2.3.2) this exchange may decrease as the Walloon Coal Measures are dewatered. The magnitude of this exchange is currently not quantified.

6. *Reinjection (of associated water following treatment via surface bores) from Walloon Coal Measures to GAB aquifers*
   - Even though this process is from one non-MDB water component to another, it is a driver of potential changes to MDB water flows and has management and/or technical challenges. All proponents are investigating re-injection (APLNG, 2010, Vol. 5, Ch. 24; Santos, 2010, Appendix Q). QGC suggesting reinjection to GAB aquifers only. 2 - 4ML/well/d expect to need 70 wells targeting Hutton/Precipice Sandstone (QGC 2010, Vol. 3, Ch. 11).
7. *Redistribution (potentially with water quality change) from Alluvium to Walloon Coal Measures*
   - It is possible that water that has redistributed from other aquifers to the Walloon Coal Measures is subsequently extracted as associated water. Therefore, if this is licensed for other beneficial uses, it may actually be a re-allocation of entitlement from the source aquifer. Therefore, overall, entitlements may be increased if this is not monitored and appropriate corrections made. It is likely that this water will have been the subject of make good provisions if it was previously allocated to an entitlement holder.
   - The only proponent to predict water table drawdown (APLNG, 2010, Vol 5 att 21) has not estimated leakage rate from the alluvium to underlying strata. The predicted drawdown was on average 2 m and was not predicted to extend beyond the current boundaries of CSG tenements. Thus drawdown of the alluvium water table may be restricted to a small area of the Central Condamine Alluvium.
   - A conceptualisation of the basement of the Central Condamine Alluvium is currently being undertaken in the Healthy Headwaters Program. Water level analysis and bore water chemistry suggest that direct connectivity between the alluvium and Walloon Coal Measures may exist, although mostly outside of the

CSG development area (Sections 5.2.3.1, 5.2.3.2). Exchange between these units has not been quantified and will be dependent on the hydraulic conductivity.

6.1.3 Minor Changes

8. *Reinjection (of associated water via surface bores) from Walloon Coal Measures to Walloon Coal Measures*
    - Even though this process is from one non-MDB water component to another, it is a driver of potential significant changes to MDB water flows and has significant management and/or technical challenges. All proponents are investigating re-injection. However, reinjecting water back into the Walloon Coal Measures is not likely to be feasible during CSG operations without storing water for significant periods of time.
    - Reinjection into other aquifers affected by dewatering of the Walloon Coal Measures is the preferred option of the Queensland Government (see point 6 above).

9. *Redistribution (potentially with water quality change) from GAB aquifers to Alluvium*
    - GAB aquifers underlie the Condamine Alluvium in some areas. Water levels in the Marburg aquifer are typically higher than in the alluvium (Section 5.2.3.2) and water quality data suggest there may be some exchange from the Marburg aquifer to the alluvium. This exchange has not been quantified. It should also be noted that the area of the alluvium where water level analysis has suggested that Marburg aquifer waters may exchange with the alluvium is not located within the area of CSG development or the area of predicted drawdown of this aquifer. Hydraulic relationship between the Springbok or Gubberamunda aquifer and the Condamine Alluvium has not been quantified.

10. *Redistribution (potentially with water quality change) from Alluvium to GAB aquifers*
    - Water level analysis suggests that Marburg aquifer water levels are neutral or higher than water levels in the Alluvium (Section 5.2.3.2). Drawdown of the Marburg aquifer could reverse the gradient. The area where this water level

analysis has been conducted is outside of the area where drawdown of the Hutton/Marburg aquifer is predicted.

11. *Discharge (gaining stream reaches) from GAB aquifers to Rivers*
    - Only a limited number of river reaches possibly receive baseflow from GAB aquifers, this baseflow contribution is likely to occur only sporadically (Section 5.1.3.2). Regional impact on flow in MDB streams is likely to be minimal. Local effect is also likely to be limited.
12. *Licensing of associated water (potentially following treatment) extracted from any system component other than the Walloon Coal Measures to other beneficial uses*
    - It is possible that water that has redistributed from other aquifers to the Walloon Coal Measures is subsequently extracted as associated water. Therefore, if this is licensed for other beneficial uses, it may actually be a re-allocation of entitlement from the source aquifer. Therefore, overall, entitlements may be increased if this is not monitored and appropriate corrections made. It is likely that this water will have been the subject of make good provisions if it was previously allocated to an entitlement holder.
13. *Licensing of associated water (potentially following treatment) extracted directly from the Walloon Coal Measures to other beneficial uses*
    - It is possible that water that has redistributed from other aquifers to the Walloon Coal Measures is subsequently extracted as associated water. Therefore, if this is licensed for other beneficial uses, it may actually be a re-allocation of entitlement from the source aquifer. Therefore, overall, entitlements may be increased if this is not monitored and appropriate corrections made. It is likely that this water will have been the subject of make good provisions if it was previously allocated to an entitlement holder.
    - Use of treated associated water to supplement town water supply, crops and forestry plantations has been proposed.

6.1.4 No changes

14. *Recharge (from losing stream reaches) from Rivers to Alluvium*

- This "no change" categorisation assumes that cumulative water entry under conditions including associated water regulated discharge is the same as under current conditions because historical water extraction has disconnected the alluvial aquifer from the streams.
- Alluvium water table drawdown for streams not at maximum losing capacity may reduce stream flow for short periods of time (Section 5.1.3.1).

15. Recharge from losing streams into intake beds (Walloon Coal Measures)

- Recharge mechanisms of Walloon Coal Measures have not been quantified. However, dewatering is unlikely to affect recharge because it will be dependent on rainfall and stream input in exposed outcrops. The recharge rate will be dependent on the hydraulic conductivity of intake beds.

16. Recharge from losing streams into intake beds (GAB aquifers)

- It is expected that recharge of GAB aquifers via intake beds will not be affected by CSG activities and therefore will not impact streamflow.

17. Discharge (gaining stream reaches) from Alluvium to Rivers

- Central Condamine alluvial aquifer may be connected to Condamine River for only brief periods (days) after large rainfall events (Section 5.1.3.1). Contribution of alluvial aquifer to stream flow is negligible (Table 4).
- Balonne River alluvium water levels are not likely to be impacted by CSG activities.

6.2 Groundwater Impacts

Based on the analysis presented above CSG development is likely to principally impact the alluvial aquifer in the following ways:

1. Alluvial aquifer water availability due to:
    a. drawdown of the water table by induced leakage into the Walloon Coal Measures.
    b. drawdown of the water table by induced leakage into GAB aquifers. This is a secondary effect of induced leakage of GAB aquifers created by dewatering of the Walloon Coal Measures.
2. Alluvial aquifer bore water quality may be affected by local re-distribution of water responding to drawdown.

6.2.1 Groundwater Quantity

From the information available in the EIS documents it is not possible to separately assess drawdown of the alluvium water table resulting from direct connectivity with the Walloon Coal Measures and drawdown as a result of connectivity of the alluvial aquifer with other aquifers, in particular GAB aquifers.

Drawdown of aquifers predicted by all proponents is summarised in Table 7. It can be clearly seen that the predicted drawdown varies considerably between aquifers and between proponent estimates. Interestingly, although QGC state that the conservative assumptions in their model would provide estimates of drawdown that are likely to represent maximum values, APLNG estimates for drawdown in the Springbok aquifer (for example) in a similar area are on the order of 3 times greater. Possible explanation of the differences between proponent estimates include:

- Differences in sophistication of models: number of layers and size of spatial elements.
- Values used for hydraulic properties.
- Assumptions used as boundary conditions- QGC assumed constant head conditions beyond the model boundary
- Reported drawdown on different spatial basis. For example, QGC estimated drawdown is for a point 1.8 km from the edge of the depressurised zone. Neither the extent of the depressurisation zone or maximum drawdown was specified.

In general the largest predicted drawdown occurs in areas where the coals are located at deeper depths and the confining units are thin.

The predicted drawdown by APLNG for the cumulative case (i.e. considering all proponents) was "essentially the same as predicted for their project case, with an extension in the predicted area of drawdown" (APLNG, 2010, Vol 5 att 21). No figures or data were available to assess the increased extent. Higher than average drawdown might be expected to occur in tenements of each of the proponents with a higher concentration of producing wells (Figure 2).

APLNG was the only proponent to estimate drawdown of the water table (APLNG, 2010, Vol 5 att 21). Numerical groundwater modelling showed that for the APLNG tenement area only, maximum average drawdown occurred in 2049 with average watertable drawdown estimated to be less than 2 m with localised areas of higher drawdown (APLNG, 2010, Vol 5 att 21). Drawdown between 5 – 7 m was predicted to occur in two small areas. These areas are located immediately downstream of the Chinchilla Weir and in an area on the margin of the alluvium just south of Miles (Figure 8). Higher drawdown was coincident with the area of greater predicted drawdown of the underlying Gubberamunda and Springbok aquifers (Figure 9, Figure 10) and where the confining layer was thin or absent (APLNG, 2010, Vol 5 att 21). APLNG (2010) suggest that operation of the weir may compensate for the expected decrease in baseflow in the Condamine River due to drawdown of the water table in the area downstream of the Chinchilla Weir. It should be noted that groundwater use downstream of the Chinchilla Weir is low.

APLNG modelling results for all proponents (cumulative case) suggested that on average drawdown was < 2 m, although again with localised higher drawdown predicted in the same areas as above and also to the north and northwest of their Gilbert Gully development area. Although the area of increased drawdown for this southern area was not shown in the APLNG EIS the location is likely to correspond to the southern extent of Arrow and QGC development areas (APLNG, 2010, Vol 5 att 21).

The timing of maximum drawdown for the cumulative case was not specified in the APLNG EIS (APLNG, 2010, Vol 5 att 21).During CSG production the areal extent of watertable drawdown was projected to be close to the tenement boundaries and projected to increase during the recovery phase. No maximum areal extent was given in the APLNG EIS (APLNG, 2010, Vol 5 att 21).

Water level drawdown in some areas of the Condamine Alluvium due to groundwater abstraction has been on the order of 5 – 30m (Macalister – Dalby – Cecil Plains) in the decade between 1990 -2000. By comparison the projected drawdown of the alluvial water table predicted by APLNG, on average 2 m by 2049, is comparatively small. Even the greater drawdown predicted in localised areas of 5 - 7m is comparatively small. Thus on average, CSG activities are not likely to dramatically impact water availability in the Condamine Alluvium. However, local impacts may be more significant. Data and model outputs were not available for this report to determine the likely local drawdown. APLNG and other proponents used average hydraulic properties in the models. Hydraulic connectivity between the alluvium and underlying sequences, including the Walloon Coal Measures, has been indicated by both water level analysis and water quality data (Hillier, 2010; KCB draft in review). Currently there are no estimates of the magnitude of this exchange. This connectivity is likely to be heterogeneous and will therefore result in drawdown that deviates from the average in some areas.

It should be noted that only one water bore was identified in the area where drawdown of the water table was predicted to be greater than 5 m by APLNG (2010). However, a significantly greater number of bores are located along the western margin of the Condamine Alluvium (the Eastern extent of CSG development, Figure 1). Further work is required to predict magnitude and spatial and temporal extent of drawdown along the western margin of the Central Condamine Alluvium.

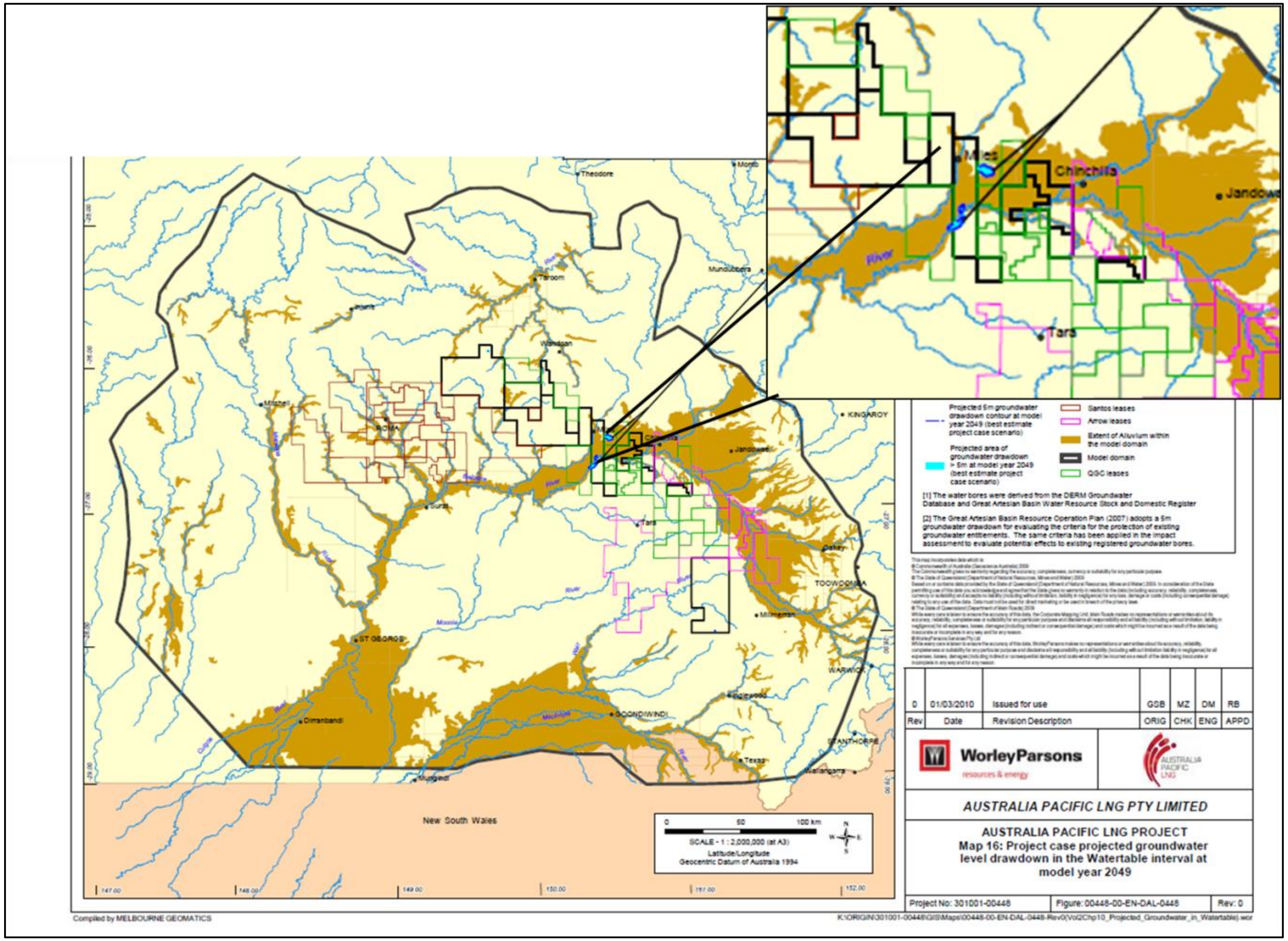

Figure 8. Area of > 5m drawdown of the water table predicted by APLNG (APLNG, 2010, Vol 5 att 21).

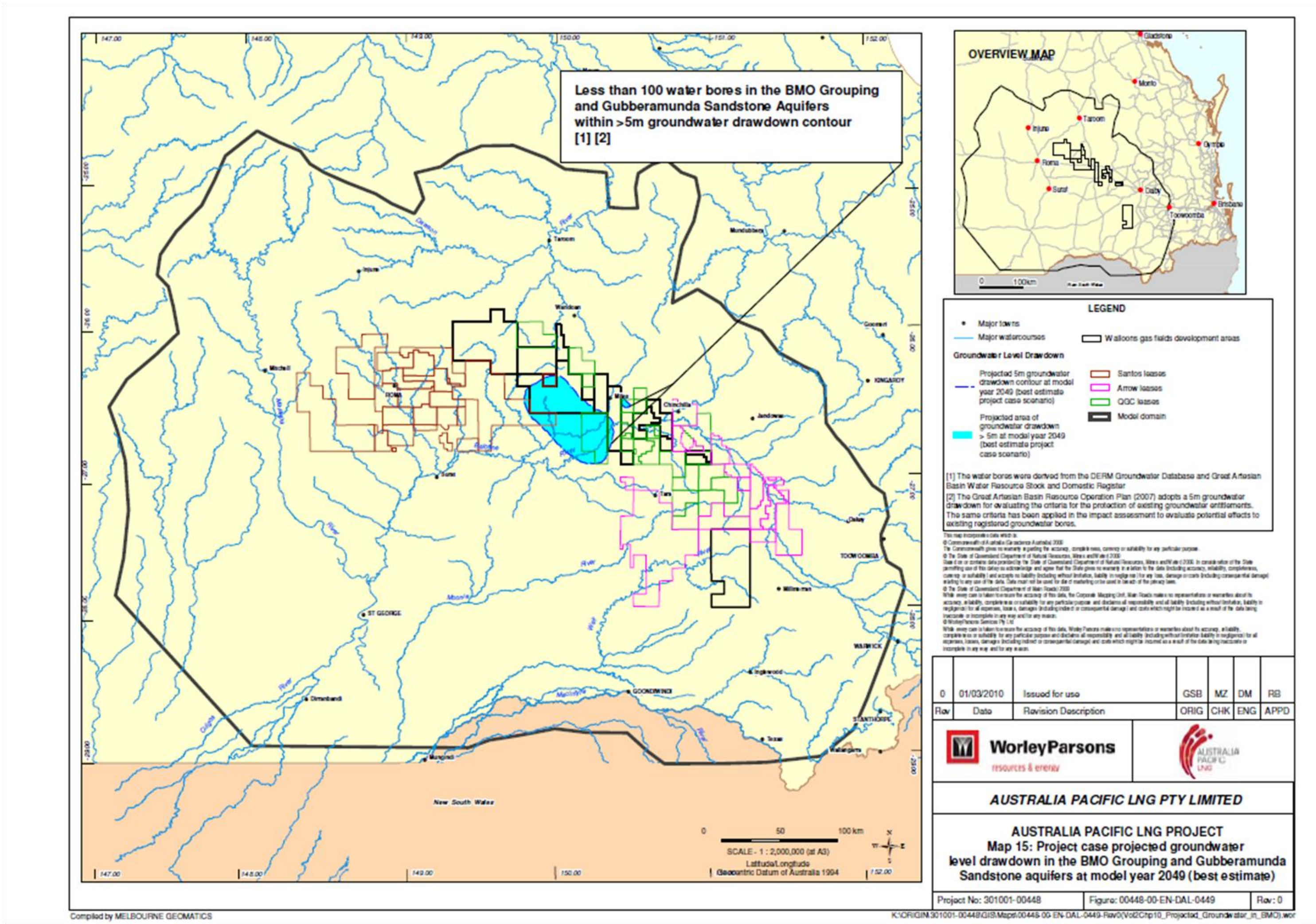

Figure 9. Predicted drawdown area of > 5m in the Gubberamunda Aquifer for APLNG project (APLNG, 2010, Vol 5 att 21).

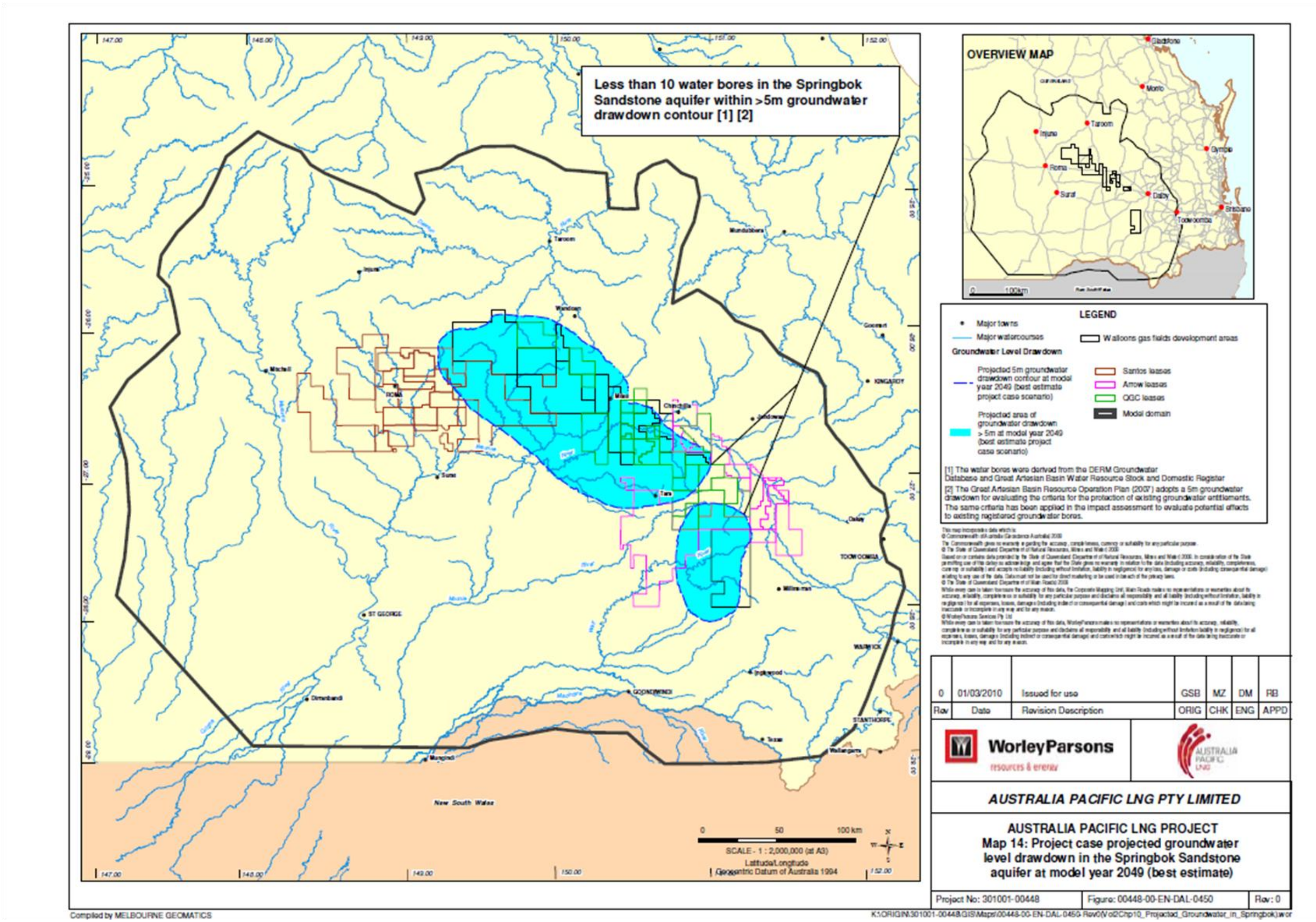

Figure 10. Predicted drawdown area of > 5 m in the Springbok Sandstone for APLNG Project (APLNG, 2010, Vol 5 att 21).

Table 7. Summary of predicted drawdown for aquifers potentially affected by CSG activities (from APLNG 2010; QGC 2010; Santos2010).

Aquifer		APLNG - Project	QGC	Santos (Roma field)	APLNG- Cumulative
Water Table	average (m)	2			2
	max (m)	5-7			
	Area of maximum drawdown	East of Condabri Central and South			East of Condabri Central and South; north and Northwest of Gilbert Gully
BMO and Gilbert	average (m)	3			
	max (m)	8			
	Area of maximum drawdown	Carinya			
Gubberamunda	average (m)		minimal		3
	max (m)	10			10
	Time	2029 - 2199			
	Area of maximum drawdown	Southwest Miles			100km SW Pine Hills
Springbok	average (m)	15			15
	max (m)	300	85		
	Range (m)		10 - 85		
	Time	2019-2039			
	Area of maximum drawdown	South Miles	CDA		
Hutton	average (m)	2			10
	max (m)	10	8	3.2	
	Range (m)		0 - 8		
	Time	2029 - 2149		20y	
	Area of maximum drawdown	West Miles	SEDA	Tenement boundary	
Precipice	average (m)	0			
	max (m)	0	6		
	Range (m)		0 - 6		
	Time				
	Area of maximum drawdown		SEDA		

6.2.2 Groundwater water quality

Determining the impact of CSG activities on water quality in the alluvial aquifer, and more specifically the impact on individual bore water quality is difficult to quantify with the data that is currently available.

Given the wide range of salinity and water types determined in the alluvial aquifer, CSG activities are perhaps not likely to significantly impact general water quality in the aquifer. Dewatering of the Walloon Coal Measures in areas where the alluvium is hydraulically connected will likely alter the hydraulic gradient between the two units so that water will tend to flow from the alluvium to the coal measures. On average, therefore, water with lower salinity would be expected to move from the alluvium to the Walloon Coal Measures. Similarly, where GAB aquifers are hydraulically connected to the alluvium, drawdown of the GAB aquifers will tend to weaken or reverse the hydraulic gradient between the alluvium and GAB aquifers. However, given the heterogeneity of water quality in the alluvium and particularly the variation in hydrochemistry between boreholes in some areas (Section 5.2.4), local redistribution of groundwater within the alluvium in response to the changes in hydraulic gradient may result in movement of poorer quality water to areas where water quality was previously good. This local redistribution may therefore compromise water quality of individual bores.

Changes to alluvium water quality during re-pressurisation of the Walloon Coal Measures and GAB after CSG extraction has ceased cannot currently be predicted.

In addition, alluvial aquifer water quality may changed in cases where CSG wells are compromised, e.g. due to lack of maintenance, faults or accidents.

6.3 Surface water changes

6.3.1 Surface water quantity

All proponents have identified discharge of treated associated water (permeate) to rivers as an management option. Santos have indicated that it is not their preferred option for the Roma development. All proponents have conducted modelling to estimate the impact of associated water discharge on stream flow.

APLNG have proposed to discharge permeate into the Condamine River downstream of the Chinchilla Weir at Talinga and Condabri. APLNG (2010) undertook IQQM modelling to establish the expected changes to flow regime in the Condamine River under a range of release scenarios. This modelling showed that while continuous discharge would significantly alter low/no flow periods, releases could be managed to conform to the Environmental Flow Objectives in the Water Resource (Condamine and Balonne) Plan (2004). Permeate discharge by APLNG only was estimated to be in the range of 20-100 ML/d (APLNG, 2010, Vol. 5 Att. 23) would represent 3 - 17 % of the volumes currently being extracted upstream of the Chinchilla Weir in the Condamine River.

The modelling conducted by APLNG (2010) showed that the timing and volume of permeate discharge to the Condamine River could be managed so that the flow regime was not significantly altered.

If either of the other proponents discharge associated water to the Condamine River in addition to APLNG, an assessment will required to determine the cumulative impact of discharges from multiple proponents. Timing and volumes of discharge from different proponents will most likely need to be managed in a coordinated fashion in order to avoid significant changes to river flow regimes.

6.3.2 Surface water quality

The Queensland regulatory framework under the Environmental Protection Act (EP ACT) requires that any CSG water discharged to surface water needs to be of an appropriate quality to ensure the receiving waters environmental values are protected. Discharges will be conditioned through an environmental authority issued under the EP Act. In addition, town water quality requirements to protect public health are addressed under the proposed amendment to the Water Supply Act currently under consideration by the Queensland Parliament.

Some proponents have identified some dissolved constituents in permeate may be present in concentrations that exceed ANZECC/ARMCANZ (2000) water quality guidelines. The constituents of primary concern are Boron and Fluoride (APLNG, 2010, Vol. 5 Att. 22; Santos, 2010, Section 6.5). Conversely, permeate discharge may reduce the concentration of key constituents such as calcium. These impacts can be managed through setting appropriate discharge criteria for aquatic ecosystem protection and in some cases selected ion addition prior to discharge.

Increased erosion and delivery of sediment the streams could result from three activities. These are construction activities, including road construction; changes to stream hydraulics during permeate discharge; and, changes to overland flow paths as a result of subsidence.

All proponents identified increased erosion during construction activities as a risk to stream water quality. Activities include road construction and in some areas waterway crossings. The mitigation activities such as undertaking activities during the dry season and containment of runoff in sedimentation dams should minimise the water quality risk to streams.

Each of the proponents conducted hydraulic modelling to determine possible changes to stream hydraulics during permeate discharge that may result in increased erosion of stream banks or stream meander migration. Mitigation activities including managing discharge volume and conditions at the point of discharge (e.g. rock armouring of streambed etc.) should minimise impacts of these activities.

Each of the proponents estimated compaction of the coal seams and consequent subsidence. The predicted compaction from these studies is similar to predictions from CSG field in the Western United States (Case, 2000). A subsidence bore was established in the Condamine in the early seventies and indicates that there may have been minor subsidence due to water extraction. DERM has recently established a bore line for monitoring subsidence along a transect across the alluvium that will be monitored on an ongoing basis.

Based on current knowledge, subsidence due to dewatering of the coal seams is likely to be significant in spatial extent but minor, by comparison with long wall mining for example, in magnitude vertically. However, consequences of subsidence and small changes to land surface topography in the study region could be important in terms of changing overland flow patterns, which may increase erosion and gully formation.

In addition, proponents did not consider whether compaction of coal seams in the Walloon Coal Measures after dewatering might result in deformation of overlying or underlying aquifers or confining units. This deformation may result in opening of new or existing fractures in these units which would change the hydraulic relationships and may change groundwater flows between aquifers.

6.4 Mitigation activities

The CSG industry water management and environmental performance in Queensland is regulated under the EP Act (EIS/EA and adaptive environmental regulatory regime) and the Water Act 2000.

The proposed WOLA Bill amends the *Water Act 2000* to ensure any impacts on landholder's water supply bores are properly managed in order to maintain a reasonable or alternative water supply. WOLA includes an obligation on CSG companies to enter into an agreement to "make good" any impairment on landholder's bores prior to these impacts actually occurring. Importantly, the WOLA Bill requires the production of underground water impact reports at least every three years. These reports will provide an assessment of monitoring results, a projection of predicted water level impacts using progressively updated groundwater flow models, a spring impact management strategy, and an updated water monitoring strategy. This adaptive management regime will apply to allow progressive improvement in the understanding of impacts and also to support timely implementation of "make good" arrangements.

Make good obligations will continue beyond the life of the tenure – this is due to the fact that the impacts on underground water resources may possibly continue beyond the life of the tenure. As such, there will be no cap on the period for which tenure holders' underground water obligations continue.

It should be noted that 'make good' provisions only apply to the impact resulting from water extracted under CSG activities not general water extraction for other purposes or natural change.

Two issues are raised by these provisions. Firstly the length of time that the water supply might be affected and secondly the spatial heterogeneity in water quality and quantity must be considered. Predicting the time when re-pressurisation is likely to be achieved is difficult and although associated water could be treated during CSG production phase and used to supplement existing bore owners this option will become increasingly difficult as gas production ramps up and water production declines. Sourcing water after gas production has ceased and until aquifer re-pressurisation has occurred may be required for a considerable length of time.

The Queensland State Government's preferred option for management of associated water from CSG development is aquifer reinjection and proponents have included reinjection as part of their water management strategy. The timing of re-injection and targeted aquifers will be critical to mitigate some of the potential impacts on surrounding aquifers. A substantial amount of additional work will be required to better quantify changes to hydraulic interactions between aquifers and the dewatered coal seams.

7 Discussion

The spatial scope of this study has been restricted to activities directly upon alluvium as opposed to impacts of activity anywhere on alluvium and related surface and ground water flows. Only 22% of the total area of CSG tenements in the MDB is classed as alluvial in this study. Consequently, the volumes of water are relatively small by comparison to the volumes for agriculture and urban uses that are extracted from the alluvium.

There are significant challenges to separate changes from CSG from activities on the alluvium with CSG activities more generally and other activities that impact the water balances of the alluvium. For example, Great Artesian Basin Strategic Management Plan aims to save 211,000 ML/y across the basin over a 15 year period. The total water savings during the Phase 1 of the GABSI for Queensland has been 53,771 ML/y (Surat only = 10, 782 ML/y) and for the whole of the GAB has been 98,004 ML/y (SKM, 2008). Total average water production reported in GA and Habermehl (2010) for APLNG and QGC was 36,656 ML/y (APLNG: 15,931 ML/y; QGC: 20,725 ML/y based on 829 GL produced over 40 years). Using the estimates of water production for these two proponents provided to GA and Habermehl (2010) and assuming the same average water production both on and off the alluvium, the total water production for activity of these two proponents on the alluvium would be expected to be on the order of 7,223 ML/y.

The proponents however acknowledge uncertainty in the estimates of water production and the values noted above are lower than previously predicted in the EIS documents:

- QGC estimated total peak water production to be 190 ML/d (in 2012/2013) and average production to be ~165 ML/d between 2015 – 2025 yielding 1,200 GL over the life of the project (QGC Vol 3, Ch. 11).
- Santos estimated water production from the Roma field to peak at around 20 ML/d in 2014, declining to 10 ML/d for the following 5 years, with a maximum total estimated production of 91,336 ML over the life of the field (Santos, 2010, Att. Q).
- APLNG anticipate their water production to peak 170 ML/day (62,050 ML/year) in sometime in the first twenty years (APLNG, 2010, Vol. 5, Att. 24).

7.1 Regional Impact

As noted earlier, the scope of this report is restricted to activities undertaken on the alluvial plains of the MDB. Therefore, it is important that the water volumes and changes in aquifer interaction are interpreted in terms of this area and not confused with the entire extent of proposed CSG activities. The analysis above, and the analysis conducted by GA and Habermehl (2010) suggests that although large volumes of water will be extracted from the Walloon Coal Measures during extraction of CSG across the entire spatial extent of CSG, the changes to regional groundwater fluxes and balances of MDB aquifers due solely to CSG activities on the floodplain may be relatively minor. Depending on the water production scenario, estimated leakage between GAB aquifers induced by dewatering of the Walloon Coal Measures in any given development area varies between 0.07 – 111 % of recharge for individual GAB aquifers (GA and Habermehl, 2010). Reinjection into GAB aquifers could alleviate some of the predicted drawdown of these aquifers.

No estimates of induced leakage from the alluvial aquifer have been made, although drawdown of this aquifer has been predicted by one proponent (APLNG, 2010) to be on average 2m. This average drawdown predicted to occur over the next ~ 40 years is smaller than the drawdown that has occurred due to abstraction from some areas of the alluvium for agricultural production and smaller than drawdown predicted for GAB aquifers.

Induced leakage from the alluvial aquifer is likely to be variable depending on whether the Walloon Coal Measures have direct hydraulic connectivity to the alluvium or whether drawdown is induced indirectly via a GAB aquifer. CSG activity is likely to have little impact on processes of diffuse recharge to the alluvial aquifers. Riverine recharge may be impacted but, again, the volumes are not large, particularly in comparison to the abstractions associated with irrigation from aquifers and downstream surface waters.

Several aspects of the regional water balance remain unestimated or have only been estimated using analogue (by area equivalent) approaches rather than the preferred method of direct measurement. Recharge rates were computed using an area estimate by GA and Habermehl (2010) to provide an order of magnitude estimate for comparing with induced leakage rates for GAB aquifers. Current numerical modelling by proponents either does not include recharge or uses average rates. In reality, this process for both GAB and Alluvial aquifers is likely to be a stochastic process and only occur during high rainfall events. Sensitivity analyses for hydraulic properties and for stratigraphical conceptualisation could be conducted to improve understanding of likelihood of regional effects.

At a regional level better understanding of recharge processes and subsurface redistribution of water recharged to the GAB aquifers is required to better predict changes during repressurisation of the both GAB and alluvial aquifers and the coal measures. This is also important for determining reinjection strategy. Better constraining these hydraulic relationships will also help better understand potential consequent water quality changes in some parts of the system.

7.2 Local impacts

Although the proponents did not provide detailed estimates or contour maps of the predicted drawdown, the APLNG EIS modelling and subsequent information provided to GA suggests that in some areas large local decreases in potentiometric head could occur (APLNG, 2010, Vol 5 att 21; QGC, 2010; Santos, 2010). In particular, the area south of Miles and North East of Chinchilla and the area north of APLNG's Gilbert Gully tenement were identified in the APLNG EIS cumulative case as areas of great drawdown of both the water table and underlying GAB aquifers (APLNG, 2010, Vol 5 att 21). It is important to note that the areas of greater drawdown were predicted from numerical models using regional average hydraulic parameters. Local drawdown will be determined by local hydraulic conditions, including thickness of confining layers, and the presence of fractures or faults. There is currently insufficient information to determine the extent to which local drawdown will deviate from the average.

Data on hydraulic properties is scarce, there is evidence of considerable spatial heterogeneity in the hydraulic properties of some aquifers (Hodgkinson etal., 2010; KCB, draft in review), confining units (Hodgkinson et al. 2010) and Walloon Coal Measures (Hodgkinson et al., 2010; APLNG, 2010, Vol 5 att 21). Isopach thickness of the confining units is similarly variable. This variability could result in local drawdown that is dramatically different from the average predicted by current models.

In addition, the location of fractures and faults have not been included in the models or considered by the proponents. These features may alter local drawdown and connectivity of aquifers.

Numerical groundwater models will be required to be updated to include local data as it becomes available, this will likely necessitate improved parameterisation and process/stratigraphic representation in the models. Targeted areas for monitoring and additional data on hydraulic properties should be prioritised. Ongoing validation of model predictions of drawdown and water production could provide insights into areas that may require better characterisation and/or additional monitoring. Water production data must also include water produced during exploration as this extraction will contribute to the water deficit of the system. It is not clear that this is currently included in water production estimates.

Water quality analyses, including isotope tracers and dating of waters may aid in identification of changes to local hydraulic conditions. Changes in water types and salinity in the Central Condamine Alluvium in combination with analysis of water levels have been interpreted to be indicative of hydraulic exchange between the alluvium and underlying Walloon Coal Measures and sandstone aquifers. Colloquial reports of changes to water quality in some Condamine Alluvium water bores have been reported. However, good quality water quality time series from individual bores were not available for this study. Given the heterogeneity of water quality in the alluvium (KCB, draft in review) changes to bore water quality may occur due to lateral migration of poor quality water rather than changes to vertical connectivity with the underlying Walloon Coal measures or GAB aquifers.

In summary, given the certainty of variability/spatial heterogeneity in stratigraphy, hydraulic properties, recharge rate variations and hydraulic connectivity of aquifers and intervening regolith, it is certain that local effects will occur. The nature of these effects can be described. However, where and when they will manifest will remain unpredictable until more data is available. It is important that communities are made aware of the types of effects that may occur and that the governing authorities have adaptive management processes in place to deal with them when they arise.

7.3 Gaps

Many of the gaps identified in this work are similar to those identified by GA and Habermahl (2010). In particular, there appears to be little data that quantifies spatial variation in fundamental aquifer hydraulic properties. For impacts to be predicted and adequate management to be put in place then these data would need to be collected and be made available to the government, and the Queensland Water Commission.

To allow improvements in the assessment of aquifer drawdown and impact on other water users, the proponents would need to provide spatially explicit contour maps of the drawdown areas. The cumulative effect of all proponent activities is currently not able to be assessed.

All the proponents have postulated an adaptive management regime to development, with monitoring networks of water levels and water quality. The adaptive management loop will also need to include ongoing updating of the groundwater models used to predict drawdown with data on the hydraulic properties as well as ongoing review of the predicted with measured drawdown. Data required for this would need to include storativity, horizontal and vertical permeability for both aquifers and confining units. It will be critical to establish in advance what corrective measures will be enacted (risk mitigation strategies) when local effects occur.

The proponents acknowledge uncertainty in their estimates of water production. The average annual production estimates of QGC for example are ± 50% (GA and Habermehl, 2010). There are significant differences between different methods for estimating the amount of associated water depending on modelling approach, information available and assumptions regarding gas production quantities over time. Individual well water production should be monitored and data made available to the government along with water:gas profiles. These would be required to monitor predicted and actual water production allowing better forecasting predicted drawdown and aquifer impacts. Further, to improve modelling and forecasting assumptions and methods for estimating associated water would need to be explicitly stated with error estimates to ensure comparability of different estimation techniques and the volumes predicted.

A great deal of relevant data is currently held by the proponents. To enable this data to be included in models and assessments of cumulative impacts, data provided by proponents could be held as confidential for a period of time before becoming publically available. This would ensure the competitive and commercial interests of the companies while allowing the government to review model predictions and monitoring results thereby increasing the certainty of impact prediction and a timely and appropriate management response.

Vertical permeability and connectivity between aquifers has not been well quantified.

Full sensitivity analyses should be done using project and cumulative scenarios for the likely range of hydraulic variables. Results need to be spatially explicit and presented as contour plots.

The impact of such large scale dewatering and changes to capillary pull of the coal seams is completely unknown.

Existing faults and fractures must be accounted in the models, or at least signalled as areas of concern. To enable models to be kept up to date, ongoing monitoring of water levels and water production (including during exploration) in areas with known faults or fractures should be compared with modelled predictions and the models updated. In some areas analysis of the water:gas profile of different wells in relation to known locations of faults or fractures may be a useful first assessment of the importance of these fast flow paths.

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9 Appendix 1: Terms of Reference

Terms of Reference for an independent expert study under s255AA of the Commonwealth *Water Act 2007*

Background

1. Section 255AA – Mitigation of unintended diversions – of the Commonwealth *Water Act 2007* states that:

> *"Prior to licences being granted for subsidence mining operations on floodplains that have underlying groundwater systems forming part of the Murray-Darling system inflows, an independent expert study must be undertaken to determine the impacts of the proposed mining operations on the connectivity of groundwater systems, surface water and groundwater flows and water quality".*

2. The preconditions for triggering this provision and necessitating an independent expert study (referred to hereafter as "the study") are:

- It needs to be a subsidence mining operation;
- It needs to be on a floodplain; and
- It needs to have potential to impact on Murray-Darling Basin (MDB) system inflows.

3. Based on advice in a report by Geoscience Australia (Geoscience Australia and Habermehl 2010), the location and nature of current proposed coal seam gas (CSG) developments in Queensland mean that the above preconditions may potentially be met and it is therefore prudent to commission an independent expert study.

Scope of work

4. The study will seek to determine the impacts of the proposed mining operations on the connectivity of groundwater systems, surface water and groundwater flows and water quality in the Murray-Darling Basin.

5. The study will be conducted by an independent expert with relevant science qualifications and experience and be assisted by Geoscience Australia. .

6. The study will involve a review of all available information on the proposed developments, including reports by the Queensland Coordinator General, Geoscience Australia, and other relevant information. The independent expert will be able to request further information from the CSG proponents and other experts as they see fit. In particular, the independent expert will engage with holders of relevant technical data, information and knowledge, including:

- the proponent companies: Santos, British Gas, AP LNG, Arrow, and Shell;
- science and data agencies within the Commonwealth and Queensland governments; and
- the Murray-Darling Basin Authority.

Governance

7. The Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) and the Queensland Department of Environment and Resource Management (DERM) will jointly facilitate technical and logistical support as requested by the independent expert. Senior officials of both agencies will form a joint liaison committee for this purpose.

8. The final report will be provided to the Commonwealth and Queensland governments, who may make the report publicly available.

Timeframe

9. The review will be completed no later than 22 November 2010. A draft report will be provided to the joint liaison committee by no later than 8 November 2010.

10 Appendix 2: CSG Proponent Groundwater Modelling for assessing impacts on groundwater.

Three CSG operators have used groundwater models to estimate drawdown in surrounding aquifers due to CSG activity. APLNG used FEFLOW a finite element groundwater simulation model with 22 layers and variable sized elements. The model had a finer (3km) mesh close to APLNG tenements that increased to 12km at distances greater than 70km from the tenements. QGC and Santos used MODFLOW, a finite difference model approach, in their EIS. All models were assessed by GA and Habermehl (2010) as providing reasonable preliminary estimates of likely impacts of dewatering for CSG extraction. The model used by APLNG was clearly superior in its extent, conceptualisation, discretisation (i.e. greater number of layers represented, particularly in the Walloons and smaller spatial elements) and calibration.

No information was available from Arrow to provide an assessment. However, the cumulative case presented by APLNG includes projected water production from the development of all tenements in the area under study.

The conceptualisations of the groundwater systems used by the proponents were consistent with previous work. The models also represented structural geological features based on stratigraphic interpretation derived from company records, DERM and GSQ.

All the proponent models contained significant assumptions that introduce uncertainty into the predicted drawdowns and changes to water balance of surface water, alluvial and GAB groundwater systems.

These assumptions include:

- Average hydraulic parameter values for each layer based on literature values for all layers - except perhaps Walloons in APLNG
- Vertical hydraulic conductivity data is lacking; APLNG used assumed aniostrophy values
- APLNG assumed uniform storativity value 4 x 10-6 (derived from pump test in precipice near Kogan Ck) and specific yield 0.03 in upper layers. GA and Habermehl (2010) suggested that these values may be low estimates.

- The APLNG model included recharge estimates for the upper alluvial layers based on Kellett et al., (2003), Lane (1979) and Huxley (1982). The QGC model did not include recharge.
- The QGC model assumed constant head boundary at the model domain
- All models assumed the Precipice sandstone to be a no flow boundary (ie no connectivity with the underlying Bowen Basin)

There was a general consensus that there is a paucity of data against which to calibrate the models. The methods by which the models were calibrated varied between proponents. QGC calibrated the model by matching predicted water production. Estimates of water production were reported to have an uncertainty of ± 50% and four water:gas typologies were identified. The method by which these typologies were used to estimate water production is not clear. APLNG and Santos calibrated the models against measured water levels. The models relied heavily on calibration to set the values used in model runs in particular hydraulic conductivity values. None of the proponents specified hydraulic properties after calibration used to produce drawdown estimates.

There was no representation of fractures and faults- this could represent a significant source of underestimation of drawdown and may be exacerbated where well completion includes fraccing.

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

DEPARTMENTAL ADVICE

Coal Seam Gas Field activities associated with the Australia Pacific LNG Project

EPBC 2009/4974

January 2011

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Definitions and abbreviations used in this advice

APLNG Project	Australia Pacific Natural Gas Project.
CG	Queensland Coordinator-General.
CSG	Coal seam gas.
Department	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (formerly the Department of the Environment, Water, Heritage and the Arts).
EIS	Environmental Impact Statement (including the Supplementary EIS, unless indicated otherwise).
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
Fraccing	The process of hydraulic and chemical fracturing of coal seams which facilitates gas extraction. Also called fracking.
GAB	Great Artesian Basin.
LNG	Liquefied Natural Gas.
Minister	The Minister responsible for administering the EPBC Act.
MNES	Matters of national environmental significance, protected under Part 3 of the EPBC Act.
proponent	Australia Pacific LNG Pty Limited.
Referred action (referral)	The proposal referral by Australia Pacific LNG Pty Ltd for gas field development, construction and operational activities associated with the proposed APLNG Project (unless otherwise indicated) and referenced as EPBC 2009/4974.
SDPWO Act	*State Development and Public Works Organisation Act 1971* (Queensland).
SEIS	Supplementary information provided in lieu of publishing a supplementary EIS.

DEPARTMENTAL ADVICE

(EPBC 2009/4974)

Overview

The proposal includes development, construction and operation of the CSG field component of the proposed APLNG Project. This includes expansion of the existing APLNG operated coal seam gas fields in the Walloons gas fields in the Surat Basin to accommodate the gas demand of the proposed LNG Plant on Curtis Island and will require significant expansion of well development, in-field processing, associated water management, land access and infrastructure activities. The proposed gas field project area is indicated in Figure 1 below (see also A0 map of CSG fields at Attachment A1 of the brief to which this advice is attached).

The proposal is one of three components of the overall 'APLNG Project'. The other components of the Project are proposed LNG plant and associated onshore and marine facilities (2009/4977) on Curtis Island, and the high pressure gas transmission pipeline to transport gas from the CSG fields to Curtis Island (2009/4976).

On 3 August 2009, the Minister's delegate decided that the proposal was a controlled action, because of its likely significant impacts on declared Ramsar wetlands; listed threatened species and communities; and listed migratory species (the 'controlling provisions') which are each protected under the EPBC Act. As such, the proposal has been assessed for its impacts on those controlling provisions. Under the EPBC Act, the Minister must decide whether or not to approve the action for each controlling provision.

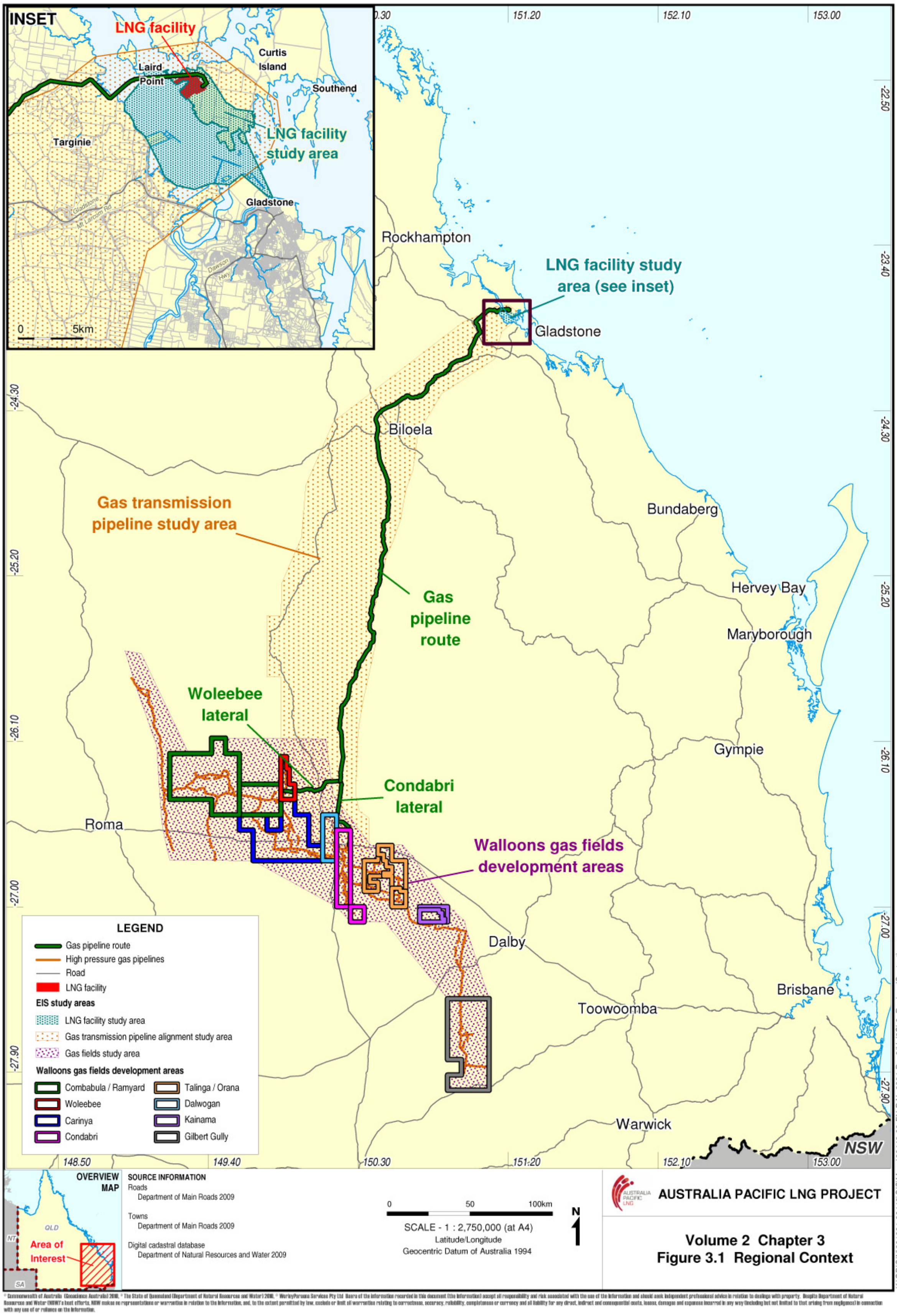
The proposal has been assessed under the bilateral agreement with Queensland. A single assessment was undertaken by the Queensland Government which covered all components of the Project including gas field development. The Project has been the subject of a report and approval by the Queensland Coordinator-General, provided to the Commonwealth in November 2010.

Recommendations

This advice recommends that the impacts of the proposal are not unacceptable, having regard to the proposed conditions, mitigation measure, and offsets and should therefore be **approved**, for the following controlling provisions under the EPBC Act:

Controlling Provisions for the action	Recommendation	
	Approve	**Refuse to Approve**
Wetlands (Ramsar) (ss 16, 17B)	Approve	
Listed threatened species and communities (ss 18, 18A)	Approve	
Listed migratory species (ss 20, 20A)	Approve	

Figure 1: APLNG Project area (APLNG gas field tenements and related linear infrastructure for the gas field)



Background

The proponent

1. The APLNG project is proposed by Australia Pacific LNG, a 50:50 joint venture between Origin Energy Limited (Origin) and ConocoPhillips. The project brings together two companies with significant experience in coal seam gas production for commercial markets. The joint venture arrangement sees Origin responsible for the construction and management of the gas fields and associated infrastructure, and the gas pipeline to the LNG facility on behalf of Australia Pacific LNG. ConocoPhillips will be responsible for the construction and management of the LNG facility on behalf of Australia Pacific LNG.

2. Australia Pacific LNG was previously known as Origin Energy CSG Limited and was a wholly-owned subsidiary within the Origin Group. In September 2008, Origin announced that it had selected ConocoPhillips to invest in the joint development of a CSG to LNG project using Origin's CSG reserves and resources in Queensland.

3. Origin is the largest integrated energy company operating across Australia and New Zealand. Listed in the ASX top 20, the company has more than 4,000 employees. Origin is a leading developer of coal seam gas in Australia and on behalf of Australia Pacific LNG undertakes exploration in the Bowen Basin, the Surat Basin (covering the Walloon Coal Measures) and the Gallilee Basin. Origin also owns and operates some CSG exploration acreage in the Surat Basin in its own right.

4. Origin is also a major producer of gas in eastern Australia, the largest owner and developer of gas-fired electricity generation in Australia and a leading wholesaler and retailer of energy. On behalf of Australia Pacific LNG, Origin operates the Spring Gully and Peat CSG fields in the Bowen Basin, and the Talinga CSG field in the Surat Basin.

5. ConocoPhillips is an international, integrated energy company. As of 30 September 2009, ConocoPhillips was:

   - The third-largest integrated energy company in the United States based on market capitalisation, oil and natural gas reserves, and production. ConocoPhillips' current net production is 2.2 million barrels of oil equivalent (BOE) per day from an assets base valued at $152 billion dollars US;
   - The fourth-largest refiner in the world;
   - The seventh-largest worldwide reserves holder of non government-controlled companies with 10 billion BOE of reserves.

6. ConocoPhillips has more than 25 years experience developing and producing coal seam gas, is one of the largest CSG producers in North America and is the world's leading developer and operator of LNG projects using lean (low energy content) gas similar to CSG. ConocoPhillips currently operates facilities in Kenai, Alaska and Darwin, Australia, and has licensed its proprietary LNG liquefaction process to operators on three continents.

The proposed action

7. Australia Pacific LNG (the proponent) is proposing to develop CSG resources in the Walloons gas fields in the Surat Basin in south central Queensland with up to 10,000 CSG wells. The proposed gas field development as illustrated in Figure 1 as the 'APLNG gas field tenements and related linear infrastructure for the gas field' will supply methane gas to a related proposal for an LNG liquefaction and export facility on Curtis Island, near Gladstone, Queensland.

8. In addition to the development of the gas field which is the subject of this Departmental advice, the Project includes the following separate but related referrals submitted by the proponent:

   - Construction, operation and decommissioning of a high pressure gas transmission pipeline to connect the Walloons gas fields with the LNG facility on Curtis Island (EPBC 2009/4976);

   - Construction, operation and decommissioning of an LNG facility near Laird Point on Curtis Island for production and export of approximately 18 Mtpa of LNG and development of associated onshore and marine facilities such as wharves (EPBC 2009/4977);

9. Origin Energy currently has CSG operations underway in the study area. Origin currently operates the Talinga gas processing facility and water treatment facility within the proposed project area (refer to Figure 1). These operations consist of a limited number of approved CSG wells and related production facilities located in the southern part of the Talinga development area. This field is approximately 25km south-west of the town of Chinchilla and has been in operation since 2005 (See figure 2 for an aerial image of gas field development).

10. Exploration activities are currently being undertaken by Origin Energy within all the Walloons gas fields permit areas (refer to Figure 1 and Attachment C1). Activities undertaken during 2009 included the drilling of 55 exploration and appraisal wells (including pilot test wells) and completion of two seismic surveys (Quinn Gully 2D and Pathfinder 2D seismic surveys).

Alternatives

11. The proponent did not propose alternative timeframes, locations or activities for the gasfields component of the APLNG project in the EIS, but does state in the EIS that proposed technologies for CSG extraction, processing and compression, and liquefaction are based on careful consideration of available technologies and the considerable experience of both ConocoPhillips and Origin. Opportunities to enhance the safety, environmental and commercial performance through alternative technologies or engineering design are being actively pursued through the project planning phase and will continue for the life of the Project.

12. Due to the large geographic extent of the gas field area to be developed and long time-frame for undertaking the gasfield development in stages, the exact locations of infrastructure will not be finalised until detailed ground truthing of individual well sites (and therefore associated infrastructure) is progressively finalised as well exploration and establishment continues in the project area over the life of the project. However, the number, size and specifications of the infrastructure components for the gasfields have been refined since the original EIS was published.

13. In the supplementary information the proponent states that advancement of engineering solutions, improved clarity around reserves in the gasfield tenements and further consideration of environmental impacts have led to the selection of alternative technologies, and project design improvements that have reduced environmental impacts, for example transitioning from portable gas fired power plants to electricity instead of gas-fired engines to power gas compression facilities means smaller impact footprints will be achieved; optimisation of high pressure pipeline layout removing a significant amount of pipeline and associated infrastructure impacts; an optimisation in methodology of establishing wells to reduce the footprint for drillpads; and ongoing studies into the pheasibility of horizontal directional drilling at certain sites to allow micrositing adjustments in order to minimise impacts in sensitive areas.

Figure 2: Example of gas field development

Potential environmental impacts

14. In the EIS, the proponent identified the range of potential environmental impacts that may result from gas field development, construction, installation, operation and decommissioning.

15. These potential impacts include:

- Direct impacts on listed ecological communities, listed threatened species and migratory species through loss of habitat resulting from initial site clearing and preparation, construction, installation and operation of infrastructure;

- Impacts to threatened artesian spring communities associated with aquifer draw down from well water extraction and;
- Disturbance to threatened artesian spring communities associated with aquifer pipeline and road construction including direct excavation and sediment delivery
- Contamination or changed flow regimes to Narran Lakes Ramsar Wetlands or Lake Broadwater from gas field operation;
- Altered low flow hydrology / hydraulics resulting from road crossings;
- Impacts on aquifers associated with groundwater drawdown from well watering;
- Removal of groundwater in coal seams and other formations with prediction of subsidence at the surface;
- Contamination caused by spillage of drilling fluids or other regulated wastes from construction of or upgrade to wells and hydrocarbon, chemical or wastewater contamination from accidental spills;
- Chemical contamination of watercourses resulting from brine pond overflows;
- Toxicity effects on aquatic organisms from elevated contaminant concentrations (boron) or low calcium concentrations in proposed permeate discharges and from overflows of contaminated water from brine ponds;
- Impact to Murray cod, other notable fish and MNES species associated with increased TSS and turbidity from pipeline, road and other infrastructure during construction and associated with temporary diversion of watercourses during construction and alteration of flow regimes from permeate discharge;
- Construction and operation related impacts on water quality, aquatic ecology or fluvial geomorphology;
- Modification of ecosystems by installation of infrastructure, associated fragmentation and loss of movement opportunities for fauna and associated changes in physical edge effects;
- Increased weed invasion - particularly exotic grasses which outcompete native species and increase fire frequency and intensity;
- Deposition of dust, sand and soil which may have potential impacts on vegetation if excessive levels are sustained over extended periods;
- Impacts associated with changes to fire regimes including the potential for increase in accidental fire;
- Impacts associated with erosion and sedimentation. There is potential for erosion on areas disturbed by works associated with the development of the gas field. Where these activities occur on erosive soils and/ or on slopes, mobilisation of sediment into watercourses can occur;
- Noise and night time lighting disturbance. Secondary impacts to fauna include disturbance from noise night lighting and vibration during construction and operation.

16. There also are potential impacts from further fragmentation of ecological communities, MNES habitat and remnant vegetation due to the extensive linear infrastructure (e.g. pipeline corridors and access tracks) which may increase access for feral and native pests and predators, feral competitors and more aggressive

native species; and impacts from noise and increased human activity, which may restrict species movements, limit access to food or other resources.

17. In the EIS the proponent acknowledges potentially significant infrastructure impacts on bioregional corridors. The proponent states that these impacts will be mitigated by offsetting habitat losses within the bioregional corridors through protection and enhancement of regrowth vegetation, replanting and re-establishing preclearing ecological communities within currently cleared areas of the corridors, and rehabilitating infrastructure locations following decommissioning.

18. At the time of writing this advice, APLNG had undertaken sufficient detailed ecological field surveys across the gas field tenements (by groundtruthing through targetted species searches, general habitat assessments and verification of current DERM regional ecosystem mapping) to inform the development of ecological sensitivity mapping for the project area. This in turn has allowed the proponent to identify an ecologically sensitive infrastructure layout, which provides the basis for the impact assessment. Comprehensive detailed ecological field infrastructure siting surveys will occur progressively across the gas field tenements prior to final location of infrastructure. Determination of actual impacts to MNES will therefore not occur until after commencement of the action. The process of reconciling predicted against actual impacts would occur over the life of the project as the gasfields are progressively developed.

19. The degree of certainty of predicted drawdown on aquifers and related impacts on listed species dependent on groundwater springs and the ecological community dependent on groundwater discharge from the Great Artesian Basin is among the issues of concern to the Department addressed in this advice.

Figure 3: Multiple well site under construction

Description of the environment

20. The Walloons gas fields are located in Queensland's Surat Basin on the Western Downs. They cover an area of approximately 570,000 hectares (ha), extending from Wallumbilla to Millmerran within the Darling Downs within petroleum tenures held by Australia Pacific LNG. The gas fields are located in the three regional council areas of Maranoa, Toowoomba and Western Downs. The larger communities in the gas fields region are Chinchilla with a population of approximately 4,385, Dalby (approximately 11,037), Miles (population approximately 1,524) and Roma (population approximately 6,647). The smaller towns and settlements in the region include Condamine, Dulacca, Drillham, Jackson, Kogan, Yuleba, Wandoan and Wallumbilla. Smaller towns outside of the project region include Brigalow, Cecil Plains, Millmerran, Tara, Taroom and Turallin.

21. The predominant land use over the gas fields' development area is cattle grazing in the rangelands. Various forms of cropping are found in areas of more fertile soil and where the use of machinery is not constrained. Other land uses include forestry, nature conservation, resource extraction and urban activities. The table below provides a breakdown of land usage in each of the proposed gas fields' development areas.

Table 6.2 Land use, gas fields' development areas

Gas fields' development area	Combabula/ Ramyard	Wolebee	Carinya	Condabri	Talinga/Orana	Dalwogan	Kainama	Gilbert Gully
Area (km^2)	**1,847**	**154**	**1,075**	**460**	**518**	**230**	**153**	**1,292**
Land use category	**Percentage of gas fields' development area**							
Grazing natural vegetation/minimal use	74.0	78.4	50.9	72.0	65.8	91.4	97.5	32.8
Grazing modified pasture	16.6	13.4	18.1	10.0	11.8	5.6	1.6	6.0
Forestry – production*	5.3	4.5	0.3	2.9	0.4	–	–	57.1
Forestry – plantation	–	–	–	0.01	–	–	–	–
Dryland cropping/horticulture	3.9	3.6	27.6	5.3	19.5	0.3	0.2	3.3
Irrigated cropping/horticulture	–	–	–	1.9	0.7	–	–	–
Intensive animal/plant production	–	–	0.02	0.2	0.2	–	–	0.05
Rural residential	–	–	0.02	0.5	–	0.02	–	–
Urban	–	–	0.05	5.8	–	–	0.3	0.01
Mining and waste	0.001	–	–	–	0.9	0.0003	–	–
Nature conservation/protected areas	0.2	0.1	3.0	1.2	0.6	0.007	0.4	0.7
Water	0.004	–	0.07	0.02	0.2	–	–	0.01

(Note: Production forestry on state forest tenures – includes grazing activities as a co-use.)

from Vol. 2 Chapter, Section 6, Table 6.2 of the *Australia Pacific LNG Project EIS*

22. Agricultural land use in the area is characterised by beef cattle grazing, dry-land cropping, irrigated cropping, and intensive animal production. There is also some grazing of goats and sheep in the area.

23. Several state forests are located in part within the gas fields. These production forests form part of the State's hardwood and cypress pine timber resource and are utilised to provide timber to sawmills, fence posts and firewood. In addition, the forests are used by the honey industry and often contain commercial sand and gravel resources.

24. The gas fields' study area contains substantial reserves of coal and CSG which are currently being investigated by a number of exploration and production companies. The area also contains bentonite deposits, two of which are being mined. These are located 29km to the south-west of Wandoan and 5km to the south-west of Miles.

25. The predominant land tenure in the gas fields' study area is freehold. The percentage of each land tenure category within each gas fields' development area is summarised in the table below:

Table 6.3 Land tenure, gas fields' development areas

Gas field	Combabula/ Ramyard	Woleebee	Carinya	Condabri	Talinga/Orana	Dalwogan	Kainama	Gilbert Gully
Area (km^2)	**1847**	**154**	**1075**	**460**	**518**	**230**	**153**	**1292**
Tenure category	**Percentage of Gas field development area**							
Freehold	72.5	70.9	90.7	82.6	94.7	95.2	94.3	39.5
Leasehold	20.2	12.7	6.5	10.2	1.1	0.4	0.01	0.8
Reserve	0.25	0.4	0.1	0.5	0.2	0.3	0.3	0.3
National park	-	1.6	-	-	-	-	-	-
State forest	5.35	4.5	0.3	2.9	0.4	-	-	57.1
Unallocated state land	-	-	-	0.1	0.01	0.5	0.02	0.03
Roads, easements, watercourses	1.7	9.9	2.4	3.7	3.6	3.6	5.4	2.3

(Source: Digital cadastral database, Queensland, Sept. 09)

from Vol. 2 Chapter, Section 6, Table 6.3 of the *Australia Pacific LNG Project EIS*

26. Two sites declared wetlands of International Importance under the Ramsar Convention, the Shoalwater and Corio Bays area and the Narran Lake Nature Reserve (located the Condamine–Balonne catchment approximately 500 km downstream of the gasfield and pipeline areas) were identified for consideration of potential impacts relating to this project. As such, Wetlands of international importance were declared a controlling provision in relation to the proposal and are considered later in this advice.

27. The EIS (Volume 2: Gasfields, Chapter 8 Terrestrial ecology, Chapter 9 Water qaulity and aquatic ecology and in particular Chapter 23 matters of national environmental significance) provides discussion of the affected environment, including MNES likely to be found in the APLNG Project area and a description of environmental values relevant to the controlling provisions; identifies key impact mechanisms and details the assessment of potential impacts on all MNES including an outline of the environmental management plan and key mitigation and

management strategies proposed; and provide a summary of conclusions relating to potential impacts on MNES.

28. The proponent's approach has been based on desktop analysis supported and qualified by a range of detailed site assessments and ecological surveys. This information is the basis for the environmental values included in the proponent's environmental constraints planning for the project area.

29. In the bioregional context the EIS states that the project area is part of a highly modified landscape, within which some large remnant tracts of vegetation persist. Such remnants are primarily on less fertile lands at higher altitudes and support ecosystems which are well-represented regionally and are mostly incorporated within the State Forest network. The more fertile, lower altitude lands are intensively grazed, and generally have only small, more isolated patches of remnant vegetation remaining.

30. The EIS states that now endangered Brigalow communities were once widespread before much of this land was cleared for grazing. Flora and fauna species that are strongly associated with these ecosystems are also affected by their fragmentation, as well as by cattle damage and altered fire regimes. As a result, many of these species share the threatened status of the vegetation communities.

31. There are a range of EPBC Act listed threatened species, listed migratory species and listed ecological communities likely to be present within the APLNG gas fields project area. Much of the listed species' habitat and components of the listed ecological communities have been fragmented by and current past land use activities. These species and their habitats therefore represent important environmental values in the broader highly modified landscape.

32. The exact gas field layout and location of each item of infrastructure has not been determined. Individual well locations (and therefore associated infrastructure) will only be phased and progressively finalised as well exploration and establishment continues in the project area over the life of the project.

33. The hydrological systems operating within the Surat Basin are numerous and complex and are an important aspect of the broader environment. The EIS states that APLNG CSG developments are located between Milmerran and Roma – Wandoan, in an area where most waterbores tap the aquifers of the Bungil Formation, Gubberamunda Sandstone, Waloon Coal Measures, Hutton Sandstone and Precipice Sandstone. The APLNG gas field tenements fall predominantly within the Surat and Surat East Groundwater Management Areas, and partly within the Surat North Management Area, as defined in the *Great Artesian Basin Water Resource Plan*.

34. The Combabula/Ramyard, Carinya and Woleebee gasfields fall predominantly within the Surat Management Area. This management area overlies the full Jurassic to Lower Cretaceous sequence in the Surat Basin and the Upper Triassic sediments of the Bowen Basin in the west. The Dalwogan, Gilbert Gully, Kainama and Condabri gasfields fall within the Surat East Management Area and the Talinga/Orana gas fields fall predominantly within the Surat East Management Area (with a very small component in the Eastern Downs Management Area). The Surat East Management Area overlies sediments of Kumbarilla Beds, Walloon Coal Measures, Hutton and Precipice Sandstones of the Surat Basin and the Clematis Sandstone of the Bowen Basin.

35. The northernmost tip of the Combabula Ramyard Gasfields fall just inside the Surat North Management Area, which covers the sediments of the Westbourne Formation, Injune Creek Group, Hutton and Precipice Sandstones within the Surat Basin and the Clematis Sandstone within the Bowen Basin.

36. These aspects of the environment are further described in sections relating to the groundwater dependent listed ecological community and listed species dependent on groundwater springs, as well as the section of this advice on social and economic matters relating to groundwater.

Coordinator-General's assessment and public consultation

37. The process included the submission by the proponent on 6 July 2009 of the 3 related project referrals; the initial assessment and determination of controlled action decisions for all 3 referrals and decision that the bilateral agreement applies (accrediting the Queensland assessment process) on 3 August 2009; the assessment by Queensland under the bilateral agreement, and the subsequent report by the Queensland Coordinator-General released in November 2010. This report included a section summarizing the Queensland assessment of impacts relating to matters of national environmental significance.

38. Under the bilateral agreement, the assessment was undertaken in accordance with the State Development and Public Works Organisation Act 1971 (Qld) (SDPWO Act). Under that Act, on 9 April 2009 the project was declared to be a significant project for which an environmental impact statement (EIS) was required. The draft Terms of Reference (ToR) were advertised for public and advisory comment from 29 August and receipt of submissions closed on 12 October 2009. The final ToR which was approved by the CG and issued to APLNG on 3 December 2009. Australia Pacific LNG prepared and submitted the EIS. APLNG lodged its draft EIS with the Queensland DIP on 29 January 2010 and the final approved and publicly advertised and available for public consultation for approximately five weeks from 20 March 2010. 36 submissions were received by Qld DIP, including 18 from government agencies and local councils and 18 from the general public and NGOs.

39. Following a review of submissions received on the EIS, the CG decided that no formal supplementary EIS with public review was necessary but that supplementary information should be provided by APLNG pursuant to section 35(2) of the SDPWO Act to assist in the evaluation of the EIS. This additional material included:

- Advice on project changes since the EIS was lodged
- Additional assessment work and studies completed since the EIS was lodged
- Responses to issues raised in the EIS submissions
- Briefings of key advisory agencies on the above matters

40. The briefings of key advisory agencies were conducted over the period from 16 July 2010 to 2 August 2010. Final supplementary information was lodged with DIP on 16 August 2010 and reports on project changes and additional assessment work uploaded to the APLNG website on 17 August 2010 for access by agencies and the public. Responses to issues raised in submissions were forwarded to government

and council agencies on the 17 August 2010 while individual letters to NGOs and private parties were variously forwarded in early September 2010.

41. On 17 August 2010 the Coordinator-General requested that advisory agencies (including DSEWPaC) provide advice to the Coordinator-General on:

- the adequacy of the supplementary material and agency briefing sessions in addressing matters raised in EIS submissions
- any proposed conditions for the Coordinator-General's consideration in preparing the Coordinator-General's evaluation report
- any other advice or comment for the Coordinator-General's consideration in evaluating the project.

42. DSEWPaC provided its response on 12 October 2010. The response addressed the degree to which the draft Coordinator-General's report had addressed the identified MNES and commented on a range of issues relevant to the respective referrals. The key comments were:

- the limited attention to groundwater impacts relating to springs, both within the APLNG project area and external to it is of concern. The issue of cumulative impacts is a key issue of concern to the Commonwealth.
- while some conditions regarding mitigation and offsets, are mentioned, the preferred approach would be to present an assessment and a conclusion in relation to each MNES. The conclusions should be a clear statement in relation to acceptability of impact and appropriate risk management and mitigation for each EPBC Act matter discussed.

43. Matters raised in submissions generally are summarised in the brief to which this advice is attached. Relevant matters raised in the public submissions on the EIS and SEIS, relating particularly to the proposed gas field included concerns relating to:

- surface water, groundwater and associated water management, beneficial water uses, potential cumulative ground water impacts, brine and fracking management;
- land use and infrastructure, nature conservation, rehabilitation and decommissioning;
- air quality, noise, social and community impacts and stakeholder engagement, hazard and risk management;
- over-all assessment methodology.

44. Public comments were taken into account by the Coordinator-General when preparing his report and have been taken into account by the Department in preparing this advice and the associated briefing.

45. The Coordinator-General's report states that the APLNG assessment (through the EIS and supplementary studies and reports) had concluded that no action related to the gas fields will have a significant impact on any MNES subject to the relevant controlling provisions on the basis that all of the proposed mitigation and offset measures are fully implemented.

In relation to the gasfields, the Coordinator-General's report:

- requires that the gas field development planning will recognise and avoid, where practical, environmentally sensitive areas and threatened species therefore minimising impacts on EPBC-listed threatened species and ecological communities (Appendix 2, Part 2, Condition 1);
- requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project (Appendix 1, Part 1, Condition 7);
- requires APLNG ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced where clearing of sensitive vegetation and habitat cannot be avoided (Appendix 1, Part 1, Condition 5);
- requires consideration of potential ecological impacts (including the effects of cumulative discharges) on aquatic habitat including native fish breeding and feeding areas, potential for erosion and disturbance of riverine vegetation (including Appendix 2, Part 2, Conditions 4 and 7);
- accepts the proponent's advice that it is unlikely any discharge springs occur in the area of potential drawdown from their CSG activities, but finds that the full extent of actual impacts requires further investigation;
- requires that adaptive, rather than reactive, management of aquifers will be achieved. (Appendix 2, Part 2, Conditions 10 and 11) and refers the Water Act 2000 (Qld) provisions for a risk-based adaptive management approach to spring impact management and proponent obligation to undertake an assessment of all springs within an area of likely to have a 0.2-metre drawdown and accordingly implement any required mitigation measures;
- requires that offsets are provided where necessary to ensure appropriate management of affected EPBC-listed migratory species (Appendix 1, Part 1, Condition 5);
- requires that sufficient information is available to the CSG Industry Monitoring Group to understand and respond to the social and environmental cumulative impacts of the combined CSG and other industries in the region (Appendix 1, Part 1, Condition 13);
- supports a management regime of 'pulsed' discharges of treated water so as to reflect the natural hydrological regime of the receiving waters for release of treated CSG water to surface waterways;
- supports adoption of the APLNG commitments in relation to MNES for the proposed gas fields in the EM Plan.

46. In summary, the Coordinator-General concurs with the EIS assessment of the proposed clearing for the gas fields and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities to be that no significant impacts are predicted to MNES (including Ramsar wetlands) if the APLNG commitments in relation to MNES for the proposed gas fields (as outlined in Volume 1 Chapter 6, section 6.1.21 of the EIS); and the requirements of the conditions set by the Coordinator-General in relation to avoidance and mitigation of impacts on MNES are met.

47. The Coordinator-General notes that he has taken into account the offsets proposed by APLNG for residual unavoidable impacts of the gas field activities when reaching his conclusions in relation to his assessment of significance of impacts on MNES. The Department disagrees with this approach and notes that the determination of the significance of impacts of proposed activities should be made on the basis of the magnitude of all actual impacts and should be made prior to any consideration of

offsets put forward to mitigate those impacts. As such, some of the conclusions made by the Department as to whether proposed gasfield activities represent significant impacts differ from the Coordinator-General's conclusions.

Assessment of impacts

Overview

48. This assessment is limited to impacts on the controlling provisions for the proposed action: Ramsar wetlands, listed threatened species and ecological communities, and listed migratory species, protected under Part 3 of the EPBC Act.

49. On the basis of the information available, the Department has made the following conclusions in relation to the matters protected by the controlling provisions for the action, and recommends that the decision be made to approve the proposal for each controlling provision accordingly:

Controlling provision	**Acceptability of impacts**
Wetlands (Ramsar)	Acceptable, if: The proponent acts in accordance with the requirements of the recommended Commonwealth conditions and the Coordinator-General's requirements. This includes a requirement to avoid significant impacts to the Narran Lakes Ramsar Wetland; ensuring that brine storages comply with revised Queensland design and performance criteria and quidelines - *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* and the model EA conditions and code of compliance for high hazard dams; and that all permeate to be released to the environment meets DERM water quality criteria for beneficial use and that release is managed to mimic natural flows; and developing appropriate ground and surface water monitoring including environmental make good measures.
Listed threatened species and ecological communities	Acceptable, if: The proponent acts in accordance with the requirements of the recommended conditions. This includes developing and implementing gas field ecological constraints planning, applying no impact and impact risk zones in relation to location of infrastructure and requirements for undertaking of ecological surveys, developing species management plans, clearing only within authorised disturbance limits, rehabilitation of disturbed areas, developing appropriate ground and surface water monitoring including environmental make good measures and securing offsets where required.

Listed migratory species	Acceptable, if: The proponent acts in accordance with the requirements of the recommended conditions. This includes developing and implementing gas field ecological constraints planning, applying no impact and impact risk zones in relation to location of infrastructure and requirements for undertaking of ecological surveys, developing migratory species management plans, and clearing only within authorised disturbance limits, and rehabilitation of disturbed habitat areas.

Potential impacts to MNES

50. The Department's Environment Reporting Tool (ERT)* identified the following MNES (or controlling provisions) as potentially occurring within the project area:
- 6 listed threatened ecological communities;
- 19 listed fauna species;
- 16 listed flora species;
- 28 listed migratory species; and
- 2 Ramsar listed wetlands

51. Subsequently, APLNG and the Department identified 21 additional migratory bird species, 4 additional plant species and 1 additional mammal species that required consideration. See *controlling provisions table* (attached to this advice) for the full list of species and ecological communities ('controlling provisions') potentially impacted and brief explanation from analysis of the EIS documentation in relation to why species or communities identified as potentially occurring have been discounted by the proponent as not being impacted by the action.

EPBC listed fauna species

52. The EIS identified 14 terrestrial fauna species listed as threatened under the EPBC Act, known to occur or possibly occur within the gas fields study area (section 23.5.2). Of these 14 fauna species, the EIS recognised two undescribed species of land snail as being known to occur within the gas fields:

- Brigalow Woodland Snail (*Camaenidae* BL13)
- Dulacca Woodland Snail (*Camaenidae* BL12).

53. Both these species are currently under assessment by the Commonwealth government for listing under the EPBC Act as 'critically endangered' and 'endangered' respectively, but as neither species had been listed by the date of the referral decision (3 August 2010), both species are outside the scope of this assessment and have not been considered.

54. The Swift parrot (*Lathamus discolor*) is listed as 'endangered' and is noted in the EIS as occurring or possibly occurring within the gas fields.

55. The remaining eleven terrestrial fauna species are listed as 'vulnerable' under the EPBC Act. Two species, the Brigalow scaly-foot (*Paradelma orientalis*) and Squatter

pigeon (*Geophaps scripta*) were recorded during field surveys. The remaining species have either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area.

56. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (Vol 2, Chapter 23.5.2) and recognises that potential impacts of the gas fields on terrestrial flora and fauna are likely to be primarily associated with habitat loss, degradation, fragmentation, and loss of connectivity due to the physical clearing of vegetation. Mitigation and management measures are proposed to limit these impacts on MNES.

57. The EIS states that there is potential for 'moderate' to 'significant' impacts on the EPBC listed Brigalow Scaly-foot *Paradelma orientalis*, Dunmall's Snake *Furina dunmalli*, Yakka Skink *Egernia rugosa,* and South-eastern Long-eared Bat *Nyctophilus corbeni* in the gasfields and subsequently acknowledges that implementation of the recommended mitigation measures will not adequately ameliorate potential unavoidable impacts for the following EPBC listed fauna species and recommends habitat offsets:

- Brigalow Scaly-foot (*Paradelma orientalis)*
- Dunmall's Snake (*Furina dunmalli)*
- Yakka Skink (*Egernia rugosa)*

58. The EIS also identified one fish species listed as threatened under the EPBC Act, the *Maccullochella peelii* (Murray Cod), as known to be present or predicted to occur within the gas fields study area. Water group advised that they felt the proponent had not adequately addressed the potential impacts to this species. See threatened species section below for consideration of this species.

EPBC listed flora species

59. The Department's ERT tool identified 18 terrestrial flora species as potentially occuring in the project area. Supplementary work identified an additional 4 species for consideration. The EIS identified 16 terrestrial flora species listed as threatened under the EPBC Act, known to be present or potentially present within the gas fields study area (section 23.5.1). Of the 16 species identified, three are listed as 'endangered':

- Herbaceous xerothamnella (*Xerothamnella herbacea*)
- Slender tylophora (*Tylophora linearis*)
- Microcarpaea (*Microcarpaea agonis*).

60. The remaining 13 are listed as 'vulnerable' under the EPBC Act.

61. Five species were recorded during field surveys:

- Chinchilla wattle (*Acacia chinchillensis*)
- Thomby Range wattle (*Acacia wardellii*)
- Gurulmundi fringe myrtle (*Calytrix gurulmundensis*)
- Belson's panic grass (*Homopholis belsonii*)
- Ooline (*Cadellia pentastylis*).

62. The remaining eleven have either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area.

63. On the basis of the proposed pre-clearing scouting surveys, the capacity for minor infrastructure location adjustments and other mitigation measures required by the range environmental management plans and guidelines, the proponent states that no unavoidable direct impacts on these species will result from the gasfield development. Therefore no disturbance to these species is acknowledged and no offsets are recommended by the proponent.

64. The Department acknowledges there remains a low residual risk to threatened flora located within areas of proposed disturbance for installation and operation of infrastructure and has applied a precautionary approach to mitigate these risks. This approach requires the proponent to develop, have approved and apply a rigorous development protocol to avoid unacceptable impacts. The proponent must also develop management plans for all flora species with a residual risk of occuring within proposed infrastructure footprints prior to commencement of gasfield activities.

65. The Department is satisfied that implementing these measures will ensure no unacceptable impacts on threatened flora species as a result of the gas field activities.

EPBC listed migratory species

66. The EIS identified 28 birds listed as migratory under the EPBC Act known to occur or possibly occur within the gas fields study area (section 23.6.1 and Volume 5, Attachment 14). Two of the species were recorded during field surveys:

- Eastern great egret (*Fregata ariel*)
- White-bellied sea-eagle (*Haliaeetus leucogaster*).

67. The remaining 26 species have either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area.

68. Water Group of the Department advised that they considered the proponent had not adequately addressed the potential impacts to migratory bird species. (see threatened species section below for further consideration).

69. The Department has considered the potential impacts (including those listed above) for each threatened species, migratory species and ecological community potentially occurring within the gas field project area. Those species and ecological communities most likely to be impacted are discussed below. The Department concludes that the conditions of the Queensland Coordinator-General's approval, together with recommended conditions set out in this advice in relation to these species and ecological communities will ensure impacts on MNES are acceptable. Among these conditions are measures to ensure rehabilitation of disturbed sites occurs to restore habitat and ecological community connectivity to pre-development status or better.

Wetlands (Ramsar) (ss 16, 17B)

70. The EIS states that the only Ramsar wetlands occurring in the vicinity of the gas fields' development area with potential relevance to the controlling provisions are the Balonne River Floodplain complex, including the Ramsar listed Narran Lakes. The Department's ERT search tool also identified the Shoalwater and Corio Bays area as a wetland requiring consideration. Initial advice from Wetlands Section (attached to this advice) discounted Shoalwater and Corio Bays area from further consideration stating that it was outside the catchment area and therefore would not be impacted. Advice from the Departments Water Group states that the Gwydir Wetlands is also a Ramsar-listed Wetland of international importance and is the closer of the two wetlands to the APLNG project. Water Group advises however, that as it is not hydrologically connected via surface or groundwater systems to the proposed gas fields, there is no evidence that CSG extraction activities will pose a significant threat to the ecological character of the Gwydir Wetlands.

71. Narran Lakes Nature Reserve has an area of 5,531ha and forms part of a large terminal wetland of the Narran River (at the end of the Balonne River) in NSW. It is located approximately 500km downstream of the Project Area. Narran Lakes Nature Reserve is listed as a wetland of international importance under the RAMSAR Convention, and is internationally significant for waterbird breeding and as habitat for species including a number listed under the Japan-Australia and China-Australia Migratory Bird Agreements (JAMBA and CAMBA). It is also listed as a wetland of national importance as a major breeding site for waterbirds. Waterbird breeding is stimulated by inundation of the wetlands and successful breeding is influenced by a number of factors, including inundation area, duration, frequency, timing and depth. Migratory birds are considered separately in the Migratory Species section of this report.

72. Great Artesian Basin spring wetlands also occur on the outer edge of the GAB in Queensland, NSW and South Australia. The *community of native species dependent on natural discharge of groundwater from the Great Artesian Basin* are listed as an endangered community under the EPBC Act 1999 and are discussed in detail elsewhere this report.

Likely Impacts

73. The potential impact mechanisms for the Narran Lakes related to operation and decommissioning phases identified in the EIS include:

- alteration of flow regimes from permeate discharge
- low calcium concentration and /or elevated contaminant concentrations in permeate water discharge
- hydrocarbon, chemical or wastewater contamination from accidental spills
- contamination of watercourses resulting from brine pond overflows.

74. Initial Wetlands Section advice raised concerns regarding the potential for impacts to the Narran Lakes as a result of aquifer drawdown adversely impacting hydrology and reducing the volume of water available to the Narran Lakes. Water Group however, advises that there is little evidence of groundwater flow into Narran Lakes, therefore drawdown in groundwater levels by APLNG CSG activities is not expected to have significant impacts on the ecological character of Narran Lakes.

75. Water Group advises that their main concern regarding potential impacts to the Narran lakes relates to large scale flood events, as seen in late 2010/ early 2011 in this part of southeast Queensland, which could overtop the brine storage basins thereby mobilising salts and associated heavy metals downstream and into the Narran Lakes. Water Group recommends conditioning any approvals to ensure there are no impacts on Ramsar-listed Wetlands of International Importance. The recommended conditions (condition 26) which prohibit a significant impact on the Narran Lakes Wetlands to support this objective.

Mitigation Measures

76. The Coordinator-General notes that APLNG propose a number of mitigation and management strategies for the impacts related to operation of the proposed gas field on MNES. Measures that relate to the protection of Ramsar wetlands include:

- any water discharge to the environment will be suitably treated before release and mixed with natural flows
- design discharges to watercourses to mimic natural flows
- develop and implement water quality, aquatic ecology and geomorphology monitoring programs for treated water discharge.

77. APLNG proposes to treat CSG water by reverse osmosis, to contain brine in engineered water ponds, to dispose treated water by a number of DERM permitted methods, termed “beneficial uses”, with the major initial strategy being to discharge treated waters into suitable watercourses under controlled conditions.

78. The Coordinator-General notes that APLNG has prepared a model for pulsed release of water to the Condamine River, downstream of the Chinchilla Weir as a preferred model for permeates management. Other disposal options are being investigated including acquifer injection, agricultural and commercial uses. The Coordinator-General states in regard to the proposed release of treated CSG water to surface waterways, that the proposed management regime, to consist of ‘pulsed’ discharges of treated water so as to reflect the natural hydrological regime of the receiving waters, is supported.

79. The Coordinator-General has imposed the following conditions which the Department considers will ensure appropriate mitigation and management measures are in place to protect the Narran Lakes from potential impacts resulting from permeate discharges to waterways, including:

80. Condition 4, Part 2, Appendix 2, - requiring each gas field development area environmental management plan include specific Coal Seam Gas Water Management Plans and address the Queensland Government’s policy on Coal Seam Gas Water Management; and DERM Guideline: Approval of coal seam gas water for beneficial use; and

81. Conditions 4 and 7, Part 2, Appendix 2,– regulating discharge to surface waters to ensure consideration of potential ecological impacts (including requirements to identify and minimise the possible adverse bio-physical impacts of releasing treated CSG water into natural watercourse environments, potential adverse outcomes due to altered hydrology and water quality and manage the effects of cumulative discharges).

82. The proponent states in the EIS that there is a low risk of impact to Narran Lakes during operations. Narran Lakes is located approximately 500km downstream of the proposed discharge locations and it is unlikely that significant flows would reach Beardmore Dam, due to transmission losses and agricultural use. The EIS adds that any water that did reach Beardmore Dam would be used to supplement the St George Water Supply Scheme and potentially be available as compensation flows to the Narran Lakes. The proponent concludes that even if flows associated with the gasfields were observed at Narran Lakes it is unlikely these flows would impact the wetland habitat or lifecycle of native species dependant upon the wetland.

83. In relation to mitigating risks associated with the overtopping of brine ponds, the EIS states brine ponds will have appropriate engineering design, management and controls to meet Queensland regulatory requirements for the “significant hazard category” (a classification due to high contaminant concentrations within the brine ponds and large storage volumes).

84. In additional information, the Australia Pacific LNG Saline Effluent Management Plan – Combabula (the SEMP) (attached to this advice), the proponent commits to apply the new DERM Guideline – *Regulated dams in environmental activities*, which provides guidance on the requirements for approval of individual dams to be included in the environmental authority and the related document *Manual for Assessing Hazard Categories and Hydraulic Performance of Dams* (currently in draft form) which gives detailed technical requirements for the design, certification and operation of regulated dams. The manual requires that all regulated dams containing contaminants that could cause material or serious environmental harm must have a storage volume kept available in the pond to contain all inputs to the pond from foreseeable rainfall events in order to contain the contaminants and avoid such harm.

85. The Coordinator-General has included specific approval requirements that will contribute towards mitigating the risk of brine ponds overtopping or becoming inundated in the event of large scale flood events. Conditions have also been set to require that all storages intended to hold raw (untreated) water, partially treated and blended water be considered *regulated storages*, regardless of size and contents, and be designed, constructed, managed, monitored, decommissioned and rehabilitated in a manner that:

- prevents contamination of land and waters
- conforms with best practice environmental management (in this case the best practice environmental management of an activity is defined as the management of the activity to achieve an ongoing minimisation of the activity’s environmental harm through cost-effective measures assessed against the measures currently used nationally and internationally for the activity)
- conforms with appropriate technical guidelines and standards
- meets regulatory requirements (CG’s Condition 9, Part 2, Appendix 2)

86. The Department notes in relation to regulated dams intended for the containment of brine, that the proponent has advised no brine ponds currently in use by APLNG designed and constructed in accordance with the requirements for the significant hazard category of the DERM Guidelines and manuals (and that have been set as requirements for the project under the Coordinator-General’s approval conditions) have failed or overtopped as a result of the major flooding event experienced during December 2010 to January 2011. This has been verified by a joint statement made

by the Queensland Treasurer and Minister for Employment and Economic Development, the Honourable Andrew Fraser and the Queensland Minister for Natural Resources, Mines and Energy and Minister for Trade, the Honourable Stephen Robertson on Friday, 7 January, 2011 (Attached to this advice).

87. The Department is satisfied with the Coordinator general's assessment of potential impacts of the gas field activities on the Narran Lakes Wetlands. The Department is generally satisfied that conditions imposed by the Coordinator-General will mitigate much of the risks to the Narran lakes wetland associated with the gas field activities.

88. The Department notes that the CSG conditions applied to the GLNG and QCLNG projects recommended similar conditions to effectively address much of the remaining risks the gasfield activities pose to the Narran lakes, in particular:

- Condition 43 a) relating to the CSG Water Management Plan, requires that APLNG take all reasonable measures to ensure that CSG water, including extracted groundwater, treated or amended CSG water, and any associated waste water, brine crystals and/or solids generated as a result of treating or amending water have no significant impact on any MNES during or beyond the life of the project;
- Condition 43 b) requires that if any such impacts arise, APLNG must make good such impacts to the satisfaction of the Minister; and
- Condition 49 and 51 relating to the Coal Seam Gas Water Monitoring and Management Plan includes requirements for surface water monitoring, management and response measures.

Conclusions for Wetlands

89. The Coordinator-General noted in his report that the APLNG EIS assessed the proposed impact of the gas fields against the significant impact criteria for Ramsar wetlands, concluding that no significant impacts are predicted given the substantial geographical and hydrological separation (approximately 500 km). The Coordinator-General concurred with this assessment.

90. Based on current information, including the APLNG EIS, supplementary information and subsequent documentation developed by APLNG, advice from Water Group and Wetlands Sections, and the Coordinator-General's assessment, the Department has determined that it is unlikely that operational discharges of permeate into water courses would impact the Narran Lakes wetlands. The Department has also determined that it is unlikely that groundwater drawdown in the gasfields represents any risk to the ecological character of the Narran Lakes Ramsar wetlands.

91. The Department has determined that the risk of unacceptable impacts to the Narran Lakes Wetlands posed by overtopping or inundation of brine ponds have been effectively mitigated by the conditions imposed by the Coordinator-General and by those proposed by the Department. The Department is satisfied that the requirements of the Coordinator-General and the conditions proposed by the Department will ensure no unacceptable impacts on the Narran Lakes Ramsar listed wetlands as a result of this action.

Threatened Species and Ecological Communities (s18 & s18A)

92. The proponent states in the EIS that for many of the listed species and ecological communities identified above, the impacts from the project will be negligible. The proponent has acknowledged impacts for two of the six identified listed threatened ecological communities. The proponent states that 3 of the identified reptile species are likely to be directly impacted. The proponent states that most of the listed flora species potentially present within the project area are either unlikely to occur in areas where gas field development will occur, or are readily identifiable and will wherever possible be avoided through application of ecological constraints mapping, and through the proponent's field development planning.

93. The proponent states that the majority of identified listed fauna and listed migratory species are birds, and in relation to listed threatened bird species are highly mobile and have broad habitat requirements, large home ranges and are sufficiently mobile to avoid development areas with only temporary or minor impacts as a result of construction or operational activities within the gas fields. In relation to listed migratory bird species the EIS suggests that any existing migratory birds resources present within the study area would be used infrequently and on a transitory basis and that wetlands and watercourses important for listed migratory species will largely be avoided through application of ecological constraints mapping, and through application of the proponent's field development planning.

94. The proponent also acknowledges the presence of the listed fish species *Maccullochella peelii* (Murray Cod) as known to be present or predicted to occur within the gas fields study area in the Condamine and Balonne Rivers and their tributaries, however the proponent states that any potential impacts will be temporary and minimised through mitigation and management measures.

APLNG's Impact Assessment Approach for the Gasfields

95. APLNG's impact assessment methodology for the project area has been based on a sensitivity mapping, constraints planning and field impact management approach (that is, overlaying the forecasted gasfield development areas with terrestrial ecology sensitivity constraints mapping layers to determine proposed locations for infrastructure, and then applying the proposed field planning and management protocols to those locations in order to predict where impacts will be unavoidable). (See Vol. 2, Chapter 23.2) Desktop reviews of relevant literature and existing data was undertaken, along with field reconnaissance surveys to identify locations within the study area likely to contain important ecological values of relevance to MNES and to locate suitable sampling points for collection of additional data needed to assess potential impacts.

96. In relation to the location and number of wells required and calculation of resulting impacts, APLNG has based its base case calculations of impacts on MNES in the gas field on the assumption that single vertical drill holes from one drill pad will be employed (using alternative drilling rigs with the capability of drilling on reduced lease sizes) but that in environmentally sensitive locations, the option for drilling multiple wells from a single pad (or other technology) will be considered wherever feasible in order to minimise the footprint and impact of well pads and associated linear infrastructure in the project area (see Vol. 2, Chapter 23, 23.1.2 – Project Description).

Uncertainty in relation to likely Impacts

97. There is a significant degree of uncertainty in relation to the calculation of impacts on MNES as the size of the project area and the staged nature of the gas fields development means the actual physical locations of the infrastructure (wells, pipelines and roads/access tracks etc.) have not yet been determined. Physical impacts on MNES will ultimately be determined as the project area is gradually developed over the life of the project.

98. The methodology for the assessment of impacts has been based on mapping of state vegetation mapping as analogues of EPBC listed communities, with further detailed field surveys within the project area to 'ground truth' desktop mapping. Species habitat has been approached in a similar manner where their habitat is closely linked to state mapping of vegetation or presence of ecological communities. To date the proponent has undertaken sufficient terrestrial flora and fauna surveys and surveys of species habitat (involving a combination of targetted species searches, general habitat assessments and verification of current DERM regional ecosystem mapping) to inform the development of ecological sensitivity mapping for the project area. This in turn has allowed the proponent to identify an ecologically sensitive infrastructure layout, which provides the basis for the impact assessment.

99. The approach taken by the proponent will require further ground truthing via detailed ecological site surveys (field scouting) before decisions are taken on final gas field configuration and siting of infrastructure and before actual impacts can be identified and reconciled against predicted impacts. This further detailed site specific evaluation is proposed to be undertaken progressively over the gasfield project area as part of the 5 year operational field planning regimes.

Mitigation Measures

100. The proponent proposes to mitigate impacts on MNES primarily by avoidance and minimisation of unavoidable actual disturbance based on constraint based planning and a proposed field management protocol, which will include individual site assessments and ecological surveys for detection and further avoidance of identified flora and fauna values through relocation or micro-siting of infrastructure wherever possible and through the development and application of Terrestrial Ecology Habitat Management Guidelines (draft guidelines attached to this advice).

101. The Department has set a disturbance limit for clearing of listed ecological communities and habitat for listed species based on the proponent's maximum predicted unavoidable disturbance. These limits are included in the recommended proposed conditions, to ensure that the proponent operates within its predicted scenario of impact. The Department has also recommended conditions for the proponent to provide offsets appropriately calibrated against these maximum predicted impacts.

102. There are potential groundwater drawdown impacts that relate to listed species dependent on groundwater springs and the ecological community dependent on groundwater discharge from the Great Artesian Basin. The uncertainty of predicted drawdown on aquifers and the related impacts of drawdown has led to recommended approaches for the management of groundwater, including drawdown risk mitigation through re-pressurisation (if specified drawdown threshholds are reached), and monitoring responses, being included in proposed conditions.

103. The Department has considered the potential impacts, including those listed above for each listed species and ecological community potentially occurring within the project area. Only those MNES likely to be impacted are discussed below.

104. The Department concludes that the recommended conditions will ensure impacts on MNES are acceptable. Among these conditions are measures for monitoring and rehabilitation of disturbed sites. The latter is intended to restore habitats and connectivity to pre-development status or better.

Direct Impacts - Ecological Communities (s18 & s18A)

EPBC listed ecological communities

105. The EIS states that the EPBC Act protected matters search tool identified the potential presence of 6 ecological communities within the gas fields area. The EIS stated that the following communities are not confirmed to be present nor considered likely in the gas fields study area:

- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin
- The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin
- White box-yellow box-Blakely's red gum grassy woodland and derived native grassland.

106. Section 7.5 of the Coordinator-General's report discusses potential impacts of groundwater drawdown on springs and associated groundwater-dependent ecosystems. APLNG advised that there is only one recognised spring within APLNG's gas fields' tenements and that field investigations could not identify any evidence of groundwater dependent vegetation at the site. The proponent considers it very unlikely any discharge springs occur within the area of potential drawdown from their CSG activities and that the closest registered discharge springs are at the Eulo springs complex, which is located approximately 500km southwest of the gas fields. The Coordinator-General's report largely concurs with these findings, but the Department is of the view that (as for the other CSG projects) there is a potential for drawdown effects resulting from gas field activities impacting on the GAB springs community (see section below entitled *the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin)*.

107. The EIS identified the following remaining three ecological communities (listed under the EPBC Act as endangered) as present in the gas field study area:

- Brigalow (*Acacia harpophylla dominant and co-dominant*)
- Semi-Evergreen Vine Thicket
- Weeping Myall Woodland

108. The Coordinator-General's report notes that terrestrial ecology sensitivity mapping undertaken as part of the EIS concluded (Vol 2, Chapter 23.3.1) that the most sensitive areas are associated with remnant Brigalow communities and highly sensitive remnant vegetation occurring within Bioregional corridors.

109. The Coordinator-General also notes that the EIS includes an assessment of the proposed clearing for the gas fields against the significant impact criteria for the

threatened ecological communities (Vol 2, Chapter 23.4) and that the result determined no significant impacts are predicted for threatened ecological communities. Although not assessed as significant, the EIS recognises that potential impacts of the gas fields on threatened terrestrial communities are likely to be primarily associated with habitat loss, degradation, fragmentation, isolation and loss of connectivity due to the physical clearing of vegetation.

110. In the supplementary information the proponent states that the recommended mitigation measures can not adequately ameliorate potential unavoidable direct impacts for the *Brigalow (Acacia harpophylla dominant and co-dominant)* ecological community *and the Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions* ecological community and recommends offsets for the residual impacts (see discussion below).

111. The proponent states in supplementary information that Weeping Myall woodland does occur in APLNG tenements in the gasfields, however almost all of the Weeping Myall Woodland is within roadside/stock routes and this ecological community will be avoided (Note: Calculations of actual areas of unavoidable impacts (in hectares) were revised after the EIS was published (these figures were provided supplementary to the EIS). The finalised calculations of impacts on listed threatened species and communities can be found in The Final APLNG offset strategy Q-LNG01-15-EA-0021 attached to this approval).

The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin (GAB)

112. *The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin* (GAB discharge springs) is listed as endangered under the EPBC Act. The Great Artesian Basin (GAB) is a hydrological basin that consists of several interconnected geological basins and spans more than 1.7 million km^2, and underlies approximately one-fifth of the Australian continent. It extends 2,400 km from Cape York in the north to Dubbo in the south (NRW, 2006). At its widest, it is 1,800 km from the Darling Downs to west of Coober Pedy (NRW, 2006).

113. Almost 80 plant and animal species are known to be endemic to the GAB discharge springs, seven are EPBC Act listed threatened species (four animal species, three plant species). One species, the Boggomoss Snail or Dawson Valley Snail (*Adclarkia dawsonensis*) is critically endangered. Groundwater drawdown impacts on relevant listed threatened species are addressed later in this advice.

114. While the connectivity of groundwater sources to spring vents is understood in general terms, the details of the hydrology at individual discharge spring locations is poorly understood. In some cases, the identity of aquifers supplying groundwater to springs is not known with certainty. Drilling of bores since the nineteenth century has created free-flowing artesian bores resulting in aquifer pressure declines. As a consequence spring flows in discharge areas have declined dramatically. Current data indicates that 40 percent of discharge spring complexes have become completely inactive since settlement, with loss of springs resulting from draw-down most severe in the Flinders River, Bourke, Springvale, Barcaldine and Eulo supergroups.

115. *The Recovery Plan for The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin* (February 2010) notes the extraction of CSG as an emerging industry within the GAB. In relation to CSG

extraction the Recovery Plan notes that most of the CSG water associated with gas extraction comes from coal deposits within the confining beds that lie between major water bearing aquifers. These include sequences within the GAB (Walloon Coal Measures) and beneath the GAB (Bowen Basin). The dewatering of coal measures for methane gas extraction in the vicinity of GAB discharge springs (Departmental data – see GAB springs map) in the Springsure supergroup (i.e. North of APLNG's proposed Combabula/Ramyard gas field) is occurring from Bowen Basin sediments that underlie the GAB. While current knowledge indicates they are hydrogeologically isolated from the likely aquifer feeding the springs, there may be some connectivity between GAB aquifers and the sediments containing methane gas and petroleum. The Recovery Plan concludes that there is a clear need to monitor the impacts of these extractive industries on GAB groundwater, and to put in place contingency planning in case available CSG related water extraction limits are too low, to ensure future water allocations preserve spring flow.

116. The EIS states that APLNG's gas fields encompass parts of three river catchment areas, the Condamine-Balonne, Fitzroy and Border Rivers drainage basins. The majority of the gas wells are located within the Condamine-Balonne drainage basin. The north-western portion of the development is adjacent to the Dawson River tributaries and the isolated area of Gilbert Gully is situated within the Border Rivers drainage basin. Tributaries within all three catchments generally experience long periods of low to no flow, and are referred to as ephemeral watercourses. The dominant catchment streams, Condamine River and Dawson River, are similarly affected by climatic conditions, reduced to a series of pools and waterholes during dry periods.

117. The APLNG EIS states that the natural geologic and hydrologic conditions combined with extensive land clearing and inappropriate land management practices, has lead to poor water quality, introduction of weed species, and varying habitat quality and aquatic flora and fauna diversity and acknowledges that the existing natural environment within the study area has been, for the most part, moderately to severely modified as a result.

118. The Coordinator-General's report notes that there are a number of springs on the register located in the Surat North and Surat Management Areas. The register maintains a list of springs for the purpose of implementation of the Water Resource (Great Artesian Basin) Plan 2006.

119. The GAB springs are characterised into twelve 'Supergroups'. Each Supergroup comprises smaller spring groups and spring complexes. The APLNG IES acknowledges that springs and areas of seepage are abundant in the marginal regions of the GAB, particularly in the southern, south-western and northern areas. The EIS acknowledges that 'Groundwater dependant ecosystems' are commonly associated with springs and are classified as ecosystems which have their species composition and their natural ecological processes determined by, and reliant on, groundwater and that 'recharge' springs with high conservation value exist approximately 25km north and northeast of the Roma township. These springs are located within outcropping areas of the Gubberamunda Sandstone. One GAB Spring community is known to occur within the vicinity of the study area and is located 25km north of Roma.

120. APLNG identify numerous high value "recharge" and "discharge" spring complexes, associated with the Hutton Sandstone and Precipice Sandstone units, also occur in proximity to the Taroom and Injune townships, outside the project's development areas. The discharge spring complexes located near the Taroom township are

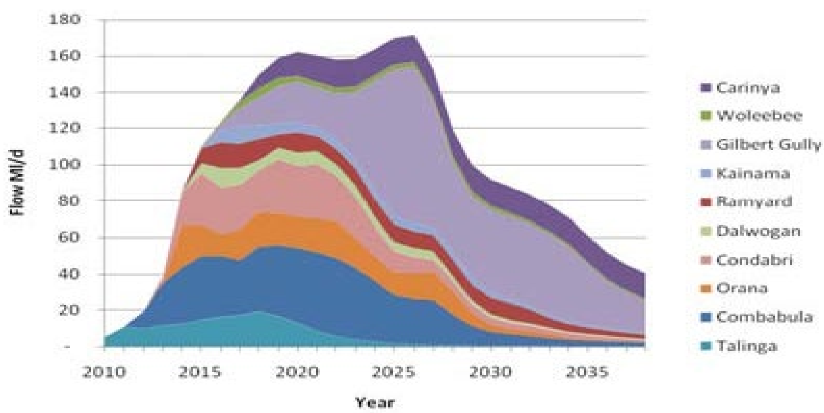
supplied by artesian flow from the Precipice Sandstone, rising to the surface through joints and fractures in that unit. These complexes are known locally as 'boggomosses' (203 vascular plant taxa have been identified in the boggomosses), and provide a wetland habitat in an area that experiences prolonged drought conditions.

121. APLNG advised in it's EIS that there is only one recognised spring within APLNG's gas fields' tenements (and no evidence of groundwater dependent vegetation at the site), and states that the main discharge springs (the Eulo Springs Group) are approximately 500km SW of APLNG project area. In the most recent information presented to the Department by APLNG (the Groundwater Assessment component of the APLNG/DEWHA engagement workshops of 11 August 2010) APLNG confirmed that field investigations had identified only 1 registered "recharge spring" within APLNG leases (which were inspected and assessed July 2010). This spring showed no surface expression or vegetation indicative of groundwater dependent ecosystems.

Likely Impacts

122. The likely impacts of CSG water extraction on GAB discharge springs is dependent on the level of drawdown on a related aquifer and the degree to which that drawdown translates to a pressure head decline reducing the flow to the GAB discharge springs. The species composition associated with each GAB discharge spring and their environmental resilience may also be an important factor. Historical records suggest that if a GAB discharge spring loses significant pressure this can lead to stress on spring dependent species and if a spring becomes inactive as a result of pressure head decline it can reduce the viability of the ecological community component through impact on the species dependent on discharge, in some cases leading to species extinctions.

123. The groundwater modelling and related assumptions establish the predictions of total volumes of groundwater to be extracted and the consequential drawdown impacts. A diagramatic representation of APLNG's maximum water extraction modelling is as follows:



maximum production project scale case (subsequent modelling scenarios indicate a lower level of water production and related drawdown).

124. Geoscience Australia advise that associated groundwater production for APLNG (the project case) is expected to peak at around 170 ML/day, and this is predicted to

occur within the first 20 years. However there remains a high level of uncertainty regarding both the magnitude and timing of this estimate. The *APLNG Associated Water Management Plan* notes that the associated water production profile is fundamentally a function of gas production management and notes that although several pilots have operated throughout the Walloons development, a clear understanding of water production and its subsequent quality is only progressively being developed.

125. APLNG present two numerical hydrogeological simulation models in the EIS – the initial groundwater modelling which provides projections of the groundwater level response in the Walloon Coal Measures and overlying and underlying aquifers as a consequence of associated water production from the Project's gas fields or the 'project-scale' model which predicts impacts for their proposed operations; and the cumulative case or 'cumulative' model, which includes all other existing and proposed CSG developments in the Surat Basin and attempts to account for impacts resulting from multiple CSG operations in the region. The EIS states that some of the initial model parameters are considered conservative. Further refinement of the numerical model is expected to project reduced groundwater level drawdowns.

126. APLNG has provided significantly more comprehensive and detailed modelling in its EIS than the QCLNG or GLNG project EIS. Although noting shortfalls with the data, and the need for further work to establish the uncertainties and sensitivity of the model, Geoscience Australia determined in its advice to the Department that the APLNG 'project scale' model is suitable for estimating hydrogeological impacts on potentially impacted surface and groundwater systems within the influence of APLNG operations.

127. The APLNG groundwater modelling carried out for the EIS projected that during the CSG operational period, the projected radial extent of groundwater level drawdown in the coal seam units is limited to the development areas and nearby proximities, and within 50km of the development area boundaries. Post-production, during the groundwater level recovery phase, the radial extent of the drawdown is projected to broaden to less than 100km beyond the development area boundaries.

128. In summary, the Springbok Sandstone is projected to experience the highest groundwater level drawdown outside the Walloon Coal Measures. On average, the groundwater level drawdown is projected to be less than 15m across the CSG development areas and their proximities. The BMO Grouping and Gubberamunda Sandstone are projected to experience comparatively less drawdown (on average below 3m), but in a localised area may approach between 5m and 8m. The Hutton Sandstone is projected to experience very limited groundwater level drawdown of less than 2m, on average APLNG stated in an advisory agency engagement workshop on water on 26 July 2010, that the magnitude of the drawdown diminishes significantly in shallower aquifers, such that the Condamine Alluvium, which is an important aquifer in the area, should have negligible drawdown.

129. Only limited data is provided on predicted times for natural recharge of the targetted aquifers but this would be expected to extend well beyond the project's life. In a Queensland advisory agency engagement water workshop on 27 July 2010, APLNG provided modelling (based on the maximum project case only) which suggested that the Springbok aquifer might make a substantial recovery (to between perhaps the 3 to 10 meter drawdown level) by 2300, but that a full recharge of the aquifer may take an additional 300 to 1000 years. For the Gubberamunda aquifer with a significantly lower maximum drawdown, recovery to a 5m threshold level was modelled to occur around the year 2100, but again a full recovery was projected not to occur for at

least another 1000 years (a more detailed analysis of the projected drawdowns for the various formations can be found in Vol.2 Gasfields, Chapter 10 Groundwater - of the APLNG EIS).

130. The EIS states that based on conceptual groundwater modelling, the proposed development and operation of the gas field is expected to have a negligible impact on ecosystems, including groundwater dependent ecosystems, and present the view that this evaluation is reinforced by noting that the initial model parameters determining the level of drawdown are considered conservative; and by noting that there have be no groundwater dependent ecosystems identified within the APLNG gas field. APLNG has also assessed that a basin ridge separates the Surat Basin from the Eromanga Basin, which, it is argued, further protects the springs from any impact due to drawdown or changes in water quality.

131. According to its initial ‘project case’ and ‘cumulative case’ numerical groundwater simulation model projections, APLNG determine that associated water production may have the following implications for spring complexes (and their dependent ecosystems) post-CSG operations:

- High-value spring complexes and their associated ecosystems that occur east of the town of Injune - low risk that groundwater levels (and potentially the rate of vertical groundwater flows) will be affected by the APLNG operations.
- High-value spring complexes and their associated ecosystems (“discharge” spring complexes) located near Taroom - not considered by APLNG to be at risk of reduced groundwater levels or vertical flows as a consequence of APLNG operations.
- Spring complexes that occur 25 km north and northeast of Roma in outcropping areas of Gubberamunda Sandstone - not expected to be affected by any reduced groundwater levels that may occur in this area.
- Various spring complexes that may exist approximately 100 km west of Roma are “recharge” springs (pers. comm. R. Fensham, 18 February 2010) and as such APLNG does not expect them to be affected by any reduced groundwater levels that may occur in this area.

132. In his report, the Coordinator-General accepts the proponent’s advice that it considers it very unlikely any discharge springs occur in the area of potential drawdown from their CSG activities, although he found that the full extent of actual impacts requires further investigation. The Coordinator-General does not make any further determinations in regard to quantifying the potential or likely impacts of gas field activities in relation to the GAB discharge springs ecological community.

133. In relation to groundwater and EPBC listed springs, the Department received advice on 17 September 2010 from Geoscience Australia (GA) and Dr M. A. Habermehl. GA and Dr Habermehl advise that the groundwater model predicted drawdown cone of depression associated with the CSG extraction of groundwater has the potential to impact on the aquifer pressure of and groundwater flows from artesian springs that are within the cone of depression from CSG activities. For a period of time post-CSG production, during the recovery phase, the groundwater level drawdown cones in the affected GAB aquifers, whilst reducing in magnitude, are projected to broaden beyond the boundaries of the CSG development areas.

134. APLNG’s groundwater modelling suggests that there is a very low risk that groundwater levels will be affected post-operation, but GA and Dr Habermehl note it is unclear whether this relates strictly to bore water levels, or whether spring levels are included in this assessment. GA and Dr Habermehl further qualify that the

APLNG (and other proponent) hydrological modelling underpins many of their conclusions and that any change to the underlying modelling has the potential to change their assessment. GA and Dr Habermehl advise that the potential impact of CSG development on GAB discharge springs has been generally identified and assessed by proponents in relation to the modelled drawdown and spatial impact zones of groundwater drawdown.

135. GA and Dr Habermehl advise in respect of CSG proponents generally (including APLNG) that:

- the modelling results reported require further work to fully establish the uncertainties and sensitivities of the models to the large predicted drawdown(s) that will occur in the coal measures and hence does not provide a level of confidence in the model outputs and the conclusions drawn from them;
- a number of additional natural discharge sites proximal to the CSG fields may need to be investigated and assessed;
- it is not clear that the measures proposed by each proponent will be adequate to fully address regional scale impacts on EPBC Act values or aquifer interactions; and
- proposed monitoring programs are likely to enable early detection of deleterious changes to groundwater level or quality.

136. Based on the available information and their assessment of it, GA and Dr Habermehl advise in relation to the APLNG proposal that:

- the risk methodology applied by APLNG is appropriate for assessing potential risk to EPBC listed communities.
- against the criteria specified in their risk assessment documentation, GA and Dr M.A. Habermehl agree with APLNG's determination that there is a high risk of impact to EPBC communities as a result of pipeline and road construction in proximity to the Cockatoo Creek springs (this matter has been assessed as part of the APLNG Pipeline referral 2009/4976); and a low risk of potential impact associated with aquifer drawdown during the operation and decommissioning phases (these conclusions are based primarily on the relative proximity of CSG activities and modelled groundwater drawdown effects to known spring communities).
- a number of surveyed and unsurveyed natural groundwater discharge sites (springs) proximal to the APLNG CSG fields (figure 2.1-2 of the GA and Dr Habermehl report dated 17 September 2010, (attached to this advice) require assessment to determine their EPBC Act status and significance. This includes those springs north of Roma APLNG have agreed to investigate (Six Mile and Spring Ridge); investigations of the springs east of Taroom (Cockatoo Creek) in order to inform a revised route for the pipeline; and further investigation of the spring north of the Pine Hill's development (Scott's Creek)
- outcomes of the surveys and investigations could provide input to the groundwater monitoring and management processes proposed by APLNG to ensure the baseline datasets are robust and complete;
- given the uncertainties in the extent of modelled groundwater drawdown the proposed adaptive management approach for groundwater monitoring and mitigation proposed require further elaboration regarding how trigger levels will be acted upon to mitigate changes to groundwater flow or quality in spring to provide confidence that critical impacts on springs can be mitigated (GA propose additional monitoring bores in the Springbok Sandstone between Miles and Surat); and

- controls on the location and construction of infrastructure would avoid physical impacts on environments suitable for hosting EPBC Act listed ecological communities.

137. While the potential impacts on GAB discharge springs is generally considered to be low, based on the predictive modelling to date and from a regional perspective, there is uncertainty and therefore a greater risk of potential long term impacts. GA and Dr Habermehl however have noted that the groundwater flow into depressurised coal seam measures from adjacent aquifers would reverse in time although this would be decades to centuries, depending on the specific aquifer and the management strategies applied.

138. GA and Dr Dr Habermehl also note that further models are being developed by APLNG (and other proponents) with information in the form of hydrological datasets which will enable a more comprehensive assessment of the proposed CSG extraction activities on groundwater resources and related impacts on MNES, particularly at a regional scale.

139. The Queensland Coordinator-General required Santos and QGC to prepare a groundwater impact assessment report, to be provided to DERM as a component of the Environmental Management Plan with applications for environmental authorities with a range of inclusions that related to GAB discharge spring communities. The Queensland Government has recently made revisions to legislation governing underground water management. The existing provisions relating to underground water management are being relocated from the Petroleum Act 1923 and the P&G Act (Petroleum legislation) to the Water Act 2000. The provisions of the Water Act 2000 are also be expanded to provide for the Queensland Water Commission (QWC) to manage groundwater monitoring and develop regional groundwater models for declared cumulative management areas.

140. These changes came into effect after the Coordinator-General's approvals for the QCLNG and GLNG projects. This means that APLNG has not been conditioned by the Coordinator-General to prepare a groundwater impact assessment report (as Santos and QGC were). Instead, a comprehensive regional model on the cumulative groundwater impacts of APLNG and other proponents CSG activities is now to be developed by the Queensland Water Commission, with a requirement for CSG producers to fund the operations of the QWC through an annual levy, and to provide information as required.

141. Under the proposed arrangements a petroleum tenure holder will have an obligation to develop and implement a monitoring strategy. If the proponent is in a Cumulative Management Area the monitoring strategy will be developed by the QWC. It is also proposed that the QWC will also identify specific monitoring obligations for individual tenure holders. Until the QWC's role in ground water modelling is operational, the Coordinator-General will receive ground water monitoring reports relevant to gas field development proposals.

Mitigation measures

142. Under the revised Queensland Government's arrangements from August 2010 to protect groundwater resources in CSG extraction areas (outlined in the DERM information sheet *New arrangements to protect groundwater resources in coal seam gas extraction areas*) APLNG will be required to apply the trigger thresholds values for impacts on bores of a 5 m drop for consolidated aquifer such as in sandstone,

and 2 m drop for shallow aquifers, and a 0.2 drop for springs. These trigger thresholds are set under the *Water Act 2000* (Qld).

143. The Coordinator-General states that under this regulatory framework for managing groundwater impacts, proponents will have an obligation to undertake an assessment of all springs within an area of likely to have a 0.2m drawdown, and accordingly propose and implement a strategy to minimise or mitigate impacts on these springs. The new regulatory framework provides for a risk-based adaptive management approach to spring impact management and may also be of benefit for monitoring impacts on GAB discharge springs.

144. GA and Dr Habermehl note that the monitoring and mitigation strategies proposed by APLNG are based on the principles of adaptive management. The main advantage of this approach is seen by APLNG to be the ability to utilise new groundwater quality and quantity knowledge generated in the region to update the conceptual hydrogeological model and associated numerical groundwater flow simulation model and adapt CSG operations and associated water management decisions accordingly (EIS Vol. 5, Attachment 21).

145. Although the likelihood of potential impacts of CSG development on GAB discharge springs has been determined by the proponent to be low, the consequences of those risks are considered by the Department to be high for this ecological community. Any adverse impacts could be difficult or impossible to remediate. In order to mitigate the risk of long term impacts occurring, the Department proposes a precautionary approach that takes into account the GA and Dr Habermehl's advice relating to groundwater extraction. The Department's recommended approach includes the requirement that, prior to commencement, the proponent re-appraise the regional presence of GAB discharge springs using an appropriately refined regional model to predict the CSG water extraction hydrological impact zone based on more recent cumulative impact assessment and regional modelling.

146. While APLNG has previously assessed spring communities in its EIS and supplementary information and described the aquatic environmental values of creeks and artesian springs in the CSG gas fields, GA recommends further assessment of these communities where there is any ambiguity about the type of spring and the associated ecological values and where there is a potential for drawdown effects to impact on springs from APLNG gasfield activities. The Department has recommended proposed conditions to ensure field spring surveys are undertaken that will confirm the characteristic of each spring or spring complex.

147. If GAB discharge springs are located within identified drawdown impact zones, or a refined hydrological impact zone from the APLNG tenements, then the Department proposes that the proponent be required to take measures to exclude activities from the vicinity and prepare a management plan and monitoring program. In the absence of a refined hydrogeological impact zone the Department has nominated a 100km radius from the proponent's predicted drawdown impact zone as a precautionary approach (see EPBC GAB Springs map attached to this advice) . If GAB discharge springs are located within this area the proponent must develop a range of response measures for approval and implementation should the monitoring determine that there is a risk to the identified component of the GAB discharge spring ecological community.

148. Further the Department has considered the advice from GA and Dr Habermehl in terms of trialling, and if feasible as a protection measure, undertaking reinjection (or other repressurisation methods) of appropriately treated associated water into

suitable permeable aquifers as a means to mitigate regional and long term drawdown impacts from gas field water extraction as a precaution against potential impacts on GAB discharge springs. This is particularly relevant as a mitigation measure considering the large volumes of water to be extracted from the project area, the uncertainties associated with groundwater management, and the long term nature of natural recharge. The duration of the proposed term of approval for the action is relatively short when compared the expected natural recharge, which may be longer when refined cumulative and regional modelling is completed.

149. The Department proposes that the monitoring and management be addressed in a *CSG water monitoring and management plan* which would require Ministerial approval before commencement of CSG extraction for production.

Conclusions for GAB discharge springs

150. Based on current information available, including the APLNG EIS, supplementary documentation developed by APLNG, and advice from Water Group, GA and Dr Habermehl, the Department considers the likelihood of impacts on the GAB discharge springs due to groundwater extraction and groundwater drawdown associated with APLNG activities to be low but uncertain. The Department also recognises that the consequences for this ecological community from regional scale drawdown are high, particularly given the long timeframes for natural recharge to occur.

151. The Department notes that based on its assessment the potential impacts to MNES resulting from the APLNG CSG project are in nature and extent, comparable with those identified for the Santos GLNG project and the British Gas QCLNG project. As such, the Departments recommends that an appropriately similar conditioning approach be applied.

152. Based on the advice from GA and Dr Habermehl relating to groundwater impacts regionally, the proposed conditions adopt a precautionary approach. The Department recommends proposed conditions that include:
- review to confirm the presence, condition, and status of springs within the predicted drawdown impact zone from APLNG Tenements, or a revised hydrological impact zone based on more recent cumulative impact modelling of the APLNG and other CSG tenements.
- include the spring complexes approximately 25km north and north-east of Roma, 50km north and north-west of Roma (including Six mile and Spring Ridge), and 100km west of Roma; and the units east of the Taroom and Injune townships including Lucky Last, Scotts Creek, Dawson River 8 and Cockatoo Creek spring complexes in the review;
- the proponent developing a management plan and actions to protect GAB discharge springs from physical disturbance within the project area;
- the proponent developing a comprehensive CSG water monitoring and management plan for approval, which has the objective of ensuring a regime of modelling, monitoring, trigger levels for action, and trialling and corrective actions to address the regional nature of the problem, the likelihood of cumulative impacts, and the potential for an unknown risk but potentially high consequence of impact on GAB discharge springs;
- further actions from APLNG to ensure no adverse impacts on GAB discharge springs or broader regional landscape impacts occur if any unexpected impacts are detected; and
- trials and development of measures for re-injection of appropriately treated associated water into relevant permeable aquifers to either directly, or indirectly

reverse drawdown impacts from CSG proponents and other groundwater users. This could include providing useable water for groundwater users that would otherwise be impacting on the GAB related aquifers, or directly contributing to the recharge of aquifers linked to the Great Artesian Basin.

153. The recommended conditioning relating to review, monitoring and protection of GAB discharge springs would need to be conditioned on the proponent, but in practice it could be applied as a proportionally based financial contribution from all CSG proponents that could be directed towards monitoring and management implemented through an independent third party.

Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community (hereafter Brigalow ecological community)

154. In its EIS (Volume 2 Chapter 23) APLNG state that gas field activities are likely to impact on 70 hectares of the Brigalow ecological community. With the possible exception of a very limited number of patches located within state forest, much of the Brigalow within the study are has been highly disturbed and is in poor condition due primarily to the invasion of Buffel Grass. APLNG state that given the fragmented and degraded nature of Brigalow communities within the study area, and the fact that minimal clearing is proposed at the project scale, it is unlikely that the proposed action will result in a significant impact on this community. Offsets are proposed to compensate for the unavoidable loss of up to 70 hectares and sites will be chosen to enhance connectivity of remnant vegetation communities across the local landscape. APLNG proposes restrictions to clearing outside of already disturbed areas. Habitat management guidelines for works within 200 meters of these areas will be developed. APLNG's Environmental Offset Strategy (attached to this advice) revises the impact on Brigalow ecological communities to 75.41 hectares.

155. The Coordinator-General concurs with the conclusions of APLNG that proposed clearing and other activities associated with the gas fields will not result in a significant impact to EPBC-listed threatened species and ecological communities. The Coordinator-General imposed conditions (Appendix 2, Part 2, Condition 1) that gas field development planning must recognise and avoid, where practical environmentally sensitive areas and threatened species therefore minimising impacts on EPBC-listed threatened species and ecological communities. The Coordinator-General has also imposed conditions to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced.

Conclusions for Brigalow ecological community

156. The Department agrees with the conclusions of the Coordinator-General, however does not agree that offsets should be considered in the determination of a likely significant impact of the project itself. Provided that disturbance limits are imposed and offset requirements conditioned, the Department is confident that impacts will be acceptable. The proposed conditions therefore require the proponent to offset 888.9 hectares to compensate for the unavoidable impacts to the Brigalow ecological community as a result of gas field and pipeline activities (this proposed offset accounts for maximum impacts to the Brigalow ecological community, as well as impacts to the habitat of various listed species for which Brigalow provides suitable habitat).

157. Proposed conditions also limit disturbance to a maximum of 75.41 hectares. Because of the relatively small amounts of clearing resulting from pipeline activities (EPBC 2009/4976), the proposed offset requirements (which, in line with the other approved CSG projects, applies a 10 times offset ratio for the Brigalow ecological community) also includes offset requirements for the Brigalow impacts of 13.48 ha within the pipeline referral. These impacts have been incorporated into this proposed approval in order to promote better environmental outcomes, as it is anticipated that the proponent will secure larger offset areas, selected strategically in accordance with the criteria outlined in the APLNG Offset Strategy (attached to this advice) to improve regional habitat connectivity. This approach will also simplify compliance with the Department's approval requirements and rationalise post approval processes. The proposed conditions require Brigalow ecological community offsets to comprise 30% remnant Brigalow (Acacia *harpophylla* dominant or co-dominant) and a 70% combination of high value Brigalow regrowth and other Brigalow regrowth that has potential to be restored to remnant Brigalow status. Based on available information and the Coordinator-General's assessment, the Department is confident that impacts to Brigalow ecological communities will be not be unacceptable provided there is compliance with the disturbance limits and offsets requirements of these proposed conditions.

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (SEVT)

158. In its EIS, the proponent states that this ecological community has been substantially reduced from its former range. As a result of clearing, this community generally occurs as fragmented patch sizes of less than 100 hectares. As a result of their small size, these patches are subject to further degradation and decline from such threatening processes as clearing, inappropriate fire regimes, grazing and weed invasion.

159. The proponent estimates that there is approximately 3,600 hectares of the community across the gas fields study area with the potential for up to 13 hectares impacted from gas fields activity (subsequently revised down to 4.36 hectares as a result of infrastructure relocation and by exercising other avoidance opportunities in the Environmental Offsets Strategy attached to this advice). The Coordinator-General concurs with the conclusions of APLNG that no significant impact on SEVT will result from gas field activities. The Coordinator-General imposed conditions (Appendix 2, Part 2, Condition 1) that gas field development planning must recognise and avoid, where practical environmentally sensitive areas and threatened species therefore minimising impacts on EPBC-listed threatened species and ecological communities. Provided that disturbance limits are imposed and specific offset requirements conditioned, the Department is confident that impacts will not be unacceptable.

160. The Department has therefore proposed conditions that require the proponent to develop an Offset Plan that provides for a 37.84 hectare offset to compensate for the unavoidable impact to this community. Because of the relatively small amounts of clearing resulting from pipeline activities (EPBC 2009/4976), this offset requirement also addresses the offset requirements for the 0.37 ha impacts to the ecological community resulting from pipeline activities (An offset ratio of 8 times was applied to determine the offset requirements for SEVT, which is consistent with the multiplier applied to this community for previous CSG projects). This simplifies the Department's requirements and will promote better environmental outcomes, as it is anticipated that the proponent will secure larger offset areas, strategically acquired

to improve habitat connectivity. The proposed conditions also limit disturbance to a maximum of 4.36 hectares. Disturbance in excess of this figure is not covered by this approval and would (if a significant impact), require separate referral.

Conclusions for SEVT

161. Based on available information and the Coordinator-General's assessment, the Department is confident that impacts to this ecological community will not be unacceptable, provided the proponent complies with the proposed disturbance limits and offset requirements.

Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin

162. The *Natural Grasslands of the Queensland Central Highlands and the Northern Fitzroy Basin* ecological community are native grasslands typically composed of perennial native grasses. The ecological community is found on soils that are fine textured (often cracking clays) derived from either basalt or fine-grained sedimentary rocks, on flat or gently undulating rises. These grasslands occur in areas with relatively high summer rainfall and a tree canopy usually absent, but when present projective crown cover is no more than 10%.

163. The ecological community occurs entirely within an area extending from Collinsville in the north to Carnarvon National Park in the south. This ecological community occurs within the Brigalow Belt North and Brigalow Belt South Bioregions and within the Fitzroy Basin, Burdekin, South West Qld, Border Rivers Maranoa-Balonne and Desert Channels Natural Resource Management Regions.

164. The proponent has not stated any anticipated impact on this ecological community. Although the Coordinator-General's assessment concludes that no EPBC listed ecological communities will be significantly impacted by the gas field activities, the Department recommends a precautionary approach. The Department has therefore specified a zero disturbance limit.

Conclusions for Natural Grasslands

165. The Department has recommended proposed conditions that include a zero disturbance limit for the Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin ecological community. If this approach is applied, it becomes a condition of the approval (and the proponent's responsibility) to ensure no disturbance to any area of this ecological community as a result of gas field activities. Based on the available information and the Coordinator-General's assessment the Department is confident that impacts to this ecological community will be acceptable provided there is compliance with the disturbance limits specified in these proposed conditions.

Weeping Myall Woodlands

166. In its EIS, APLNG state that as this community occurs on arable land, much of its former range has been cleared for cropping, or significantly modified by grazing. Most areas remaining in good condition are in little-grazed, uncropped sites such as road reserves, stock routes and reserves. Areas of structurally intact woodland tend to be relatively small and exist in a matrix of agricultural development with poor

landscape connectivity. Within the study area, this ecological community potentially occurs within Queensland Regional Ecosystem 11.3.2. Field surveys undertaken for the EIS recorded 30 hectares within the study area, the majority of which is within roadside reserves. APLNG state that there is a potential loss of up to 129 hectares of suitable habitat, which equates to 0.9% of the study area extent, and 0.1% of the relevant provincial extent.

167. In correspondence between APLNG and the Department, APLNG confirms that although Weeping Myall woodland does occur in APLNG tenements in the gas fields almost all of the Weeping Myall woodland is within roadsides and stock routes and as such will be completely avoided.

Conclusions for Natural Grasslands

168. Proposed conditions include a zero disturbance limit, meaning the proponent cannot disturb this ecological community without submitting a separate referral for assessment. The Department is confident that these measures will ensure no impact to this ecological community.

Threatened Species (s18 & s18A)

169. Based on an assessment of existing terrestrial ecological values, APLNG identified EPBC listed threatened flora and fauna species known from or likely to be found within the gas fields study area. The proposed conditions require the proponent to develop management plans for those species likely to be encountered in the gas fields study area but where the impacts are uncertain. These species are listed in the tables within the proposed conditions. The majority of species identified by the proponent and the Departments Environment Reporting Tool are unlikely to be impacted by gas field activities, although they may exist within the study area. Impacts on these species are assessed in the ‘controlling provisions’ table attached to this advice. It is likely that gas field activities will impact on:

- *Paradelma orientalis* (Brigalow Scaly-foot) habitat;
- *Furina dunmalli* (Dunmall’s Snake) habitat;
- *Egernia rugosa* (Yakka Skink) habitat.

170. The impacts from gas field activities on these species are discussed below.

Fauna Habitat Calculations for the Gas Fields

171. In November 2010, APLNG provided the Department with the document ‘*Fauna Habitat Calculations for the Gas Fields’* (attached to this advice). This document explains the APLNG methodology for calculating potential impacts from gas field activities on three, difficult to locate threatened species - the Yakka Skink (*Egernia rugosa*), Brigalow Scaly-foot (*Paradelma orientalis*) and Dunmall’s Snake (Furina dunmalli). These species require a different method to assess potential impacts because they are cryptic or secretive and are difficult to detect, even with targeted surveys. For the majority of threatened species potentially impacted by gas field activities, surveys have been or will be undertaken prior to disturbance to determine presence. For those species likely to be encountered during gas field activities but where an impact cannot be reliably calculated, the Department’s proposed

conditions require management plans to be approved and implemented prior to commencement in order to mitigate any risks associated with non detection.

172. Calculating the direct impact habitat offset requirements for the project, requires quantification of areas of habitat to be impacted (lost/disturbed) for each of the target species in the gas fields. Estimates of vegetation loss associated with the Project were calculated using regional ecosystem mapping. Initial calculations of potential habitat loss for individual listed species were calculated based on the broad habitat preferences of the target species being matched to the occurrence of individual regional ecosystems which represent known habitat for that species (or for plants, regional ecosytems in which the species is known to occur). Regional Ecosystems are a repeated combination of vegetation, geology and landform that occur at a landscape scale.

173. In recognition that threatened species are typically patchily distributed throughout the landscape, not all areas of potential habitat will contain the target species, and at the regional ecosystem level, not all patches should be considered of equal value. Some species will only be present where microhabitat elements such as rock outcrops or woody debris occur. The distribution of microhabitat elements can vary greatly within regional ecosystems. The report estimated potential unavoidable impacts for each of the target species in the gas fields based on the proportion of potential habitat impacted which is actually suitable for those species, rather than the presence of potential habitat indicated by broad scale mapping of regional ecosystems.

174. Field data from 214 sample sites was reviewed to determine the proportion (percentage) of all habitat assessment sites which were considered to be either of low (1-2), moderate (3-4) or good quality habitat (5), using overall habitat rankings, for each of the target species. Survey sites which are ranked as 1-4 overall lacked some essential microhabitat elements or were considered sub-optimal for the target species by observers in the field. Whereas, sites ranked 5 overall were considered good quality habitats for the target species. Species presence was assumed at those sites ranked 5. The table below shows the percentage of potential habitat in each overall habitat ranking band. To calculate the area of potentially suitable habitat for each target species the total area of each impacted RE was multiplied by the percentage of potential habitat for each species. The results of this impact assessment reflect the estimated impact on each target species across the entire gas field project area. The estimated impacts to each target species are:

- 703.84 hectares of *Paradelma orientalis* (Brigalow Scaly-foot) habitat*;
- 238.63 hectares of *Furina dunmalli* (Dunmall's Snake) habitat*;
- 66.77 hectares of *Egernia rugosa* (Yakka Skink) habitat*.

*Note: For the habitat impacted above, APLNG calculations assume species presence.

Approach to calculating offsets for the *Egernia rugosa* (Yakka Skink), *Paradelma orientalis* (Brigalow Scaly-foot) and *Furina dunmalli* (Dunmall's Snake)

175. Consistent with the approval decisions made for the British Gas/QGC and Santos CSG projects, the Department has applied a 1:1 ratio for calculating habitat offsets for Brigalow reptiles. Given the cryptic nature of these species, quantifying an impact on individuals, or important populations is difficult. Even pre-targeted surveys often fail to detect individuals from locations in which they are known to occur. The proponent has therefore applied what they consider a precautionary approach to

calculate impact on these species, by following the steps described above. On the basis that this approach assumes presence, where good quality (rank 5) habitat exists, the Department is confident that an offset ratio of 1:1 will compensate for the unavoidable impacts on these species. The proposed conditions require that the proponent's offsets must be of equal or greater habitat value (at least rank 5) for each cryptic Brigalow reptile.

Egernia rugosa **(Yakka skink)**

176. The Yakka Skink is a robust skink growing to an average length of 40 cm making it one of the largest lizards in the region. It is an extremely secretive species that hides under rocks, in hollow logs or ground vegetation, or in burrow systems. Presence is often indicated by a pile of droppings near shelter sites. It is usually found in open dry sclerophyll forest or woodland and core habitat of this species is within the Mulga Lands and Brigalow Belt South Bioregions. The main threat to the Yakka Skink is habitat reduction and degradation. In particular, the Brigalow ecological communities have been severely modified and are poorly reserved and have declined to approximately 10% of their former area.

177. In the 'Fauna Habitat Calculations for the Gas Fields' report, APLNG clearly document the estimated impact to this species as a result of gas field activities. They estimate that gas field activities will impact on 66.77 hectares of habitat where the species is assumed to be present. The Coordinator-General concurs with the conclusions of APLNG that no significant impact on EPBC-listed species will result from gas field activities. The Coordinator-General imposed conditions (Appendix 2, Part 2, Condition 1) that gas field development planning must recognise and avoid, where practical environmentally sensitive areas and threatened species therefore minimising impacts on EPBC-listed threatened species and ecological communities. Conditions (Appendix 1, Part 1, Condition 7) also require the proponent to develop a *Significant Species Management Plan* for all threatened species potentially impacted by the Project.

178. The Department has proposed conditions that limit disturbance to 66.77 hectares. Proposed conditions also require the proponent to offset 66.77 hectares of good quality habitat (equivalent to habitat rank 5 as described in the '*Fauna Habitat Calculations for the Gas Fields report'*).

Conclusions for Yacka Skink

179. Based on available information and the Coordinator-General's assessment, the Department is confident that the impacts on the Yakka Skink will be acceptable, provided the proponent complies with the disturbance limits and offset requirements proposed in these conditions.

Paradelma orientalis **(Brigalow Scaly-foot) and** ***Furina dunmalli*** **(Dunmall's snake)**

180. The Brigalow Scaly-foot occurs in the Brigalow Belt Bioregion in south-central Queensland. Its range extends from Nebo in the north, Boyne Island in the east, Wyaga (NSW) in the south and Ulcanbah Station and Idalia National Park (NP) in the west. This species is found in a wide variety of open forest habitats on a number of soil types and has been found in cultivated areas, suggesting some resilience to clearing.

181. Dunmall's snake is a robust, shiny snake with small dark eyes and little or no pattern that may reach a total length of about 60 centimetres. It is very rare or secretive with limited records existing. Its range is largely restricted to the Brigalow Belt Bioregion. It has been recorded from Brigalow (*Acacia harpophylla*), bulloak (*Allocasuarina luehmannii*) and white cypress pine (*Callitris glaucophylla*) forest and woodland over black cracking clays, clay loam and sandy soils. This species has declined dramatically and is considered to be of particular conservation significance. Key threats to both species are similar to the Yakka Skink with the drainage of swamps an additional threat for Dunmall's Snake.

182. In the 'Fauna Habitat Calculations for the Gas Fields' report, APLNG state that gas field activities are likely to impact on 703.84 hectares of suitable habitat for the Brigalow Scaly-foot and 238.63 hectares of suitable habitat for Dunmall's Snake. These calculations assume the species is present. APLNG states that impacts on this species will be acceptable, provided mitigation measures and offset requirements are proposed. The Coordinator-General concurs with the conclusions of APLNG that no significant impact on EPBC-listed species will result from gas field activities. The Coordinator-General imposed conditions (Appendix 2, Part 2, Condition 1) that gas field development planning must recognise and avoid, where practical environmentally sensitive areas and threatened species therefore minimising impacts on EPBC-listed threatened species and ecological communities. Conditions (Appendix 1, Part 1, Condition 7) also require the proponent to develop a Significant Species Management Plan for all threatened species potentially impacted by the Project.

183. The Department has proposed conditions that limit disturbance to 703.84 and 238.63 hectares for the Brigalow Scaly-foot and Dunmall's Snake respectively. Proposed conditions also require the proponent to offset 703.84 hectares of good quality Brigalow Scaly-foot habitat and 238.63 hectares of Dunmall's Snake good quality habitat. Good quality habitat is habitat equivalent to rank 5 as described in the 'Fauna Habitat Calculations for the Gas Fields report'.

Conclusion for Brigalow Scaly Foot and Dunmall's Snake

184. Based on available information and the Coordinator-General's assessment, the Department is confident that the impacts on the Brigalow Scaly-foot and Dunmall's Snake will be acceptable, provided the proponent complies with the disturbance limits and offset requirements proposed in these conditions.

Maccullochella peelii (Murray Cod)

185. The EIS also identified one aquatic fauna species listed as threatened under the EPBC Act, *Maccullochella peelii* (Murray Cod), as known to be present or predicted to occur within the gas fields study area in the Condamine and Balonne Rivers and their tributaries (Vol 2, Chapter 23.5.3). An aquatic ecology, water quality and geomorphology assessment was undertaken in order to assess the potential impacts of the gas fields area on the Murray Cod (EIS Volume 5, Attachment 14).

186. The assessment concluded that there is a low risk of impact to Murray Cod during construction and/or operation of the gas fields, but recognises that potential impacts of the gas fields on the Murray Cod could be associated with increased sediment delivery to waterways during construction, damming of perennial watercourses during crossing construction, and increased baseflows. These impacts are

considered temporary and mitigation and management measures have been proposed to limit these impacts on MNES. Supplementary information states that the residual potential impact to the species is low because the species has a natural tolerance to high levels of suspended sediment and their main food resources - frogs, small fish and crayfish, are unlikely to be impacted by elevated flows.

187. Section 7.4.3 of the Coordinator-General's report outlines the proponent's proposed CSG water management strategy which includes a range of 'beneficial use' options such as discharge to surface waters including the potential release of large volumes of water into intermittent rivers such as the Condamine River through 'pulsed' discharges of treated water so as to reflect the natural hydrological regime of the receiving waters; irrigation and aquifer injection.

188. The Coordinator-General has imposed conditions (including Appendix 2, Part 2, Conditions 4 and 7) to ensure consideration of potential ecological impacts (including the effects of cumulative discharges) on aquatic habitat including native fish breeding and feeding areas, potential for erosion and disturbance of riverine vegetation.

Conclusion for Murray Cod

189. Based on available information and the Coordinator-General's assessment the Department is confident that the impacts on the Murray Cod will not be unacceptable, provided the proponent complies with the Coordinator-General's requirements.

Eriocaulon carsonii (Salt pipewort) and *Adclarkia dawsonensis* (Boggomoss Snail)

190. Reduced artesian pressures caused by extraction of artesian groundwater from bores has been identified as a serious problem in the GAB, and which affects other bores, natural springs and their environmental values, and species dependent on emerging groundwater.

191. APLNG EIS states that no springs that qualify as this threatened ecological community occur within the gas fields. The one GAB Spring community known to occur within the vicinity of the study area is located 25km north of Roma. APLNG acknowledges that these communities may include *Eriocaulon carsonii* (Salt Pipewort) endangered under the EPBC Act. This species require actively flowing artesian water for survival. GA advise that there are is only one natural discharge spring within the CSG fields or the modelled zones of groundwater drawdown.

192. APLNG states in its EIS that the potential impacts associated with groundwater drawdown from well watering on GAB springs or their associated dependent ecology were assessed to be low. However, APLNG committed in it's EIS to undertake further investigation of the spring complex located 25km north of the gas fields to verify that there are no 'discharge' springs in this area and assess existing condition of known recharge springs.

193. APLNG did not identify any potential for the presence of the critically endangered *Adclarkia dawsonensis* (Boggomoss Snail) in the CSG fields or the study area in the EIS. In relation to impacts on any populations present as part of those ecological communities likely to occur approximately 80-100km to the north east of APLNG's Combabula, Ramyard and Woleebee CSG field, APLNG state that the high-value

spring complexes and their associated ecosystems ('discharge' spring complexes), including the boggomosses' located near Taroom were not considered to be at risk of reduced groundwater levels or vertical flows as a consequence of APLNG operations.

194. On the basis of the available documentation, Geoscience Australia and Dr M.A. Habermehl consider that the majority of risks of significant impacts to the GAB and other affected surface and groundwater systems have been adequately identified and assessed. However, there are several identified springs (communities) within and in close proximity to their tenements for which the risk has been inadequately assessed. This includes the 'Six Mile and Spring Ridge springs north of Roma, the Cockatoo Creek springs east of Taroom and the Scott's Creek spring north of the Pine Hills development

195. The proponent's conclusions, as with the risk assessments themselves, are based primarily on the relative proximity of CSG activities and modelled groundwater drawdown effects to possible spring communities. GA and Dr Habermehl note that any variation in the groundwater simulation model predicted lateral and vertical extent of groundwater drawdown, resulting from uncertainties in the modelling, could alter the consequence and hence risk rankings.

Mitigation measures

196. The Department considers potential groundwater drawdown impacts that relate to listed species dependent on groundwater springs, and the ecological community dependent on groundwater discharge from the Great Artesian Basin, are uncertain and need to be reviewed for presence and status, and monitored for cumulative and regional impacts. If GAB discharge springs are located within the an identified drawdown impact zones, or a refined hydrological impact zone from the APLNG tenements, then the Department proposes that the proponent be required to take measures to exclude activities from the vicinity and prepare a management plan and monitoring program.

197. In the absence of a refined hydrogeological impact zone the Department has nominated a 100km radius from the proponent's predicted drawdown impact zone as a precautionary approach. If GAB discharge springs are located within this area the proponent must develop a range of response measures for approval and implementation should the monitoring determine that there is a risk to the identified component of the GAB discharge spring ecological community.

198. The uncertainty of predicted drawdown on aquifers and the related impacts of drawdown has led to recommended approaches for the management of groundwater, including drawdown risk mitigation through reinjection, and monitoring responses, being included in proposed conditions.

Conclusion for Salt Pipewort and Boggomoss Snail

199. Based on the information presented in the APLNG EIS and subsequent information provided by the proponent, the Department concludes that listed threatened species or ecological communities other than those assessed in detail by the proponent may be present in the APLNG gas field but these will not be unacceptably impacted by infrastructure development. As a precautionary approach the Department has recommended conditions that, should additional species or an ecological community be found by the proponent within the gas field through ecological surveys or otherwise, that the proponent would be required to develop a management plan for

the species or ecological community to inform the proponent's future field development activities, ongoing management, and decommissioning.

200. Based on current information available, including the APLNG EIS and advice from GA and Dr Habermehl, the Department considers the likelihood of impacts on the groundwater dependent listed species due to groundwater extraction and groundwater drawdown associated with APLNG activities to be low. However, the Department also recognises that the consequences for these species are potentially high if the drawdown impact zone is more extensive than predicted by the proponent, particularly given the regional scale of impact and the long timeframes (decade to centuries) for natural recharge to occur.

201. Based on the precautionary advice from GA and Dr Habermehl relating to regional groundwater impacts (also discussed in discussion on social and economic impacts of groundwater extraction) the proposed conditions adopt a precautionary approach. The Department recommends a suite of proposed conditions that include:
- review to confirm the presence of discharge springs and other springs supporting listed threatened species within the APLNG tenements, and within the hydrogeological impact zone of the APLNG tenements, or an appropriately refined prediction of the hydrological impact zone based on more recent cumulative impact modelling;
- the proponent developing a management plan and actions to protect GAB discharge springs and listed threatened species dependent on springs within the APLNG tenements, and within 100km radius of the predicted hydrogeological impact zone of the APLNG tenements, or a radius reflecting an appropriately refined prediction of the hydrological impact zone based on more recent cumulative impact modelling;
- the proponent developing a comprehensive water monitoring and management plan for approval. The plan will ensure a regime of groundwater modelling, monitoring, trials for reinjection, and corrective actions are in place to address the groundwater uncertainties including the regional nature of the problem, the likelihood of cumulative impacts, and the potential for an unknown risk but potentially high consequence of impact on GAB discharge springs and listed threatened species dependent on springs;
- requiring further actions from APLNG should any unexpected impacts be detected to ensure no adverse impacts on GAB discharge springs, and/or listed threatened species dependent on springs, or broader regional landscape impacts occur; and
- requiring trials to be undertaken to re-inject appropriately treated associated water into relevant permeable aquifers to determine feasibility with the intention of either directly, or indirectly, reversing drawdown impacts from CSG proponents and other groundwater users.

Migratory Species (ss. 20 and 20A)

202. The ERT identified 12 migratory bird species as potentially occuring in th gas field project area. The EIS identified 28 birds listed as migratory under the EPBC Act known to occur or possibly occur within the gas fields study area (section 23.6.1 and Volume 5, Attachment 14) and 5 additional species were subsequently identified as requiring consideration. Only two species were recorded during field surveys:

- Eastern great egret (*Fregata ariel*)

- White-bellied sea-eagle (*Haliaeetus leucogaster*).

203. The remaining species have either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. Twenty of the bird species identified are strongly associated with water bodies which are not a significant feature of the study area. In addition, the EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis.

204. The Coordinator-General notes that the EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1) and that the result determined there are no significant impacts predicted for any of the identified migratory birds species. The Coordinator-General concurs with this finding and is satisfied that the gas field development would not affect important habitat for migratory species given the nature of the resources in the area. The constraints planning for the gas field development (Appendix 2, Part 2, Condition 1) will recognise and avoid, where practical, environmentally sensitive areas including key wildlife habitat, therefore minimising potential impacts on EPBC-listed migratory species. The Coordinator-General has imposed a condition (Appendix 1, Part 1, Condition 5) to ensure offsets are provided where necessary to ensure appropriate management of affected EPBC-listed migratory species.

205. The Department concludes that based on the information provided in the EIS, that there is a low level of residual uncertainty in relation to the likely occurrence and potential for adverse impacts from gasfield activities on those migratory birds species which potentially utilise wetlands and other habitat resources within the project area. The Department has required under Condition 7, that a management plan be developed for the species prior to the commencement of the activity, and is satisfied that these measures together will ensure no unacceptable impacts to the species as a result of the gasfield activities.

Indirect impacts

Listed ecological communities and potential habitat for listed threatened species

206. Indirect impacts on listed ecological communities and potential habitat for listed threatened species will occur as a result of the development and operation of the gas fields including fragmentation of ecological communities and species habitat; the range of detrimental ecological impacts associated with edge-effects from installation and operation of infrastructure. This is possibly the most significant consequence of installation of linear infrastructure such as gas and water feeder lines, access tracks and pipelines. There is also potential for these indirect impacts to represent larger cumulative impacts from the multiple large-scale CSG projects proposed in the bio-region over the next 20 to 30 years.

Mitigation measures

207. The proponent has proposed ecological constraints mapping and field development protocols to identify environmentally sensitive areas (including areas of MNES), proposes the application of field management protocols in planning the location of

infrastructure to avoid environmentally sensitive areas, and proposes to employ pre-clearance surveys to avoid impacts wherever possible.

208. In order to minimise impacts on listed ecological communities and species, through impact on potential habitat for listed threatened species, the Department's recommended conditions require the proponent develop and implement a more rigorous constraints planning and field development protocol to ensure that gas field development takes into account MNES in an appropriate high environmental constraint class to inform the proponent's development activity decisions and ensure these can reported and audited.

209. The Department also recommends conditions for site rehabilitation and decommissioning which aim to restore the impacted areas within ecological communities and species' habitat to at least pre-disturbance quality or better. This would support reconnection of fragmented ecological communities and species' habitat consistent with threat responses in relevant Recovery Plans and Conservation Advices, addressing one of the major threats identified for these MNES as a result of gas field development.

210. The Department's recommended conditions require the securing of a rehabilitation area as an offset for indirect impacts. This will contribute to offsetting unavoidable indirect impacts resulting from the development of the gas fields and address the uncertainty around the accuracy of calculations estimating impacts on listed ecological communities and potential habitat for listed threatened species in the project area. The area of the rehabilitation offset has been based on a ratio of approximately 1:1 for all impacts on listed ecological communities and potential habitat for listed threatened species identified for the project. Based on this methodology the area of the rehabilitation offset area has been calculated as a minimum of 1102.86 ha.

Conclusions for indirect impacts on listed ecological communities and potential habitat for listed threatened species

211. The Department considers the proposed rehabilitation offset is appropriate to account for likely indirect impacts on listed ecological communities and is satisfied that the recommended conditions will ensure no unacceptable impact on listed ecological communities and potential habitat for listed threatened species as a result of the action.

Impacts from groundwater extraction

Groundwater impacts on MNES

212. Potential impacts on MNES from groundwater extraction are primarily related to Great Artesian Basin springs that occur within the vicinity of the gas field tenements. Some of these springs support EPBC listed ecological communities and threatened species. The proposed conditions focus on the protection of these matters and this is discussed in greater detail above. There are also a number of other potential impacts on MNES, including indirect impacts. Indirect impacts on MNES may arise from such large volumes of associated water affecting surface waters and soils through the use and management of CSG water which may be of variable environmental quality and chemistry.

213. The development of gas field infrastructure may also affect surface water flow and environmental water quality and contribute to erosion and sedimentation which in turn may indirectly impact on MNES such as the *Maccullochella peelii* (Murray Cod). Other risks from APLNG gas field development activities identified in the EIS include:

- increased run-off into watercourses as a result of the creation of impervious surfaces (e.g. access roads, ponds, compressor stations);
- potential for increased nutrient loads from erosion and sedimentation as a result of vegetation clearance;
- damage to in-stream biodiversity due to impacts on riparian vegetation and water inappropriate quality and environmental characteristics entering streams;
- contamination from fuels and drilling fluids;
- salinity impacts due to over use of inappropriately treated water (e.g. for gas field use such as dust suppression);
- loss of surface water through subsidence and fracturing; and
- salinity loading of soils due to the use of amended or partially treated associated water for intensive irrigation and other intensive agricultural uses.

Other Groundwater impacts (Social and Economic considerations)

214. Although not directly impacting on MNES, associated groundwater extraction and management is likely to result in other economic and social impacts that may be considered as a part of the EPBC Act process. These include:

- **Potential impacts on groundwater levels:** During the combined CSG activities in the region, the radial extent of groundwater level drawdown in the coal seam units is projected to be limited to the cumulative development areas and nearby proximities, within 50km of the area boundaries. Post-production, during the groundwater level recovery phase, the radial extent of the drawdown is projected to broaden to less than 100km beyond the cumulative development area boundaries. The Springbok Sandstone is projected to experience the highest cumulative groundwater level drawdown outside the Walloon Coal Measures. On average, the groundwater level drawdown is projected to be approximately 15m across the cumulative CSG development areas and their proximities. The Hutton Sandstone is projected to experience groundwater level drawdown, particularly in areas where both the coal seam elevations are comparatively deep and the overlying aquitards (i.e. Taroom mudstones and Eurombah Formation) are believed to be thin. Groundwater level draw downs are generally expected to be less than 10m;

- **Potential impacts on groundwater storage:** while associated water production will primarily affect groundwater storage in the Walloon Coal Measures, storage in overlying and underlying aquifers potentially may also be affected through a reduction in hydrostatic pressure as water moves towards the low pressure area created in the Walloon Coal Measures. Notably, groundwater released from these overlying and underlying confined aquifers is almost exclusively from storage.

- **Potential impacts on groundwater quality:** The production of associated water from the Walloons Coal Measures, in both the project case and cumulative case, is not expected to have a detrimental effect on the groundwater quality (including salinity) in the region. Given the quality of groundwater in the non-coal bearing aquifers is broadly similar, any groundwater transfers induced by associated production are unlikely to compromise the regional quality of groundwater aquifers outside of the coal measures.

- **Potential impacts on existing water bores:** pressurisation from associated water production may potentially affect water levels and water availability in existing bores licensed under the Water Act (2000). These effects extend to other stock and domestic bores, which are authorised under the Act but not licensed. The bores accessing groundwater from the Hutton Sandstone and Precipice Sandstone aquifers are not expected to experience drawdowns greater than 5m as a consequence of associated water production. It is anticipated that the drawdown levels associated with CSG activities will not significantly add to the currently already observed drawdown levels in water supply bores accessing the Condamine Alluvium.

- **Potential impacts to stream flow:** According to the initial project case model projections, the potential drawdown effects to the watertable aquifer is expected to be of limited extent, and is projected to occur immediately downstream of the Chinchilla Weir. Drawdown of the watertable aquifer could potentially alter groundwater – surface water interaction rates between the Condamine River and underlying aquifers in this localised area. However, operation of the weir itself is likely to override any potential changes to the groundwater–surface water relationship at this location.

- **Potential impacts for aquifer compression and subsidence:** The risk of land subsidence associated with the extraction of water and natural gas from consolidated underground reservoirs such as the Walloons Coal Measures is minimal. While subsidence due to groundwater extraction is known to occur in unconsolidated sediments (and primarily in highly compressible clays), its occurrence in consolidated formations is far less common. Groundwater in the GAB is stored in consolidated, confined, porous sandstone aquifers with limited compressibility.

Cumulative impacts

215. In addition to the proposed gas field activities associated with the APLNG Project, the projects identified below are expected to involve significant gas field development for extraction of CSG from the respective gas fields in southern Queensland to supply LNG facilities on Curtis Island. These projects include:

- BG/QGC QCLNG Project is proposing to develop a maximum gas field development of 26,760 ha within a gas field area of 4,500 km², with a maximum of 6,000 production wells over the approximately 25-30 year life of the project.

- Gladstone LNG Project is proposing to develop a maximum gas field development area within petroleum tenures of 6,887 km2 with a maximum of 2,650 production wells and impacts related to associated gas field development over the approximately 25 year life of the project (with potential to refer 2 further trains for EPBC approval for over additional fields covering an area of 12,100 km2).

- (Subject to EPBC Act and State approval) Arrow Energy Surat Coal Seam Gas Project is proposing to develop over a maximum gas field development area of 8,000 km^2 with a maximum of approximately 7,500 wells over the 20 year + life of the project.

- (Subject to EPBC Act and State approval) the CILNG Project (owned and operated by Shell), has plans for up to 16 mtpa of LNG from four production trains. The project received 'Significant Project' status from the Queensland Government in June 2009. The project FID is due in 2012 with first LNG by 2015.

216. The cumulative impacts relating to the above gas fields are likely to include drawdown on aquifers, use and disposal of produced water, management and disposal of brine and salt, cumulative impacts on terrestrial species and ecological communities from infrastructure installation and operations including further fragmentation and edge effects. Cumulative impacts are also likely to include a range of social and economic impacts.

217. The Department has had regard to the cumulative impacts of these other proposals in formulating this advice on the APLNG Project. The Department has also had regard to the likelihood of the above projects proceeding. From discussions with the proponent and media reports, the Department is aware of recent commercial investments and agreements relating to the projects, including advice from the proponent and media reports of sales agreements between the proponent and overseas buyers of LNG.

218. Reference to cumulative impacts of other referrals for the APLNG Project is referred to separately in other attachments to the brief. Recommendations and information on the three proposals that comprise the APLNG Project have been provided at the same time, so that a decision on each separate proposal may have regard to the related impacts of each other proposal.

Monitoring, mitigation and management

219. In its EIS, APLNG state that although monitoring will not reduce the potential impacts associated with the Project, the information acquired from the monitoring program will be used to inform management decisions to limit potential impacts. APLNG has committed to implementing a performance monitoring and management system to measure operational groundwater levels and groundwater quality during CSG development and operation.

220. APLNG state that although most of the potential groundwater-related impacts will be managed through appropriate well design, construction and management practices, there is still risk that requires addressing through appropriate mitigation measures. Examples of APLNG's proposed mitigation measures are provided below:

- **Minimising drawdown effects through appropriate production well Construction:** Where APLNG identifies a direct hydraulic connection between the Walloon Coal Measures and the unconformably overlain Springbok Sandstone, the upper most coals will be sacrificed, sealing them off from the productive part of the CSG well;

- **Mitigating impacts to existing water bores:** If the result of the investigation confirms that declining water levels are the result of Australia Pacific LNG's activities, and if the make good provision is required, Australia Pacific LNG will make good the water supply to the impacted water bore in compliance with the PAG Act.

The Coordinator-General's assessment of groundwater impacts

221. The Coordinator-General states that subsequent to the approval decisions for the British Gas/QGC and Santos projects progress has been made in understanding the scope of the possible impacts on aquifers of the GAB due to CSG activities. The groundwater modelling undertaken by APLNG together with the supplementary information provided, has better defined the potential impacts. The development of a comprehensive groundwater model is dependent on calibration by an extensive and thorough groundwater level monitoring program in all aquifers. To be effective the monitoring must commence in advance of gas production and continue as gas production proceeds.

222. The Coordinator-General states that drawdown of the CSG aquifer is integral with development of the gasfield and extraction of CSG. However, the effects that this may have on other aquifers are largely unknown. For this reason monitoring of aquifers likely to be affected is an essential component of the environmental management of the gas fields.

223. The proponent has estimated the quantity of CSG water that will be extracted during the first 5 years would approximate 120 ML/d in 2013–2014. The EIS also indicates that the peak production of CSG water would rise to around 170 ML/d later in the development, and that over the life of the project more than 1000 GL could be extracted. DERM raised the issue that if the Walloon coal measures are proven to be inter-connected to higher alluvial strata, then the potential for long-term changes to land uses that rely on groundwater must be considered. Further, drawdown of the aquifers in the alluvial strata might induce change in surface water percolation rates in groundwater recharge areas. These points are included in the reasoning for the appointment of the Queensland Water Commission as the agency which can take an overview monitoring role, and investigate and predict potential for future impacts on a scientific basis.

224. With the above issues in mind, the Coordinator-General confirms the need to monitor aquifers likely to be affected as an essential part of an adaptive Environmental Management Plan for the CSG field that will form part of the application for the Environmental Authority. The relevant conditions are contained in Appendix 2, Part 2 (Conditions 10 and 11). It is envisaged that this will feed into the Queensland Water Commission groundwater monitoring program to ensure that adaptive management will be achieved rather than reactive management. The Coordinator-General emphasises that the cumulative volume of CSG water extracted in the Surat Basin could be very large (possibly as much as 5000 gigalitres over the life of the gas field development) and that monitoring of groundwater levels and other changes where they occur will be an essential part of the long-term land use strategies for the region.

Groundwater impacts and the trigger for the Commonwealth 2007

225. In response to the requirements of s.255AA of the Water Act 2007, the Department commissioned Moran and Vink (2010) to undertake a desktop study to determine the impacts of the proposed CSG operations on the connectivity of groundwater systems, surface water and groundwater flows and water quality in the Murray-Darling Basin. Moran and Vink (2010) conclude that for impacts to be predicted and adequate management to be put in place then existing data gaps, similar to those identified by Geoscience Australia and Dr Habermehl need to be addressed by the proponents. The Department has considered this report in this assessment (Attached in the Expert Advice section of the brief to which this advice is attached).

Mandatory Considerations

226. Under s.136 of the EPBC Act, in deciding whether or not to approve an action and what conditions to attach to the approval, the Minister must consider the following matters, in so far as they are not inconsistent with any other requirement of Subdivision B, Division 1 of Part 9 of the EPBC Act:

Matters relevant to any matter protected by the controlling provisions (s.136(1)(a))

227. The proposed actions were assessed under the bilateral agreement with Queensland, by a report by the Queensland Coordinator-General under Part 4 of the *State Development and Public Works Organisation Act 1971* (Queensland) and the State Development and Public Works Organisation Regulation 1999. This assessment process is used where the Coordinator-General declares, for the purposes of section 26 of the *State Development and Public Works Organisation Act 1971*, that the proposed action is a significant project for which an EIS is required. Chapter 10 of that report addresses impacts on MNES. The Coordinator-General's report has been considered in providing this advice and the associated briefing, including the recommended conditions.

228. While the Coordinator-General's report addressed impacts on MNES and summarised the relevant discussion in the EIS and in supplementary information provided by the proponent, the report did not make any clear conclusions regarding the acceptability of these impacts. The Department has therefore provided you with a range of additional information, and further considered those impacts in this advice and the associated briefing.

Economic and social matters (s.136(1)(b))

229. Economic and social matters are further discussed in the brief to which this advice is attached.

Principles of ecologically sustainable development (ESD)

230. The Department considers that the proposals would be consistent with the principles of ESD if the conditions and mitigation measures are imposed as recommended. The principles of ESD are set out in s.3A of the EPBC Act.

231. The Department has considered both the impacts on the relevant controlling provisions for each action and the long-term and short-term economic and social impacts of the proposal in making its recommendations to approve, with conditions, the proposed actions.

232. The proposed action will have impacts on the relevant controlling provisions. Some of the impacts to particular listed species and ecological communities are difficult to predict with certainty. The Department does not consider that the impacts would, if properly managed and implemented according to the proposed conditions of approval, and if appropriately managed and conditioned by the Queensland Government, create irreversible or serious environmental damage. In addition, the

proponent is committed to avoiding impacts as far as possible through responsible environmental management.

233. There will be some impact on individual listed species, and components of ecological communities. The Department does not consider this would constitute an adverse or unacceptable impact on either the populations as a whole, or ecological communities, given the scale and duration of the proposed activities and the management and mitigation measures to be adopted. Any uncertainties in relation to such impacts are also addressed by the proposed conditions. This view is subject to the management, monitoring and mitigation measures that are recommended for adoption and which have provision for review as the development proceeds. The relatively high level of uncertainty in relation to such impacts, particularly those relating to GAB discharge spring ecological community, spring dependent listed species, and the related regional groundwater impacts, is addressed by the proposed conditions. The Queensland Government regulatory arrangements for gas field development activity will support the management of MNES indirectly through environmental conditions currently being developed by DERM.

234. The conditions imposed on the proposed actions, including conditions for offsets for potential unavoidable impacts, will ensure that there is no net loss of biodiversity relevant to the matters protected under the EPBC Act. In this respect, the Department has also considered the related mitigation measures and offsets proposals for other referrals relating to the APLNG Project. By requiring offsets (both in relation to this and other referrals for the project), the conservation values lost as a result of the proposals has been evaluated and compensated.

The assessment report

235. The Queensland Coordinator-General's report is an 'assessment report' which you must take into account under s.136 of the EPBC Act. The final report was provided to the Commonwealth in November 2010. That report has been taken into account by the Department in providing advice and making recommendations on the proposal.

Other information and comments

236. Section 136(2)(f) requires that you take into account any relevant comments given to the Minister by another Minister in accordance with an invitation under section 131 or 131AA and 131A. In the brief to which this advice is attached, we have recommended that you write to relevant Ministers (and to the proponent) seeking comments on the proposed decision and conditions.

237. Section 136(2)(g) requires that you take into account any information given in accordance with a request for further information under section 132. Further independent expert advice was sought on groundwater issues as described above.

Precautionary principle (s. 391)

238. Under s.391(1) of the EPBC Act, you must take account of the precautionary principle in making a decision whether or not to approve the taking of an action. You must therefore take account of this principle in making a decision on whether to approve each of the referrals which are the subject of the APLNG Project.

239. The precautionary principle is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage. In the absence of any adequate regional models, it is impossible to specify which particular EPBC matters may be at risk. Strategies to reinject CSG water and re-pressurise aquifers generally within the region can be expected to mitigate such risks. Taking a precautionary approach, the mitigation measures, including trials for reinjection, proposed by Geoscience Australia and Dr Habermehl are strongly recommended. The Department has adopted precaution in framing conditions and considers that proposed conditions are sufficient to manage, monitor and mitigate the relevant risks of environmental impacts associated with the referral to which this Departmental advice relates.

Person's environmental history (s.136(4))

240. In accordance with section 136(4) of the EPBC Act, the Minister may also consider whether the person proposing to take the action is a suitable person to be granted an approval, having regard to the person's history in relation to environmental matters and if the person is a body corporate, the history of its executive officers and if relevant, the history of the parent company and its executive officers in relation to environmental matters.

241. On the basis of the information available to the Department, APLNG or any associated company does not appear to be, or have been, subject to proceedings in relation to a conviction for an offence or ordered to pay a pecuniary penalty, under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of resources.

242. APLNG is a 50/50 joint venture between ConocoPhillips and Origin Energy. Both companies have a long history of conducting activities in a way that avoids or minimises potential impacts on the environment. APLNG state that the construction of the gas transmission pipeline will be contracted to Origin. Origin's successful environmental record is demonstrated in winning the Ethical Investor Magazine's 'Sustainable Company of the Year' for 2007. Origin has also received the 2007 APPEA Environment Award for the implementation of the Coal Seam Gas Produced Water Treatment Facility at Spring Gully.

243. Origin operates in accordance with its Health Safety and Environment (HSE) Management System. The HSE management system provides a framework for Origin to continually improve management systems and ensure responsible management practices that minimise any adverse health, safety or environmental impacts arising from activities products or services. The gas transmission pipeline will be developed and operated under Origin's management systems.

Minister not to consider other matters (s.136(5))

244. In deciding whether or not to approve the taking of an action, and what conditions to attach to an approval, you must not consider any matters that you are not required or permitted, by Subdivision B, Division 1, Part 9 of the EPBC Act, to consider. This Departmental advice and the associated briefing, does not contain matters that you are not required or permitted to consider in making your decision.

Considerations in deciding on conditions (s.134(4))

245. In accordance with section 134(4) of the EPBC Act, in deciding whether to attach a condition to an approval, you must consider any relevant conditions that have been imposed, or you consider are likely to be imposed, under a law of a State or self-governing territory or another law of the Commonwealth on the taking of the action.

246. The Queensland Coordinator-General's evaluation report on the APLNG project set out conditions at:

- Appendix 1 – relating to the whole of project;
- Appendix 2 – relating to the gas fields;
- Appendix 3 – relating to the gas transmission pipeline; and
- Appendix 4 – relating to the LNG facility.

247. Under section 134(4) of the EPBC Act, you must also consider information provided by APLNG. Documentation provided by the specified proponent includes the EIS and the SEIS. Other documentation provided by the proponent, as relevant to this proposal, is set out below (under the heading 'References') and is described in this advice, in the brief and in other attachments which this advice forms part of.

248. Under section 134(4) of the EPBC Act, the Minister must also consider the desirability of ensuring as far as practicable that the conditions are a cost effective means for the Commonwealth and the proponent to achieve the object of the conditions.

249. The Department believes the conditions are practicable and cost effective. In formulating the proposed conditions of approval, the Department has had regard to relevant conditions imposed by the Queensland Coordinator-General. The Department has also provided and/or discussed draft conditions, on which those proposed are based, with the proponent; the Queensland Department of Infrastructure and Planning, the Queensland Department of Environment and Resource Management; the Great Barrier Reef Marine Park Authority; and the Heritage and Marine Divisions and Water Group of the Department.

Duration of proposed approval

250. If approved, the proposed action is likely to commence in 2011. As the life of the APLNG project as a whole is expected to be at least 30 years, it is proposed that the duration of the approval and conditions attached to this Project would have is approximately 50 years, having effect until 22 February October 2060. This timeframe will accommodate a longer production life for the LNG facility, and allow for any CSG field activity associated with a decommissioning and rehabilitation period.

Other considerations

251. Under ss. 139 of the EPBC Act, the Minister must have regard to any approved conservation advice for a relevant listed threatened species or ecological community. Relevant conservation advices have been taken into account, referenced in the relevant discussion of impacts, and copies of relevant conservation advice are attached to the main brief.

References

252. In formulating this advice, the Department has considered all relevant available documents. This includes, but is not limited to, the following:

- Email to DEWHA identifying existing APLNG Eastern QLD Operations operations (includes a map and a table) – 20 January 2010 (Attachment C1);
- Controlling provisions table - potential species impacted for 2008/4974 (Attachment C2);
- Wetlands Section advice (original referral advice – subsequent wetlands section advice came as part of Water Group advice) (Attachment C3);
- Australia Pacific LNG Saline Effluent Management Plan – Combabula (Q-4200-15-MP-0003) (Attachment C4);
- DERM Regulated Dam Guideline, Manual for Assessing hazard Categories and Hydraulic Performance of Dams, and Model Environmental Authority Conditions (Schedule C – Dams) Note: all of these documents are consultation drafts only (Attachment C5);
- Joint statement: Queensland Treasurer and Minister for Employment and Economic Development, the Honourable Andrew Fraser and the Queensland Minister for Natural Resources, Mines and Energy and Minister for Trade, the Honourable Stephen Robertson on Friday, January 07, 2011 (Attachment C6);
- Letter from APLNG regarding proposed water discharge and potential impacts on Ramsar Wetlands (Attachment C7)
- Revised Fauna Habitat Calculations for the Gas Fields (Q-LNG01-15-RP-0014), Received 26 November 2010 (Attachment C8);
- Australia Pacific LNG Offsets Environmental Offsets Strategy – 16 November 2010 (Attachment C9);
- Recovery plan for the *community of native species dependent on discharge of groundwater from the Great Artesian basin* (Attachment C10);
- Map of EPBC GAB Springs and 100km boundary (Attachment C11);
- DRAFT APLNG Project Gas Field Terrestrial Ecology Habitat Management Guidelines - 13 August 2010 (Attachment C12);

- DERM Coal Seam Gas Water Management Policy (Attachment C13);
- The referral (EPBC 2009/4974) submitted by the Proponent;
- The proponent's Environmental Impact Statement and supplementary information and presentations (Both of those documents are together treated as a single environmental impact statement for the purpose of Part 8 of the EPBC Act);
- Further information provided by the proponent in relation to CSG water extraction and management;
- The Queensland Coordinator-General's Report relating to the APLNG Project (November 2010);
- Conservation advice relating to the species mentioned in this advice;
- Independent advice from Geoscience Australia and Dr M A Habermehl regarding groundwater issues related to CSG water extraction and management;
- Species Profile and Threats Database - SPRAT (DEWHA).

Consultation

253. In addition to the proponent, the Approvals and Wildlife Division of the Department (responsible for administering the EPBC Act assessment) has consulted with a number of government agencies in the process for your approval of the Santos and QGC projects (including in relation to issues relevant to those projects and the APLNG project), and for matters specific to the APLNG project including (as they were when the primary consultation phase occurred):

- the Commonwealth Department of Resources, Energy and Tourism (DRET);
- the Commonwealth Department of Industry, Transport and Resources (DITR);
- the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF);
- the Commonwealth Department of Climate Change and Energy Efficiency (DCCEE);
- the Commonwealth Treasury;
- the Great Barrier Reef Marine Park Authority;
- Geoscience Australia and Dr M A Habermehl;
- other relevant divisions of the Department of Environment, Water, Heritage and the Arts, including the Water Group; the Heritage Division; the Strategic Policy Division (the Environmental Economics Unit); and the Marine Division;
- the Queensland Department of Industry and Planning (DIP);
- the Queensland Department of Environment and Resources (DERM).

Conclusion

254. The Department considers that, based on the available evidence and assessment, the impacts of the CSG field activities will not have unacceptable impacts on the relevant controlling provisions subject to compliance with the proposed conditions.

255. The proposed action and the proposed APLNG project as a whole, is of a substantial geographic and temporal scale, and will interact with a number of matters of national environmental significance. The proposed conditions are designed to ensure that any impacts on these matters will be limited, and, if unavoidable, mitigated and compensated.

256. The proponent is well-resourced, and experienced in dealing with regulatory requirements for major projects, and a high level of compliance with the conditions is expected.

From: s. 11C(1)(a)

Sent: Thursday, 20 January 2011 7:13 PM

To: s. 22(1)(a)(ii)

Subject: FW: Request for a short description of domestic operations in the APLNG project area [SEC=UNCLASSIFIED]

Attachments: SEWPaC RFI.xlsx; GISWR_03137_RevA.pdf

Hi s. 22(1)(a)(ii)

Below and attached is the information requested on the current infrastructure in place throughout the EIS study area. Please let me know if there is any further information that you require.

Cheers

s. 11C(1)(a)

s. 11C(1)(a)
Principal Environmental Specialist
Upstream EIS Project Manager
Origin
t s. 11C(1)(a)) | m s. 11C(1)(a)

From: s. 11C(1)(a)
Sent: Thursday, 20 January 2011 3:50 PM
To: s. 11C(1)(a)
s. 42(1): s. 22(1)(a)(ii)

INCLASSIFIED]

Hi All,

Please find below and attached the requested information for SEWPaC.

Table 1 below outlines each of our tenure that falls under the APLNG EIS Project area, with associated infrastructure identified. The coordinates of each pond are included in Table 2 below. Table 3 identifies additional facilities.

The attached spreadsheet was recently prepared for the DERM and identifies all active (i.e. producing) and inactive (i.e. plugged and abandoned, cased and suspended and shut-in) wells and their locations.

The attached map illustrates all infrastructure across APLNG tenure.

Table 1: APLNG EIS Project area infrastructure

	Wells	Length of Pipeline (km)	Number of Ponds	Area of Ponds (ha)	GPFs	WTF
ATP606	63	32.04	3	10.87	0	0
ATP847	41	37.2	1	7.8	0	0

PL209	3	0	0	0	0	0
PL216	13	0	0	0	0	0
ATP702	18	14.03	1	14.72	0	0
PL226	104	166.7	3	92.28	1	1
ATP692	8	2.033	0	0	0	0
PL215	5	10.48	1	2.734	0	0
PL225	7	0	0	0	0	0
ATP663	37	9.657	3	10.84	0	0

Table 2: GPS coordinates of each pond identified in EIS Project area

	Environmental Authority	Pond Name	Latitude	Longitude
ATP606, ATP 847, PL209	PEN100068007 (150 040)	Ramyard Pond	-26.357261	149.815956
		Lucky Gully Pond	-26.399971	149.575428
		Pine Hills Pond	-26.305903	149.274369
		Combabula Pond	-26.783092	150.225725
ATP692, PL 215, ATP 702, PL216, PL 226, PL 225	PEN100067807	Pond B	-26.899894 -26.901292 -26.907904 -26.906446	150.368989 150.376829 150.374948 150.367332
		Condabri Pond	-26.780831 -26.782071 -26.785280 -26.784000	150.225836 150.227987 150.225534 150.223406
		Water Treatment Facility Feed Pond	-26.8707 -26.8707 -26.8748 -26.8748	150.3460 150.3521 150.3521 150.3406
		Water Treatment Facility Effluent Pond	-26.8749 -26.8749 -26.8767 -26.8767	150.3455 150.3474 150.3474 150.3455
		Pond D (Cell 1)	-26.8730 -26.8730 -26.8782 -26.8782	150.3381 150.3447 150.3447 150.3381
ATP663	PEN200252908	Gilbert Gully Pond	-27.585484 -27.585519 -27.587164 -27.587096	150.912954 150.912585 150.912437 150.913149
		Waar Waar Pond	-27.795857 -27.794427 -27.794570 -27.796001	150.950187 150.950407 150.951583 150.951363
		Zig Zag Pond	-27.964830 -27.965352 -27.967494 -27.966972	150.925761 150.926874 150.925600 150.924486

Table 3: Additional facilities located on PL226

Facility	Latitude	Longitude
Gas Plant	-26.88177	150.35266
Water Treatment Facility	-26.87593	150.34746

If you require any further information, please don't hesitate to contact me.

Thanks,
s. 11C(1)(a)

s. 11C(1)(a)
Environmental Advisor - Upstream CSG

- **Origin**
- **Level 7, 135 Coronation Drive, Milton QLD 4064**
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Tenure	Tenure Number	Environmental Authority	Tenure Operator	Well Name	Total Number of Well Pads	Latitude	Longitude	Status of Well	CSG/Conventional	Stimulation	Stimulation Type
ATP	606	PEN100068007 (150 040)	Australia Pacific LNG Pty Ltd		65						
				COMBABULA 1		-26.2452528	149.5114389	INACTIVE	CSG	No	
				COMBABULA 12		-26.2296	149.5738889	ACTIVE	CSG	No	
				COMBABULA 13		-26.2290083	149.5696639	ACTIVE	CSG	No	
				COMBABULA 14		-26.227225	149.5630194	ACTIVE	CSG	No	
				COMBABULA 15		-26.2314083	149.5591806	ACTIVE	CSG	No	
				COMBABULA 19		-26.2341239	149.5652222	ACTIVE	CSG	No	
				COMBABULA 2		-26.2459583	149.5287611	ACTIVE	CSG	No	
				COMBABULA 20J		-26.2304417	149.5641806	ACTIVE	CSG	No	
				COMBABULA 20T		-26.2307	149.5642	ACTIVE	CSG	No	
				COMBABULA 21J		-26.2322167	149.5689528	ACTIVE	CSG	No	
				COMBABULA 21T		-26.2322167	149.5689528	ACTIVE	CSG	No	
				COMBABULA 23		-26.2860556	149.3931944	ACTIVE	CSG	No	
				COMBABULA 24		-26.2310026	149.5641834	ACTIVE	CSG	No	
				COMBABULA 3		-26.2462222	149.5288333	ACTIVE	CSG	No	
				COMBABULA 4		-26.184086	149.455307	ACTIVE	CSG	No	
				COMBABULA 5		-26.1843611	149.5108	ACTIVE	CSG	No	
				COMBABULA 6		-26.185482	149.5603151	ACTIVE	CSG	No	
				COMBABULA 7		-26.2447806	149.4621333	ACTIVE	CSG	No	
				COMBABULA 8		-26.2379306	149.5682581	ACTIVE	CSG	No	
				GLENAVON 1		-26.38176	149.169717	INACTIVE	Conventional	No	
				HILLSIDE WANDOAN 1		-26.248425	149.401102	INACTIVE	Conventional	No	
				LUCKY GULLY 1		-26.2978944	149.5318639	ACTIVE	CSG	No	
				LUCKY GULLY 2		-26.3042389	149.45715	ACTIVE	CSG	No	
				LUCKY GULLY 3		-26.3421778	149.5474306	ACTIVE	CSG	No	
				LUCKY GULLY 4		-26.3987861	149.5832139	ACTIVE	CSG	Yes	Fracture
				LUCKY GULLY 5		-26.4076639	149.5817861	ACTIVE	CSG	No	
				LUCKY GULLY 6		-26.406075	149.5718778	ACTIVE	CSG	No	
				LUCKY GULLY 7		-26.396984	149.573032	ACTIVE	CSG	Yes	Fracture
				LUCKY GULLY 8J		-26.4024306	149.5775583	ACTIVE	CSG	No	
				LUCKY GULLY 8T		-26.402251	149.576995	ACTIVE	CSG	Yes	Fracture
				LUCKY GULLY 9		-26.4066667	149.5816667	ACTIVE	CSG	Yes	Fracture
				MEELEEBEE 1		-26.1833333	149.2	INACTIVE	Conventional	No	
				MEELEEBEE 2		-26.2007306	149.2416444	ACTIVE	CSG	No	
				MEELEEBEE 3		-26.262617	149.300388	ACTIVE	CSG	No	
				MEELEEBEE 4		-26.1882623	149.3248834	ACTIVE	CSG	No	
				MEELEEBEE 5		-26.241775	149.1974528	ACTIVE	CSG	No	
				MEELEEBEE 6		-26.229075	149.3759972	ACTIVE	CSG	No	
				MUGGLETON 1		-26.4056667	149.3023889	INACTIVE	Conventional	No	
				MUGGLETON 2		-26.3394278	149.3891556	ACTIVE	CSG	No	
				MUGGLETON 3		-26.3791222	149.2502778	ACTIVE	CSG	No	
				MUGGLETON 4		-26.3361306	149.1965083	ACTIVE	CSG	No	
				MUGGLETON 5		-26.3205833	149.2630167	ACTIVE	CSG	No	
				MUGGLETON 6		-26.3487167	149.3175944	ACTIVE	CSG	No	
				PINE HILLS 1		-26.2894167	149.2843333	INACTIVE	CSG	No	
				PINE HILLS 2		-26.3118444	149.2786583	ACTIVE	CSG	No	
				PINE HILLS 3		-26.3042722	149.275775	ACTIVE	CSG	No	
				PINE HILLS 4		-26.3010828	149.2850863	ACTIVE	CSG	No	
				PINE HILLS 5		-26.3094444	149.2886944	ACTIVE	CSG	No	
				PINE HILLS 6		-26.3067556	149.2808111	ACTIVE	CSG	No	
				PINE HILLS 7		-26.292556	149.216821	ACTIVE	CSG	No	
				PINE HILLS 8		-26.2894361	149.334325	ACTIVE	CSG	No	
				REEDY CREEK 1		-26.3565083	149.4993639	ACTIVE	CSG	No	
				REEDY CREEK 2		-26.4504083	149.5061	ACTIVE	CSG	No	
				REEDY CREEK 3		-26.35611	149.4270431	ACTIVE	CSG	No	
				REEDY CREEK 4		-26.4220556	149.4498611	ACTIVE	CSG	No	
				REEDY CREEK 5		-26.3548551	149.4212069	ACTIVE	CSG	No	
				REEDY CREEK 6J		-26.3581098	149.4235287	ACTIVE	CSG	No	
				REEDY CREEK 6T		-26.3581115	149.4234285	ACTIVE	CSG	No	
				REEDY CREEK 7		-26.3601129	149.4198139	ACTIVE	CSG	No	
				REEDY CREEK 8		-26.3613678	149.4256502	ACTIVE	CSG	No	
				REEDY CREEK 9		-26.4713333	149.4492222	ACTIVE	CSG	No	
				ROMA 7 (GSQ)		-26.24837	149.384427	INACTIVE	Conventional	No	
				SANDPIT 1		-26.1483	149.868	INACTIVE	CSG	No	
				UWALLA 1		-26.3833472	149.1690889	INACTIVE	CSG	No	
				WUBAGUL 1		-26.1577611	149.9087389	INACTIVE	CSG	No	

Tenure	Tenure Number	Environmental Authority	Tenure Operator	Well Name	Total Number of Well Pads	Latitude	Longitude	Status of Well	CSG/Conventional	Stimulation	Stimulation Type
ATP	663	PEN200252908	Australia Pacific LNG Pty Ltd		44						
				DURABILLA 1		-27.55	150.8625	INACTIVE	Conventional	No	
				GILBERT GULLY 1		-27.5503917	151.0814083	INACTIVE	CSG	No	
				GILBERT GULLY 11		-27.6036139	150.8596861	INACTIVE	CSG	No	
				GILBERT GULLY 14		-27.651967	150.946731	INACTIVE	CSG	No	
				GILBERT GULLY 16		-27.601136	150.981953	INACTIVE	CSG	No	
				GILBERT GULLY 17		-27.6048972	150.9039417	INACTIVE	CSG	No	
				GILBERT GULLY 18		-27.5977722	150.8977361	ACTIVE	CSG	Yes	Fracture
				GILBERT GULLY 2		-27.5405111	150.9077139	INACTIVE	CSG	No	
				GILBERT GULLY 3		-27.5982444	150.8997694	ACTIVE	CSG	No	
				GILBERT GULLY 4		-27.5934389	150.9083222	ACTIVE	CSG	Yes	Fracture
				GILBERT GULLY 5J		-27.598925	150.907025	ACTIVE	CSG	No	
				GILBERT GULLY 5T		-27.5993722	150.9066806	ACTIVE	CSG	Yes	Fracture
				GILBERT GULLY 6		-27.6008389	150.9136028	ACTIVE	CSG	No	
				GILBERT GULLY 7		-27.6048972	150.9039417	ACTIVE	CSG	No	
				GILBERT GULLY 8		-27.547871	150.861036	INACTIVE	CSG	No	
				NANGWAY 1		-27.77835	150.957195	INACTIVE	Conventional	No	
				STATION CREEK 1		-27.7866667	150.9886111	INACTIVE	Conventional	No	
				WAAR WAAR 11		-27.737244	150.860033	ACTIVE	CSG	No	
				WAAR WAAR 1-1A		-27.7679806	150.91775	INACTIVE	CSG	No	
				WAAR WAAR 14		-27.796255	150.941208	ACTIVE	CSG	Yes	Fracture
				WAAR WAAR 15		-27.789447	150.946487	ACTIVE	CSG	Yes	Fracture
				WAAR WAAR 16J		-27.793878	150.946293	ACTIVE	CSG	Yes	Fracture
				WAAR WAAR 16T		-27.794419	150.94565	ACTIVE	CSG	Yes	Fracture
				WAAR WAAR 17		-27.792545	150.951807	ACTIVE	CSG	Yes	Fracture
				WAAR WAAR 18		-27.797381	150.948747	ACTIVE	CSG	Yes	Fracture
				WAAR WAAR 19		-27.7944194	150.94565	INACTIVE	CSG	No	
				WAAR WAAR 2		-27.690314	150.8434811	INACTIVE	CSG	No	
				WAAR WAAR 5		-27.7367361	151.075269	INACTIVE	CSG	No	
				WAAR WAAR 7		-27.784603	150.873097	INACTIVE	CSG	No	
				WAGGABA 1		-27.7002778	150.9161111	INACTIVE	Conventional	No	
				WILKIE 1		-27.7722222	150.9168056	INACTIVE	Conventional	No	
				ZIG ZAG 1		-27.8902778	150.9286111	INACTIVE	Conventional	No	
				ZIG ZAG 10		-27.9635667	150.9274278	ACTIVE	CSG	No	
				ZIG ZAG 11J		-27.965125	150.9237306	ACTIVE	CSG	No	
				ZIG ZAG 11T		-27.9650389	150.9232639	ACTIVE	CSG	No	
				ZIG ZAG 12		-27.9685194	150.9249556	ACTIVE	CSG	No	
				ZIG ZAG 13		-27.9666778	150.9195639	ACTIVE	CSG	No	
				ZIG ZAG 14		-27.9655361	150.9231333	INACTIVE	CSG	No	
				ZIG ZAG 2		-27.902419	150.945288	INACTIVE	CSG	No	
				ZIG ZAG 5		-27.901221	151.070863	INACTIVE	CSG	No	
				ZIG ZAG 6		-27.9468528	150.8477333	INACTIVE	CSG	No	
				ZIG ZAG 7		-27.937111	150.9915	INACTIVE	CSG	No	
				ZIG ZAG 8		-27.866111	151.060433	ACTIVE	CSG	No	
				ZIG ZAG 9		-27.9616389	150.9217222	ACTIVE	CSG	No	

Tenure	Tenure Number	Environmental Authority	Tenure Operator	Well Name	Total Number of Well Pads	Latitude	Longitude	Status of Well	CSG/Conventional	Stimulation	Stimulation Type
ATP	692	PEN100067807	Australia Pacific LNG Pty Ltd		9						
				KAINAMA 4		-27.004	150.80175	ACTIVE	CSG	No	
				ORANA 10		-26.80455	150.5150361	ACTIVE	CSG	No	
				ORANA 11		-26.8065139	150.5195972	ACTIVE	CSG	No	
				ORANA 5		-26.8927806	150.5337147	ACTIVE	CSG	No	
				ORANA 7		-26.8517556	150.5622889	INACTIVE	CSG	No	
				ORANA 8		-26.8059972	150.5198667	ACTIVE	CSG	No	
				ORANA 9		-26.8019917	150.5200028	ACTIVE	CSG	No	
				TALINGA 20		-26.7309833	150.4937944	ACTIVE	CSG	No	
				WOLEEBEE NORTH 1		-26.1809444	149.8388083	INACTIVE	CSG	No	
PL (Application)	216	PEN100067807	Australia Pacific LNG Pty Ltd		16						
				BOYANDA 1		-26.648362	150.117752	INACTIVE	Conventional	No	
				DALWOGAN 1		-26.6871417	150.164375	INACTIVE	CSG	No	
				DALWOGAN 12		-26.6305865	150.146027	ACTIVE	CSG	No	
				DALWOGAN 13		-26.630765	150.1505541	ACTIVE	CSG	Yes	Fracture
				DALWOGAN 14		-26.6314956	150.1460107	ACTIVE	CSG	Yes	Fracture
				DALWOGAN 16		-26.6296667	150.1460278	ACTIVE	CSG	Yes	Fracture
				DALWOGAN 17		-26.516802	150.1030219	ACTIVE	CSG	Yes	Future Fracture
				DALWOGAN 2		-26.6229556	150.1222722	INACTIVE	CSG	No	
				DALWOGAN 3		-26.6292667	150.1663972	ACTIVE	CSG	No	
				DALWOGAN 4		-26.5202222	150.1506667	ACTIVE	CSG	Yes	Future Fracture
				DALWOGAN 5		-26.6438389	150.1415778	ACTIVE	CSG	Yes	Future Fracture
				DALWOGAN 6		-26.7060917	150.1423528	ACTIVE	CSG	Yes	Future Fracture
				DALWOGAN 7		-26.5752889	150.1305111	ACTIVE	CSG	Yes	Future Fracture
				DALWOGAN 8		-26.5704389	150.1248306	ACTIVE	CSG	Yes	Future Fracture
				DALWOGAN 9		-26.5710194	150.1346528	ACTIVE	CSG	Yes	Future Fracture
				PADDY CREEK 1		-26.6163889	150.0866667	INACTIVE	Conventional	No	
PL (Application)	225	PEN100067807	Australia Pacific LNG Pty Ltd		7						
				KAINAMA 1		-27.0779944	150.8062056	INACTIVE	CSG	No	
				KAINAMA 10		-27.0541345	150.7168497	ACTIVE	CSG	No	
				KAINAMA 2		-27.0722528	150.6756944	ACTIVE	CSG	No	
				KAINAMA 5		-27.0742111	150.72485	ACTIVE	CSG	No	
				KAINAMA 6		-27.0197639	150.6949361	ACTIVE	CSG	No	
				KAINAMA 7		-27.0170722	150.7539528	INACTIVE	CSG	No	
				KAINAMA 8		-27.0486667	150.7634167	ACTIVE	CSG	No	

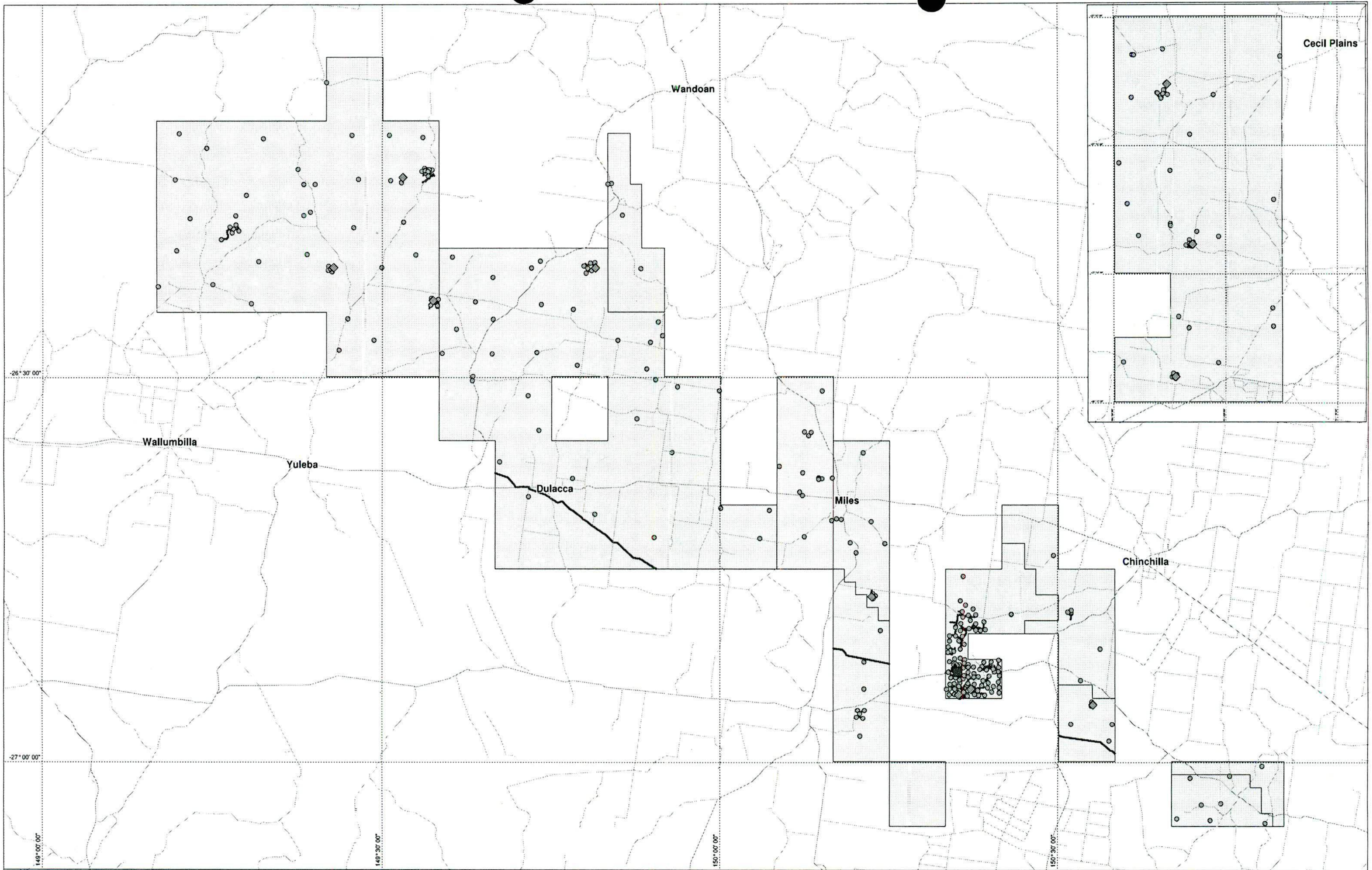
Tenure	Tenure Number	Environmental Authority	Tenure Operator	Well Name	Total Number of Well Pads	Latitude	Longitude	Status of Well	CSG/Conventional	Stimulation	Stimulation Type
ATP	702	PEN100067807	Australia Pacific LNG Pty Ltd								
PL (Application)	265		Australia Pacific LNG Pty Ltd		10						
				CONDABRI 1		-26.8277583	150.2377778	ACTIVE	CSG	No	
				CONDABRI 15		-26.930941	150.197231	ACTIVE	CSG	No	
				CONDABRI 16		-26.930739	150.209086	ACTIVE	CSG	No	
				CONDABRI 17J		-26.935588	150.203678	ACTIVE	CSG	No	
				CONDABRI 17T		-26.9355601	150.203166	ACTIVE	CSG	No	
				CONDABRI 18		-26.9404091	150.197748	ACTIVE	CSG	No	
				CONDABRI 19		-26.940629	150.208842	ACTIVE	CSG	No	
				CONDABRI 2		-26.8686639	150.2133333	ACTIVE	CSG	No	
				CONDABRI 8		-26.9034778	150.2133361	ACTIVE	CSG	No	
				CONDABRI 9		-26.965459	150.207322	ACTIVE	CSG	No	
PL (Application)	266		Australia Pacific LNG Pty Ltd		5						
				CONDABRI 10		-27.0531833	150.2784167	ACTIVE	CSG	No	
				CONDABRI 3		-27.02235	150.3171139	ACTIVE	CSG	No	
				CONDAMINE 1		-27.0327778	150.2977778	INACTIVE	Conventional	No	
				COOLOOMALA 1		-27.0525	150.2691667	INACTIVE	Conventional	No	
				MILES CREEK 1		-27.0127778	150.3263889	INACTIVE	Conventional	No	
PL (Application)	267		Australia Pacific LNG Pty Ltd		11						
				CHINCHILLA 4		-26.725	150.2	INACTIVE	Conventional	No	
				CONDABRI 12		-26.6858528	150.2223389	ACTIVE	CSG	No	
				CONDABRI 13		-26.7142583	150.1925917	ACTIVE	CSG	No	
				CONDABRI 14		-26.5976444	150.2116611	INACTIVE	CSG	No	
				CONDABRI 4		-26.7803389	150.2262028	ACTIVE	CSG	No	
				CONDABRI 5		-26.7803583	150.2267056	ACTIVE	CSG	No	
				CONDABRI 6		-26.7830778	150.2305194	ACTIVE	CSG	No	
				CONDABRI 7		-26.7868917	150.2277667	ACTIVE	CSG	No	
				DOGWOOD 1		-26.685028	150.175252	INACTIVE	Conventional	No	
				MILES 1		-26.6855	150.1786667	INACTIVE	Conventional	No	
				YUWANDI 1		-26.7153861	150.244275	INACTIVE	CSG	No	

Tenure	Tenure Number	Environmental Authority	Tenure Operator	Well Name	Total Number of Well Pads	Latitude	Longitude	Status of Well	CSG/Conventional	Stimulation	Stimulation Type
ATP	847	PEN100068007 (150 040)	Australia Pacific LNG Pty Ltd								
ATP (Application)	972		Australia Pacific LNG Pty Ltd		21						
				HORSE CREEK 12		-26.4015236	149.6393448	ACTIVE	CSG	Yes	Future Fracture
				HORSE CREEK 13		-26.4382873	149.6140914	ACTIVE	CSG	Yes	Future Fracture
				HORSE CREEK 16		-26.4490508	149.6519482	ACTIVE	CSG	Yes	Future Fracture
				HORSE CREEK 2		-26.4243472	149.6644194	ACTIVE	CSG	No	
				HORSE CREEK 3		-26.3696083	149.6641444	ACTIVE	CSG	No	
				HORSE CREEK 4		-26.3570861	149.7215389	ACTIVE	CSG	No	
				HORSE CREEK 5		-26.4052472	149.7356944	ACTIVE	CSG	Yes	Fracture
				HORSE CREEK 6		-26.468301	149.5888549	ACTIVE	CSG	Yes	Fracture
				HORSE CREEK 7		-26.4689367	149.6627007	ACTIVE	CSG	No	
				HORSE CREEK 8		-26.3429188	149.6041111	ACTIVE	CSG	No	
				RAMYARD 1		-26.3502222	149.8152222	INACTIVE	CSG	No	
				RAMYARD 11		-26.4840194	149.7881778	ACTIVE	CSG	No	
				RAMYARD 2		-26.3547056	149.7983556	ACTIVE	CSG	No	
				RAMYARD 3		-26.350875	149.8086111	ACTIVE	CSG	No	
				RAMYARD 4		-26.36051	149.81038	ACTIVE	CSG	No	
				RAMYARD 5		-26.363925	149.80202	ACTIVE	CSG	No	
				RAMYARD 6		-26.3576667	149.8046111	ACTIVE	CSG	No	
				RAMYARD 7		-26.4128778	149.7819194	ACTIVE	CSG	Yes	Future Fracture
				RAMYARD 8		-26.4670194	149.729325	ACTIVE	CSG	Yes	Future Fracture
				ROMA 2 (GSQ)		-26.348367	149.734422	INACTIVE	Conventional	No	
				ROMA 3 (GSQ)		-26.498367	149.634426	INACTIVE	Conventional	No	
ATP (Application)	973	PEN100389509	Australia Pacific LNG CSG Marketing Pty Ltd		21						
				BYME CREEK 1		-26.6705333	149.7189917	ACTIVE	CSG	Yes	Future Fracture
				BYME CREEK 2		-26.6751583	149.8163306	ACTIVE	CSG	Yes	Future Fracture
				BYME CREEK 3		-26.7076639	149.9032528	ACTIVE	CSG	Yes	Future Fracture
				CARINYA 2		-26.4274444	149.9086944	INACTIVE	CSG	No	
				CARINYA 3		-26.5023611	149.90475	INACTIVE	CSG	No	
				CARINYA 4		-26.5325278	149.9994111	ACTIVE	CSG	Yes	Fracture
				CARINYA 5		-26.4555611	149.8935694	ACTIVE	CSG	Yes	Fracture
				CARINYA 6		-26.4492333	149.8488278	ACTIVE	CSG	Yes	Future Fracture
				CARINYA 8		-26.514925	149.9366833	ACTIVE	CSG	Yes	Future Fracture
				CARINYA SOUTH 1		-26.6723278	150.0732111	INACTIVE	CSG	No	
				CARINYA SOUTH 2		-26.6815944	150.021625	ACTIVE	CSG	Yes	Future Fracture
				CARINYA SOUTH 3		-26.7088528	150.0591639	ACTIVE	CSG	Yes	Future Fracture
				DULACCA 1		-26.5547222	149.8761111	INACTIVE	Conventional	No	
				FERRETT 1		-26.4902778	149.8905556	INACTIVE	Conventional	No	
				GLENAUBYN 1		-26.4466667	149.9138889	INACTIVE	Conventional	No	
				NOONGA CREEK 1		-26.5038083	149.6333472	ACTIVE	CSG	Yes	Fracture
				NOONGA CREEK 5		-26.5208944	149.7180722	ACTIVE	CSG	Yes	Future Fracture
				NOONGA CREEK 6		-26.5648667	149.7259111	ACTIVE	CSG	Yes	Fracture
				WYGI CREEK 1		-26.6164655	149.6761471	ACTIVE	CSG	Yes	Future Fracture
				WYGI CREEK 2		-26.6231625	149.7606964	ACTIVE	CSG	Yes	Future Fracture
				WYGI CREEK 3		-26.5970793	149.9292361	ACTIVE	CSG	Yes	Future Fracture

Tenure	Tenure Number	Environmental Authority	Tenure Operator	Well Name	Total Number of Well Pads	Latitude	Longitude	Status of Well	CSG/Conventional	Stimulation	Stimulation Type
PL	209	PEN100068007 (150 040)	Australia Pacific LNG Pty Ltd		4						
				WOLEEBEE EAST 1		-26.2489444	149.838625	INACTIVE	CSG	No	
				WOLEEBEE EAST 2		-26.3580194	149.8831111	ACTIVE	CSG	No	
				WOLEEBEE EAST 3		-26.2945861	149.8576472	ACTIVE	CSG	No	
				WOLEEBEE EAST 4		-26.3860344	149.8470334	INACTIVE	CSG	No	

Tenure	Tenure Number	Environmental Authority	Tenure Operator	Well Name	Total Number of Well Pads	Latitude	Longitude	Status of Well	CSG/Conventional	Stimulation	Stimulation Type
PL	215	PEN100067807	Australia Pacific LNG Pty Ltd		6						
				DEVONDALE 1		-26.9503133	150.580484	INACTIVE	Conventional	No	
				ORANA 1		-26.9719833	150.5753694	INACTIVE	CSG	No	
				ORANA 2		-26.9199944	150.5501889	ACTIVE	CSG	No	
				ORANA 3		-26.9248083	150.5490139	ACTIVE	CSG	No	
				ORANA 4		-26.92315	150.5536111	ACTIVE	CSG	No	
				ORANA 6		-26.9495917	150.5191611	ACTIVE	CSG	No	

Tenure	Tenure Number	Environmental Authority	Tenure Operator	Well Name	Total Number of Well Pads	Latitude	Longitude	Status of Well	CSG/Conventional	Stimulation	Stimulation Type
PL	226	PEN100067807	Australia Pacific LNG Pty Ltd		107						
				TALINGA 1		-26.8849389	150.4134417	INACTIVE	CSG	No	
				TALINGA 10		-26.9052	150.3671778	ACTIVE	CSG	No	
				TALINGA 100		-26.8883528	150.3682611	ACTIVE	CSG	No	
				TALINGA 104		-26.82821	150.35597	ACTIVE	CSG	No	
				TALINGA 105		-26.81908	150.35712	ACTIVE	CSG	No	
				TALINGA 106		-26.82576	150.36886	ACTIVE	CSG	No	
				TALINGA 107		-26.82755	150.37842	ACTIVE	CSG	No	
				TALINGA 108		-26.82817	150.38606	ACTIVE	CSG	No	
				TALINGA 109		-26.82755	150.39396	ACTIVE	CSG	No	
				TALINGA 11		-26.9056333	150.3546056	ACTIVE	CSG	Yes	Fracture
				TALINGA 110		-26.81713	150.38821	ACTIVE	CSG	No	
				TALINGA 111		-26.81864	150.37948	ACTIVE	CSG	No	
				TALINGA 112		-26.80834	150.38132	ACTIVE	CSG	No	
				TALINGA 113		-26.8005	150.37621	ACTIVE	CSG	No	
				TALINGA 114		-26.81612	150.36971	ACTIVE	CSG	No	
				TALINGA 115		-26.80828	150.3686	ACTIVE	CSG	No	
				TALINGA 116		-26.81142	150.35891	ACTIVE	CSG	No	
				TALINGA 117		-26.80385	150.35883	ACTIVE	CSG	No	
				TALINGA 118		-26.78967	150.35618	ACTIVE	CSG	No	
				TALINGA 119		-26.79581	150.36425	ACTIVE	CSG	No	
				TALINGA 12		-26.9053056	150.3669389	ACTIVE	CSG	Yes	Fracture
				TALINGA 121		-26.8072722	150.4315639	ACTIVE	CSG	No	
				TALINGA 122		-26.89571	150.39769	ACTIVE	CSG	No	
				TALINGA 123		-26.90053	150.40555	ACTIVE	CSG	No	
				TALINGA 13		-26.9075861	150.3611972	ACTIVE	CSG	Yes	Fracture
				TALINGA 14		-26.9137111	150.35555	ACTIVE	CSG	Yes	Fracture
				TALINGA 15		-26.912381	150.36535	ACTIVE	CSG	Yes	Fracture
				TALINGA 15B		-26.9123	150.3665	ACTIVE	CSG	No	
				TALINGA 16		-26.8230889	150.3492167	ACTIVE	CSG	No	
				TALINGA 17		-26.7578056	150.3603111	ACTIVE	CSG	No	
				TALINGA 18		-26.9082583	150.3566889	ACTIVE	CSG	No	
				TALINGA 19		-26.9096	150.3656611	ACTIVE	CSG	No	
				TALINGA 2		-26.8766167	150.4035	ACTIVE	CSG	Yes	Fracture
				TALINGA 21		-26.9101528	150.3475	ACTIVE	CSG	No	
				TALINGA 22		-26.9104167	150.33975	ACTIVE	CSG	No	
				TALINGA 23		-26.9001556	150.3539083	ACTIVE	CSG	No	
				TALINGA 24		-26.9036361	150.3478333	ACTIVE	CSG	No	
				TALINGA 25		-26.9036833	150.3396711	ACTIVE	CSG	No	
				TALINGA 26		-26.8976389	150.3409444	ACTIVE	CSG	No	
				TALINGA 27		-26.8966583	150.3472833	ACTIVE	CSG	No	
				TALINGA 28		-26.8929333	150.3545139	ACTIVE	CSG	No	
				TALINGA 29		-26.8891556	150.3491944	ACTIVE	CSG	No	
				TALINGA 3		-26.8829306	150.4054722	ACTIVE	CSG	No	
				TALINGA 30		-26.88289	150.34478	ACTIVE	CSG	No	
				TALINGA 31		-26.88195	150.33846	ACTIVE	CSG	No	
				TALINGA 32		-26.8893	150.3422611	ACTIVE	CSG	No	
				TALINGA 34		-26.88548	150.35495	ACTIVE	CSG	No	
				TALINGA 35		-26.87928	150.35491	ACTIVE	CSG	No	
				TALINGA 36		-26.88581	150.36244	ACTIVE	CSG	No	
				TALINGA 37		-26.882325	150.3682611	ACTIVE	CSG	No	
				TALINGA 38		-26.88377	150.37654	ACTIVE	CSG	No	
				TALINGA 39		-26.89035	150.3605722	ACTIVE	CSG	No	
				TALINGA 4		-26.8828194	150.41135	ACTIVE	CSG	No	
				TALINGA 40		-26.8754028	150.4128278	ACTIVE	CSG	No	
				TALINGA 41		-26.8961748	150.3676726	ACTIVE	CSG	No	
				TALINGA 43		-26.8892083	150.3768611	ACTIVE	CSG	No	
				TALINGA 44		-26.897375	150.3769528	ACTIVE	CSG	No	
				TALINGA 46		-26.9039437	150.3812603	ACTIVE	CSG	No	
				TALINGA 47		-26.9113306	150.3922667	ACTIVE	CSG	No	
				TALINGA 48		-26.9117444	150.38355	ACTIVE	CSG	No	
				TALINGA 49		-26.9103472	150.3772278	ACTIVE	CSG	No	
				TALINGA 5		-26.87605	150.387125	ACTIVE	CSG	Yes	Fracture
				TALINGA 50		-26.88718	150.38277	ACTIVE	CSG	No	
				TALINGA 51		-26.8752	150.37608	ACTIVE	CSG	No	
				TALINGA 52		-26.9016417	150.4137778	ACTIVE	CSG	No	
				TALINGA 53		-26.86889	150.3905833	ACTIVE	CSG	No	
				TALINGA 54		-26.87853	150.38523	ACTIVE	CSG	No	
				TALINGA 55		-26.8789472	150.39539	ACTIVE	CSG	No	
				TALINGA 56		-26.8777778	150.4053167	ACTIVE	CSG	No	
				TALINGA 57		-26.8682222	150.40228	ACTIVE	CSG	No	
				TALINGA 58		-26.8662083	150.41266	ACTIVE	CSG	No	
				TALINGA 6		-26.9053444	150.3548028	INACTIVE	CSG	No	
				TALINGA 60		-26.89923	150.38789	ACTIVE	CSG	No	
				TALINGA 61		-26.89324	150.39009	ACTIVE	CSG	No	
				TALINGA 62		-26.88756	150.40036	ACTIVE	CSG	No	
				TALINGA 63		-26.90211	150.39637	ACTIVE	CSG	No	
				TALINGA 64		-26.88654	150.41429	ACTIVE	CSG	No	
				TALINGA 65		-26.8949361	150.4125972	ACTIVE	CSG	No	
				TALINGA 66		-26.9085167	150.413675	ACTIVE	CSG	No	
				TALINGA 67		-26.8775	150.34587	ACTIVE	CSG	No	
				TALINGA 68		-26.86977	150.34677	ACTIVE	CSG	No	
				TALINGA 69		-26.86857	150.33854	ACTIVE	CSG	No	
				TALINGA 7		-26.8956694	150.355675	ACTIVE	CSG	Yes	Fracture
				TALINGA 71		-26.8630417	150.3474528	ACTIVE	CSG	No	
				TALINGA 72		-26.8542	150.34728	ACTIVE	CSG	No	
				TALINGA 73		-26.85666	150.33789	ACTIVE	CSG	No	
				TALINGA 74		-26.84899	150.33832	ACTIVE	CSG	No	
				TALINGA 75		-26.87217	150.35467	ACTIVE	CSG	No	
				TALINGA 76		-26.87681	150.36106	ACTIVE	CSG	No	
				TALINGA 77		-26.87545	150.36817	ACTIVE	CSG	No	
				TALINGA 78		-26.86941	150.36076	ACTIVE	CSG	No	
				TALINGA 79		-26.86354	150.35576	ACTIVE	CSG	No	
				TALINGA 8		-26.9073806	150.3612639	ACTIVE	CSG	No	
				TALINGA 80		-26.86432	150.36323	ACTIVE	CSG	No	
				TALINGA 81		-26.87168	150.36806	ACTIVE	CSG	No	
				TALINGA 82		-26.90725	150.40259	ACTIVE	CSG	No	
				TALINGA 83		-26.85156	150.35633	ACTIVE	CSG	No	
				TALINGA 84		-26.84565	150.36154	ACTIVE	CSG	No	
				TALINGA 85		-26.84182	150.35298	ACTIVE	CSG	No	
				TALINGA 86		-26.83581	150.35966	ACTIVE	CSG	No	
				TALINGA 87		-26.83456	150.34879	ACTIVE	CSG	No	
				TALINGA 88		-26.83454	150.3401	ACTIVE	CSG	No	
				TALINGA 89		-26.84158	150.34004	ACTIVE	CSG	No	
				TALINGA 9		-26.8987028	150.366175	ACTIVE	CSG	Yes	Fracture
				TALINGA 91		-26.82366	150.34912	ACTIVE	CSG	No	
				TALINGA MB3 H		-26.892639	150.3691937	INACTIVE	CSG	No	
				XYLON 1		-26.9052778	150.3344444	INACTIVE	Conventional	No	



GIS Section
Exploration and Production
Together we can make a difference TM

origin

APLNG Existing Infrastructure

Date: 20th January 2011

State: Queensland
Project: APLNG
Permit:
Map No: 1 of 1
Map ID: GISWR_03137_RevA

LEGEND

- Gas Plant Facility
- Water Treatment Facility
- Pond
- Well
- Pipeline
- APLNG Permit

N

Locations indicative and subject to change

10 0 10 20 30

Datum: GDA 94 Lat/Long Units: Kilometres Scale 1:500,000 @ A3

2009/4974: Australia Pacific LNG Pty Limited/Energy generation and supply (non-renewable)/Walloon Gas Fields, Surat Basin, Darling Downs/QLD/Expansion of Coal Seam Gas Fields					
Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
Wetlands of international importance (s16 & 17b)	Narran Lake Nature Reserve & Shoalwater and Corio Bays Area	The only wetlands occurring in the vicinity of the gas fields' development area with potential relevance to the controlling provisions are the Balonne River Floodplain complex, including the Ramsar listed Narran Lakes. There is a low risk of impact to Narran Lakes during operations. Narran Lakes is located approximately 500km downstream of the proposed discharge locations and it is unlikely that significant flows would reach Beardmore Dam, due to transmission losses and agricultural use. Any water that did reach Beardmore Dam would be used to supplement the St George Water Supply Scheme and potentially be available as compensation flows to the Narran Lakes. As a result, any project-	p. 32, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 143, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for Ramsar wetlands (section 23.7.1). The result determined there are no significant impacts predicted for the Ramsar wetland. p. 176, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		related flow contributions into the Condamine River would provide positive benefit. Additional modelling will be completed as part of detailed design of any discharges which will confirm these findings.			
Listed threatened species and communities (s18 & 18A)	**Threatened communities**				
	Brigalow (*Acacia harpophylla* dominant and co-dominant) **Endangered**	There is a potential loss of up to approximately 70ha of this ecological community, which equates to 0.4% of study area extent and 0.06% of the relevant provincial extent. Proposed offsets will be designed to increase overall connectivity of remnant vegetation communities across the local landscape. The proposed actions will not interfere with the recovery of this ecological community.	p. 33-35, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.	The total clearing of Brigalow is 75.41ha (p. 3, APLNG Environmental Offset Strategy).	The EIS estimates 83 ha of endangered RE (excluding RE 11.3.2 which is endangered only when Weeping Myall is present) will be cleared as a result of the gas fields. This equates to less than 0.15 per cent of the provincial extent of any of the communities. These areas are generally those isolated from adjoining vegetation and/or occurring adjacent to currently disturbed vegetation and/or cleared areas. The EIS concluded that the most sensitive areas are associated with remnant Brigalow communities and highly sensitive remnant vegetation occurring within Bioregional corridors.

2009/4974: Australia Pacific LNG Pty Limited/Energy generation and supply (non-renewable)/Walloon Gas Fields, Surat Basin, Darling Downs/QLD/Expansion of Coal Seam Gas Fields					
Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					The EIS includes an assessment of the proposed clearing for the gas fields against the significant impact criteria for the threatened ecological communities (section 23.4). The result determined there are no significant impacts predicted for threatened ecological communities. Although not assessed as significant, the EIS recognises that potential impacts of the gas fields on threatened terrestrial communities are likely to be primarily associated with habitat loss, degradation, fragmentation, isolation and loss of connectivity due to the physical clearing of vegetation. p. 174, Coordinator-General's Report—Australia Pacific LNG.
	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* **Critically Endangered**	No occurrences of the remaining three endangered ecological communities have been confirmed or are considered likely for the gas fields' study area. These three communities are: • Natural grasslands on basalt and fine-textured alluvial plains of	p. 155, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS estimates 83 ha of endangered RE (excluding RE 11.3.2 which is endangered only when Weeping Myall is present) will be cleared as a result of the gas fields. This equates to less than 0.15 per cent of the provincial extent of any of the communities. These areas are generally those isolated from adjoining vegetation and/or occurring

2009/4974: Australia Pacific LNG Pty Limited/Energy generation and supply (non-renewable)/Walloon Gas Fields, Surat Basin, Darling Downs/QLD/Expansion of Coal Seam Gas Fields					
Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		northern New South Wales and southern Queensland • The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin • White box-yellow box-Blakely's red gum grassy woodland and derived native grassland.			adjacent to currently disturbed vegetation and/or cleared areas. The EIS includes an assessment of the proposed clearing for the gas fields against the significant impact criteria for the threatened ecological communities (section 23.4). The result determined there are no significant impacts predicted for threatened ecological communities. Although not assessed as significant, the EIS recognises that potential impacts of the gas fields on threatened terrestrial communities are likely to be primarily associated with habitat loss, degradation, fragmentation, isolation and loss of connectivity due to the physical clearing of vegetation. p. 174, Coordinator-General's Report—Australia Pacific LNG.
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions** **Endangered**	Endangered ecological communities representing Brigalow, semi-evergreen vine thicket and weeping myall open woodland are present within the study area.	p. 155, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.	The total clearing of Semi-evergreen vine thicket is 4.36ha (p. 3, APLNG Environmental Offset Strategy).	The EIS estimates 83 ha of endangered RE (excluding RE 11.3.2 which is endangered only when Weeping Myall is present) will be cleared as a result of the gas fields. This equates to less than 0.15 per cent of the provincial extent of any of the communities. These

2009/4974: Australia Pacific LNG Pty Limited/Energy generation and supply (non-renewable)/Walloon Gas Fields, Surat Basin, Darling Downs/QLD/Expansion of Coal Seam Gas Fields

Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		This ecological community is analogous to areas mapped as REs 11.8.3 and 11.9.4 within the study area. These REs cover an area of approximately 3,600ha of the study area, representing approximately 16% of that mapped as present in the relevant provinces. There is a potential loss of up to approximately 13ha of this ecological community, which equates to 0.4% of study area extent and 0.06% of the relevant provincial extent.	p. 37-38, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		areas are generally those isolated from adjoining vegetation and/or occurring adjacent to currently disturbed vegetation and/or cleared areas. The EIS includes an assessment of the proposed clearing for the gas fields against the significant impact criteria for the threatened ecological communities (section 23.4). The result determined there are no significant impacts predicted for threatened ecological communities. Although not assessed as significant, the EIS recognises that potential impacts of the gas fields on threatened terrestrial communities are likely to be primarily associated with habitat loss, degradation, fragmentation, isolation and loss of connectivity due to the physical clearing of vegetation. p. 174, Coordinator-General's Report—Australia Pacific LNG.
	The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin** **Endangered**	No occurrences of the remaining three endangered ecological communities have been confirmed or are considered likely for the	p. 155, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS estimates 83 ha of endangered RE (excluding RE 11.3.2 which is endangered only when Weeping Myall is present) will be cleared as a result of the gas fields. This

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		gas fields' study area. These three communities are: • Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland • The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin • White box-yellow box-Blakely's red gum grassy woodland and derived native grassland.			equates to less than 0.15 per cent of the provincial extent of any of the communities. These areas are generally those isolated from adjoining vegetation and/or occurring adjacent to currently disturbed vegetation and/or cleared areas. Section 7.5 of this report discusses potential impacts of groundwater drawdown on springs and associated groundwater-dependent ecosystems. APLNG advised that there is only one recognised spring within APLNG's gas fields' tenements and that field investigations could not identify any evidence of groundwater dependent vegetation at the site. The proponent considers it very unlikely any discharge springs occur within the area of potential drawdown from their CSG activities and that the closest registered discharge springs are at the Eulo springs complex, which is located approximately 500km southwest of the gas fields.

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
					The EIS includes an assessment of the proposed clearing for the gas fields against the significant impact criteria for the threatened ecological communities (section 23.4). The result determined there are no significant impacts predicted for threatened ecological communities. Although not assessed as significant, the EIS recognises that potential impacts of the gas fields on threatened terrestrial communities are likely to be primarily associated with habitat loss, degradation, fragmentation, isolation and loss of connectivity due to the physical clearing of vegetation. p. 174-5, Coordinator-General's Report—Australia Pacific LNG.
	Weeping Myall Woodlands* **Endangered**	Endangered ecological communities representing Brigalow, semi-evergreen vine thicket and weeping myall open woodland are present within the study area. Recent field surveys have found 30ha of this ecological community within the study area.	p. 155, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 35, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG		The EIS estimates 83 ha of endangered RE (excluding RE 11.3.2 which is endangered only when Weeping Myall is present) will be cleared as a result of the gas fields. This equates to less than 0.15 per cent of the provincial extent of any of the communities. These areas are generally those isolated from adjoining vegetation and/or occurring adjacent to currently disturbed

2009/4974: Australia Pacific LNG Pty Limited/Energy generation and supply (non-renewable)/Walloon Gas Fields, Surat Basin, Darling Downs/QLD/Expansion of Coal Seam Gas Fields

Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
		There is a potential loss of up to approximately 129ha of habitat suitable for this ecological community, which equates to 0.9% of study area extent and 0.1% of the relevant provincial extent.	Project.		vegetation and/or cleared areas. The EIS includes an assessment of the proposed clearing for the gas fields against the significant impact criteria for the threatened ecological communities (section 23.4). The result determined there are no significant impacts predicted for threatened ecological communities. Although not assessed as significant, the EIS recognises that potential impacts of the gas fields on threatened terrestrial communities are likely to be primarily associated with habitat loss, degradation, fragmentation, isolation and loss of connectivity due to the physical clearing of vegetation. p. 174, Coordinator-General's Report—Australia Pacific LNG.
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* **Critically Endangered**	No occurrences of the remaining three endangered ecological communities have been confirmed or are considered likely for the gas fields' study area. These three communities are: • Natural grasslands on	p. 155, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS estimates 83 ha of endangered RE (excluding RE 11.3.2 which is endangered only when Weeping Myall is present) will be cleared as a result of the gas fields. This equates to less than 0.15 per cent of the provincial extent of any of the communities. These areas are generally those

2009/4974: Australia Pacific LNG Pty Limited/Energy generation and supply (non-renewable)/Walloon Gas Fields, Surat Basin, Darling Downs/QLD/Expansion of Coal Seam Gas Fields					
Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland • The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin • White box-yellow box-Blakely's red gum grassy woodland and derived native grassland.			isolated from adjoining vegetation and/or occurring adjacent to currently disturbed vegetation and/or cleared areas. The EIS includes an assessment of the proposed clearing for the gas fields against the significant impact criteria for the threatened ecological communities (section 23.4). The result determined there are no significant impacts predicted for threatened ecological communities. Although not assessed as significant, the EIS recognises that potential impacts of the gas fields on threatened terrestrial communities are likely to be primarily associated with habitat loss, degradation, fragmentation, isolation and loss of connectivity due to the physical clearing of vegetation. p. 174, Coordinator-General's Report—Australia Pacific LNG.
	BIRDS				
	Anthochaera phrygia Regent Honeyeater** **Endangered**	Not expected to occur.	p. 96, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Erythrotriorchis radiatus Red Goshawk **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. A Management Plan has been required.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	*Geophaps scripta scripta** Squatter Pigeon (southern) **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Very sparse in the study area. Occurs in land zones 3, 4, 5, 7, 9 and 10. A Management Plan has been required.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 94-95, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Recorded during field surveys. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Lathamus discolor	A very occasional visitor	p. 96, Chapter 23,		The EIS includes an

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	Swift Parrot** **Endangered**	to the study area. Most likely to be recorded in REs 11.3.25, 11.3.26 and 11.3.27b in the study area. Currently recognised as occurring or possibly occurring within the study area. A Management Plan has been required.	Volume 2: Gas Fields, Australian Pacific LNG Project. p. 28, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern)* **Endangered**	Not expected to occur.	p. 97, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Polytelis swainsonii Superb Parrot **Vulnerable**	Not expected to occur.	p. 96, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Rostratula australis Australian Painted Snipe **Vulnerable**	Terrestrial species listed as Vulnerable under the EPBC Act are currently recognised as occurring or possibly occurring within the study area. Most likely in REs 11.3.2, 11.3.25 and 11.3.27b but could also occur in gilgaied areas. A Management Plan has been required.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 95, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Turnix melanogaster Black-breasted Button-quail** **Vulnerable**	Terrestrial species listed as Vulnerable under the EPBC Act are currently recognised as occurring or possibly occurring within the study area. Most likely to occur in REs 11.8.3, 11.9.4a and 11.9.4b in the study area. A Management Plan has been required.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 96, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	MAMMALS				
	Chalinolobus dwyeri Large-eared Pied Bat,	Terrestrial species listed as Vulnerable	p. 30, Chapter 23, Volume 2: Gas Fields,		The EIS includes an assessment of the proposed

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
	Large Pied Bat **Vulnerable**	under the EPBC Act are currently recognised as occurring or possibly occurring within the study area. Possibly occurs in vegetation on sandstone in the study area, such as 11.10.1 and in areas of Callitris such as REs 11.3.14 and 11.3.18. A Management Plan has been required.	Australian Pacific LNG Project. p. 98, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Dasyurus hallucatus Northern Quoll*** **Endangered**	No actual database records, EPBC search only. Not expected to occur. However a management plan has been required as it has been identified as potentially present in other adjacent CSG projects and management plans were required.	p. 97, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Nyctophilus timoriensis (South-eastern form) Eastern Long-eared Bat **Vulnerable**	EIS states that this species is no longer considered to occur in Australia, but SPRAT notes the South-eastern Long-eared Bat is mainly recorded in the Brigalow Belt South	p. 122-123, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
		Bioregion. EIS states no important population is known for the study area. Some potential habitat for this species would be lost as a result of the proposed action. A Management Plan has been required.			threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	RAY FINNED FISHES				
	Maccullochella peelii peelii Murray Cod, Cod, Goodoo** **Vulnerable**	An aquatic ecology, water quality and geomorphology assessments of the study area were undertaken. This assessment concludes that there is a low risk of impact to Murray Cod during construction or operation. The main impact during the construction phase is increased sediment delivery. Murray Cod are unlikely to be affected by short-term increases in sediment delivery as they are adapted to high levels of TSS and turbidity and populations are artificially maintained in	p. 124, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.	Potential impacts of the Project on freshwater fish habitats are currently being investigated. Impacts will be addressed in accordance with DEEDI's *Fish Habitat Management Operational Policy FHMOP 005 (2002).* (p. 9, APLNG Environmental Offset Strategy).	The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened aquatic fauna species (section 23.5.3). The result determined there are no significant impacts predicted for the threatened aquatic fauna species. p. 176, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
		the Condamine-Balonne River, through stocking. A Management Plan has been required.			
	REPTILES				
	Anomalopus mackayi Five-clawed Worm-skink, Long-legged Wormskink* **Vulnerable**	Not expected to occur.	p. 93, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Delma torquata Collared Delma* **Vulnerable**	Cryptic species that may occur elsewhere in the study area in suitable habitat. RE 11.3.2 could be an important habitat for the species but most typical habitat is Land Zone 10 in RE's 11.10.1 and 11.10.1d. A Management Plan has been required.	p. 92, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Denisonia maculata Ornamental Snake **Vulnerable**	Not expected to occur.	p. 94, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG		The EIS includes an assessment of the proposed impact of the gas fields against

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
			Project.		the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Egernia rugosa Yakka Skink **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Confirmed population of Yakka Skink on figure 23.13 of EIS. Important habitat for the species includes RE 11.3.2, 11.3.3, 11.3.14, 11.4.4 and 11.9.3. Also occurs in Land Zone 5.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 93, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.	24 RE's are identified as providing potential habitat for the Yakka Skink in the Gas Fields. However, not all potential habitat will be utilised by the target species (p. 9, APLNG, Fauna Habitat Calculations for the Gas Fields). Table 6 outlines the proportion of good quality habitat for the target species in the gas fields. This equates to 1.13% of overall habitat or 66.77ha for the Yakka Skink. (p. 12-14, APLNG, Fauna Habitat Calculations for the Gas Fields).	The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Furina dunmalli	Currently recognised as	p. 30, Chapter 23,	6 RE's are identified as	The EIS includes an

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
	Dunmall's Snake **Vulnerable**	occurring or possibly occurring within the study area. Could be widespread at low densities throughout the study area. Occurs in Land Zones 3, 4, 5, 7, 9 and 10 but insufficiently known to identify most important REs.	Volume 2: Gas Fields, Australian Pacific LNG Project. p. 94, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.	providing potential habitat for the Dunmall's Snake in the Gas Fields. However, not all potential habitat will be utilised by the target species (p. 9, APLNG, Fauna Habitat Calculations for the Gas Fields). Table 6 outlines the proportion of good quality habitat for the target species in the gas fields. This equates to 6.80% of overall habitat or 238.63ha for the Dunmall's Snake. (p. 12-14, APLNG, Fauna Habitat Calculations for the Gas Fields).	assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Paradelma orientalis Brigalow Scaly-foot* **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Could occur throughout the study area. Most important habitats are REs 11.9.5, 11.10.1, 11.10.1d, and 11.10.4.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 92-93, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.	31 RE's are identified as providing potential habitat for the Brigalow Scaly-foot in the Gas Fields. However, not all potential habitat will be utilised by the target species (p. 9, APLNG, Fauna Habitat Calculations for the Gas Fields).	Recorded during field surveys. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
				Table 6 outlines the proportion of good quality habitat for the target species in the gas fields. This equates to 11.67% of overall habitat or 703.84ha for the Brigalow Scaly-foot. p. 12-14, APLNG, Fauna Habitat Calculations for the Gas Fields. p. 3, APLNG Environmental Offset Strategy.	p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Rheodytes leukops Fitzroy Tortoise* **Vulnerable**	Not expected to occur.	p. 92, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	PLANTS				
	Acacia chinchillensis **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
		A Management Plan has been required.			the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Acacia curranii Curly-bark Wattle* **Vulnerable**	Known to occur within Talinga/Orana tenement (Craig Eddie pers. comm.) and one record within Orana tenement during the recent ground surveys. Known to occur within study area. A Management Plan has been required.	p. 45, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	*Acacia lauta** **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Restricted to the Inglewood – Tara region in the Darling Downs district of southern Queensland. Known to occur within study Area. A Management Plan	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 46, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.

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		has been required.			
	*Acacia wardelli** **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Restricted to south of Roma, south-west of Chinchilla and the Thomby Range, near Surat, south-eastern Queensland. Known to occur within Talinga/Orana tenement (Craig Eddie pers. comm.) and one record approximately 2.3km west of Condabri tenement during the recent ground survey. Known to occur within study area. A Management Plan has been required.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 46-47, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Cadellia pentastylis Ooline* **Vulnerable**	Known to occur within Woleebee tenement, between Jackson-Wandoan Road and Gurulmundi State Forest. Nine records from within Wooleebee tenement during the recent ground surveys (Volume 5 Attachment 14). REs 11.9.4, 11.9.5,	p. 50, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 62-63, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species.

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		11.7.2, 11.9.10, and 11.9.1. There is a proposed loss of approximately 703ha of potential habitat (following mitigation), which equates to 0.8% of the extent within the study area and 0.2% of the extent within the relevant provinces. Relevant provinces include provinces 25, 26, 27, 28, 30, 31 and 32 of the BBS bioregion (Section 2.3.1 of Volume 5 Attachment 14). A Management Plan has been required.			p. 175, Coordinator-General's Report—Australia Pacific LNG.
	*Calytrix gurulmundensis** **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Restricted to the Gurulmundi, Guluguba and Barakula area in south-eastern Queensland. Eleven records from within Wooleebee tenement during the recent	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 47, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.

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		ground surveys (Volume 5 Attachment 14). Known to occur within study area. A Management Plan has been required.			
	*Commersonia argentea** a shrub **Vulnerable**	Restricted to central and southern Queensland from near Injune west to Tambo. Not likely to occur within study area.	p. 43, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	*Denhamia parvifolia** **Vulnerable**	Restricted to the greater Chinchilla area in south-eastern Queensland. Known to occur in vine thicket at Allies Creek Area (Craig Eddie pers. comm.). Not likely to occur within study area.	p. 44, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Digitaria porrecta Finger Panic Grass* **Endangered**	Restricted to coastal regions of south Queensland and in	p. 49, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG		The EIS includes an assessment of the proposed impact of the gas fields against

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		northern NSW. Not likely to occur within study area.	Project.		the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Diuris sheaffiana Tricolour Diuris Was vulnerable but due to taxonomic revision because it was found to be the same species as found Diuris sheaffiana it has been delisted and is no longer EPBC listed. **Not being considered further in this assessment**.	Is known to occur within the study area and potential habitat includes REs 11.10.9, 11.3.39, 11.9.7, 11.7.2, 11.7.5, 11.7.4, 11.3.4, 11.3.19, 11.5.20, 11.7.7, 11.3.2, 11.3.14, 11.5.1, 11.5.4, 11.7.6, 11.3.25, 11.5.5, 11.10.1, 11.10.11, 11.9.10, 11.10.9, and 11.3.18. There is a proposed loss of approximately 5,728ha of potential habitat (following mitigation), which equates to 1.1% of the extent within the study area and 0.3% of the extent within the relevant provinces. Relevant provinces include provinces 25,	p. 67-68, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.

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		26, 27, 28, 30, 31 and 32 of the BBS bioregion (Section 2.3.1 of Volume 5 Attachment 14).			
	*Eucalyptus virens** **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Although EIS states restricted to two localities at Isla Gorge and north-east of Baroondah Station in central Queensland and not likely to occur within study area, a Management Plan has been required.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 47, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	*Homopholis belsonii** Belson's Panic Grass **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Restricted to Darling Downs region in southern Queensland to north-west slopes of northern New South Wales. Two records from within Carinya tenement during the recent ground surveys	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 49, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		(Volume 5 Attachment 14). Known to occur within study area.			
	*Philotheca sporadica** **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Known to occur within study area. The presence of this species within the study area has been confirmed and distribution records suggest that the study area is of high importance to this species. Potential habitat includes REs 11.4.10, 11.5.1, 11.5.4, 11.7.6, 11.7.2, 11.7.7, 11.7.5, 11.7.4, 11.5.21, and 11.3.18. There is a proposed loss of approximately 37ha of potential habitat representing 2.5% of the total available habitat within the Gurulmundi region.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 49, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 80, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Prostanthera sp. Dunmore (D.M.Gordon 84)* **Vulnerable**	Currently recognised as occurring or possibly occurring within the	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG		The EIS includes an assessment of the proposed impact of the gas fields against

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		study area. Possibly occurs within study area. Potential habitat includes RE 11.10.11. There is a proposed loss of approximately 126ha of potential habitat (following mitigation), which equates to 1.7% of the extent within the study area and 0.1% of the extent within the relevant provinces. A Management Plan has been required.	Project. p. 44, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 81-82, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Pterostylis cobarensis Cobar Greenhood Orchid* **Vulnerable**	Currently recognised as occurring or possibly occurring within the study area. Known to occur within study area. This species has a confirmed present within the study area and potential habitat includes REs 11.7.6, 11.7.2, 11.7.7, 11.7.5, 11.7.4, 11.10.9, 11.5.2, 11.5.4, 11.5.21, 11.5.5,	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 48, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 83, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
		and 11.10.1. There is a proposed loss of approximately 4,944ha of potential habitat (following mitigation), which equates to 1.1% extent within the study area and 0.3% of the extent within the relevant provinces. Relevant provinces include provinces 25, 26, 27, 28, 30, 31 and 32 of the BBS bioregion (Section 2.3.1 of Volume 5 Attachment 14). A Management Plan has been required.	p. 85, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		
	Rhaponticum australe Austral Cornflower, Native Thistle* **Vulnerable**	Not likely to occur within study area.	p. 43, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Swainsona murrayana Slender Darling-pea, Slender Swainson, Murray	Not likely to occur within study area.	p. 44, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG		The EIS includes an assessment of the proposed impact of the gas fields against

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
	Swainson-pea* **Vulnerable**		Project.		the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	Thesium australe Austral Toadflax, Toadflax **Vulnerable**	Not likely to occur within study area.	p. 49, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	*Tylophora linearis** **Endangered**	Searches for this species have failed to confirm its presence within the study area. It is considered a possible occurrence, particularly within RE 11.7.5 of which there is currently approximately 20,000ha. There is a proposed	p. 86-87, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
		loss of approximately 126ha of potential habitat (following mitigation), which equates to 0.6% of the extent within the study area and 0.2% of the extent within the relevant provinces. Relevant provinces include provinces 25, 26, 27, 28, 30, 31 and 32 of the BBS bioregion (Section 2.3.1 of Volume 5 Attachment 14). A Management Plan has been required.			
	*Westringia parvifolia** **Vulnerable**	Not likely to occur within study area.	p. 45, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
	ADDITIONAL THREATENED SPECIES IDENTIFIED IN THE EIS				
	Herbaceous	Currently recognised as	p. 28, Chapter 23,		The EIS includes an

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
	*xerothamnella** **Endangered**	occurring or possibly occurring within the study area. Restricted to the Chinchilla – Goondiwindi region of southern Queensland. Possibly occurs within study area. Potential habitat for this species within the study area includes REs 11.4.10, 11.9.1, 11.3.3, 11.4.3, 11.7.6, 11.4.7, 11.9.5, 11.3.1, 11.3.17 and 11.9.10, totally approximately 45,000ha. There is a proposed loss of approximately 83ha of potential habitat (following mitigation), which equates to 0.4% of the extent within the study area and 0.05% of the extent within the relevant provinces. Relevant provinces include provinces 25, 26, 27, 28, 30, 31 and 32 of the BBS bioregion (Section 2.3.1 of Volume 5 Attachment	Volume 2: Gas Fields, Australian Pacific LNG Project. p. 43, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 88-90, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		14) A Management Plan has been required.			
	*Microcarpaea agonis** **Endangered**	Three endangered terrestrial flora species listed under the EPBC Act are predicted or have been found to occur in the study area. These species are: • *Herbaceous xerothamnella* • *Slender tylophora* • *Microcarpaea.* Restricted to Goondiwindi – Millmerran area in southern Queensland. Searches for this species have failed to confirm its presence within the study area. There is a proposed loss of approximately 478ha of potential habitat (following mitigation), which equates to 0.8% of the extent within the study area and 0.12% of the extent within the relevant provinces. Relevant provinces	p. 42, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 50, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 76-77, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		include provinces 25, 26, 27, 28, 30, 31 and 32 of the BBS bioregion (Section 2.3.1 of Volume 5 Attachment 14). A Management Plan has been required.			
	Eriocaulon carsonii (Salt Pipewort) **Endangered**	No confirmation of presence or impact identfied. Due to uncertainty around spring types within project impact area and potential for occurrence a Management Plan has been required.			
	Adclarkia dawsonensis (Boggomoss Snail) **Critically endangered**	No confirmation of presence or impact identfied. Due to uncertainty around spring types within project impact area and potential for occurrence a Management Plan has been required.			
	Pteropus poliocephalus Grey-headed flying-fox **Vulnerable**	No confirmation of presence within the study area.	p. 119-120 Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.5.2). The result determined there are no

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					significant impacts predicted for threatened terrestrial flora and fauna species. p. 175, Coordinator-General's Report—Australia Pacific LNG.
Listed migratory species (s20 & 20A)	**MIGRATORY TERRESTRIAL SPECIES**				
	BIRDS				
	Haliaeetus leucogaster White-bellied Sea-Eagle **Migratory**	Few suitably large water bodies in the study area. This species is recorded only sparsely in the study area but could occur on any suitable waterbody. A Management Plan has been required.	p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 137-138, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Recorded during field surveys. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Hirundapus caudacutus White-throated Needletail **Migratory**	Known to occur, or potentially occur, within the study area. An aerial species may occur over any habitat type, including cleared	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 127, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		land and infrastructure. A Management Plan has been required.	Project.		within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Merops ornatus Rainbow Bee-eater **Migratory**	Common and widespread in the study area. A Management Plan has been required.	p. 131, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
	Xanthomyza phrygia Regent Honeyeater** **Migratory**	Not expected to occur.	p. 131, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	MIGRATORY WETLAND SPECIES				
	BIRDS				
	Ardea alba Great Egret, White Egret **Migratory**	Known to occur, or potentially occur, within the study area. Common and widespread species that could occur throughout the study area. A Management Plan	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Recorded during field surveys. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		has been required.			birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Bubulcus ibis/Ardea ibis Cattle Egret **Migratory**	Could occur in any open habitats within study area, particularly with livestock. A Management Plan has been required.	p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Gallinago hardwickii Latham's Snipe, Japanese Snipe **Migratory**	Known to occur, or potentially occur, within the study area. Uncommon visitor to study area.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 129, Chapter 23, Volume 2: Gas Fields,		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any

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		A Management Plan has been required.	Australian Pacific LNG Project.		existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose **Migratory**	Known to occur, or potentially occur, within the study area. It will use artificial water bodies if they provide suitable resources.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 134, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					Report—Australia Pacific LNG.
	Rostratula benghalensis s. lat. Painted Snipe **Migratory**	These species are uncommon visitors to the study area but probably occur annually. Most likely in REs 11.3.2, 11.3.25 and 11.3.27b but could also occur in gilgaied areas. A Management Plan has been required.	p. 138-139, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 95, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	MIGRATORY MARINE BIRDS				
	Apus pacificus Fork-tailed Swift **Migratory**	Known to occur, or potentially occur, within the study area. Widespread but infrequent nonbreeding visitor to the study area. A Management Plan has been required.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Ardea alba Great Egret, White Egret **Migratory**	Known to occur, or potentially occur, within the study area. Common and widespread species that could occur throughout the study area. A Management Plan has been required.	p. 30, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Bubulcus ibis/Ardea ibis Cattle Egret **Migratory**	Could occur in any open habitats within study area, particularly	p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG		Has either been recorded previously or are considered possible occurrences based on

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		with livestock. A Management Plan has been required.	Project.		the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	ADDITIONAL MIGRATORY SPECIES IDENTIFIED IN THE EIS				
	Fregata ariel Lesser frigatebird **Migratory**	There is no suitable habitat and the species is not expected to occur again.	p. 127, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Ardea alba/Ardea modesta Eastern great egret **Migratory**	Common and widespread species that could occur throughout the study area. This species is known to occur in the study area with eastern great egret being common and widespread in a variety of habitats. A Management Plan has been required.	p. 127-8, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 136, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Plegadis falcinellus Glossy ibis **Migratory**	Could occur on any suitable waterbody throughout the study area. Recorded from, or	p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 133, Chapter 23,		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area.

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Controlling Provision	Provision Trigger	Description of impact from Environmental Impact Statement (EIS)	EIS Reference	Supplementary Information - Offset Strategy - Calculation of fauna impacts	Coordinator-General's Report
		predicted to occur in the study area. Glossy ibis will be restricted to open freshwater habitats such as swamps and lakes. A Management Plan has been required.	Volume 2: Gas Fields, Australian Pacific LNG Project. p. 136, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Pandion cristatus Eastern osprey **Migratory**	Few suitably large water bodies in the study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Pluvialis fulva Pacific golden plover **Migratory**	Very occasional visitor to the study area. Most likely on artificial water bodies and in fringing non-remnant vegetation. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 128, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Limosa limosa Black-tailed godwit **Migratory**	Very occasional visitor to the study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 129, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Limosa lapponica Bar-tailed godwit **Migratory**	Either absent or very occasional visitor to study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 129, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Numenius phaeopus Whimbrel **Migratory**	Either absent or very occasional visitor to study area.	p. 130, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Actitis hypoleucos Common sandpiper **Migratory**	Very occasional visitor to the study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 130, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Tringa nebularia Common greenshank **Migratory**	Occasional visitor to study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 130, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Tringa stagnatilis Marsh sandpiper **Migratory**	Occasional visitor to study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 130, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Tringa glareola Wood sandpiper **Migratory**	Very occasional visitor to study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 130, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Calidris ruficollis Red-necked stint	Very occasional visitor to the study area.	p. 130, Chapter 23, Volume 2: Gas Fields,		Has either been recorded previously or are considered

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
	Migratory	Known to occur, or potentially occur, within the study area. A Management Plan has been required.	Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Calidris acuminata Sharp-tailed sandpiper **Migratory**	Most commonly recorded sandpiper in the study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 130, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Calidris ferruginea Curlew sandpiper **Migratory**	Very occasional visitor to study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 131 Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Philomachus pugnax Ruff **Migratory**	Very occasional visitor to study area. Known to occur, or potentially occur, within the study area. A Management Plan	p. 131 Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		has been required.	Project.		within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Hydroprogne caspia Caspian tern **Migratory**	Few suitably large water bodies in the study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 131 Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
	Rhipidura rufifrons Rufous fantail **Migratory**	Though patchy, this species is well established within the study area (Craig Eddie pers. comm.). Most likely in REs 11.8.3, 11.9.4a and 11.9.4b. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 131 Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Myiagra cyanoleuca Satin flycatcher **Migratory**	Very occasional visitor to the study area. Often in gullies and along watercourses (Higgins et al. 2006a). Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 132 Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
					impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Monarcha melanopsis Black-faced monarch **Migratory**	Very occasional visitor to the study area. Known to occur, or potentially occur, within the study area. A Management Plan has been required.	p. 132 Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project. p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area. The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.
	Acrocephalus australis Australian reed-warbler **Migratory**	Uncommon in the study area due to a lack of water bodies with suitable fringing vegetation. Other than around artificial water	p. 132 Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		Has either been recorded previously or are considered possible occurrences based on the presence of suitable habitat within the gas fields area.

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Controlling Provision	**Provision Trigger**	**Description of impact from Environmental Impact Statement (EIS)**	**EIS Reference**	**Supplementary Information** - Offset Strategy - Calculation of fauna impacts	**Coordinator-General's Report**
		bodies is most likely in RE 11.3.27b. Known to occur, or potentially occur, within the study area A Management Plan has been required.	p. 30-31, Chapter 23, Volume 2: Gas Fields, Australian Pacific LNG Project.		The EIS suggests that any existing resources present within the study area would be used infrequently and on a transitory basis. The EIS includes an assessment of the proposed impact of the gas fields against the significant impact criteria for the migratory birds (section 23.6.1). The result determined there are no significant impacts predicted for the migratory birds. p. 176, Coordinator-General's Report—Australia Pacific LNG.

NOTES

Page 42 of EIS states: "In summary, three endangered terrestrial flora species listed under the EPBC Act are predicted or have been found to occur in the study area. These species are: • *Herbaceous xerothamnella* • *Slender tylophora* • *Microcarpaea*." The *Herbaceous xerothamnella* and the *Microcarpaea* were not identified in the ERT and have been included in the controlling provisions table under 'Additional Threatened Species identified in the EIS'.
For species the EIS regularly states "occurs in land zones 3, 4, 5, 7, 9 and 10." Not sure if this is project land zones or State land zones. Assuming it is project land zones and I have therefore included it in the controlling provisions table. If it is referring to state or local land zones then can be deleted from table.
Species RE's are mentioned for different EPBC listed species. Have assumed these RE's occur within the subject area and therefore have included this in the table. If not, maybe a statement can be added saying that the specific RE's mentioned do not occur in the vicinity of the subject site.
Grey-headed flying-fox is discussed in the EIS (p119-120) however it was not picked up in the ERT Report. Have included the GHFF in the controlling provisions table under 'Additional Threatened Species identified in the EIS'.
An additional 21 migratory species were identified in the EIS that were not identified in the ERT report. These species have been included in the controlling provisions table under 'Additional Migratory Species identified in the EIS'.

LEGEND

*	**Conservation Advice**
**	**Recovery Plan**
***	**Both**

SUPPORTING ADVICE – WETLANDS SECTION

Controlling Provisions: Sections 16 and 17B (Wetlands of International Importance)

Significant impacts on ecological character of Ramsar Wetland: **YES**

Full name as appears on RAD.
Australia Pacific LNG Pty Limited/Energy generation and supply (non-renewable)/Walloon Gas Fields, Surat Basin, Darling Downs/QLD/Expansion of Coal Seam Gas Fields

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Note: whilst this advice addresses impacts to wetland habitats that may be used by threatened or migratory species, it does not address direct impacts to these species. Please refer to the relevant supporting advice for potential species-specific impacts.

Proposal
Australia Pacific LNG Pty Limited (APLNG) proposes to further develop the APLNG Coal Seam Gas (CSG) resources located in southern and central Queensland. This CSG supply is to provide feed gas for a proposed liquefied natural gas (LNG) plant in Gladstone. The development of the APLNG CSG fields is one of three components of the overall Australia Pacific LNG Project which includes:

• **Walloons Gas Fields** – the expansion of APLNG's coal seam gas (CSG) fields in the Surat Basin, to provide gas for the LNG Plant;
• **Gas Transmission Pipeline** – the construction and operation of a high pressure gas transmission pipeline(s) of approximately 447 km to link the APLNG gas fields to the LNG Plant; and
• **LNG Plant** – the construction and operation of the LNG Plant and ancillary onshore and marine facilities. The LNG plant will be developed in stages up to an ultimate production capacity of around 16 million tonnes per annum (mtpa), and nominally comprising three to four LNG trains.

This referral is for the **Walloons Gas Fields development component** of the Australia Pacific LNG project only. Separate referrals have been submitted for the other two components

The gas fields' development study area is approximately 1,468,000 ha in area. The **Walloons Gas Fields comprise some 39% of this area**. It is expected that significantly less than 1% of the study area will be affected by the project's work areas.

Drilling and completion activities will typically target 350 wells per year, but there may be times when the development may need to be accelerated to up to 500 wells per year. It is anticipated that the development of the **Walloons Gas Fields** will occur progressively up to a total of approximately 10,000 wells, over 30 years.

Timeframe: Commencement of construction – 2011. First gas production – 2014.

***Ramsar wetland** and key ecological characteristics*

- The proposed action lies:
- 238 klms from Little Llangothlin Nature Reserve and not within its catchment
- 331 klms from Shoalwater and Corio Bays and not within its catchment
- 251 Klms from Narran Lake Nature Reserve and within its catchment
- 127 Klms from the Gwydir Wetlands and not within its catchment

The Narran Lake Nature Reserve was designated under the Convention on Wetlands on 14 June 1999.

> Narran Lake Nature Reserve covers part of a large terminal wetland of the Narran River in New South Wales (NSW) at the end of the Condamine River system which flows from Queensland. The area is internationally significant for waterbird breeding and as habitat for species including a number listed under the Japan-Australia and China-Australia Migratory Bird Agreements (JAMBA and CAMBA). The Nature Reserve also contains a variety of flora associations which are considered to be threatened in NSW.

The proposed action falls within the catchment of the Narran Lakes Nature Reserve Ramsar site. It does not fall within the catchments of the three other mentioned Ramsar sites.

Nature and extent of impacts *(this may include consideration of direct, indirect, short term, long term, temporary and permanent impacts, and the frequency and duration of impacts)*
A number of areas such as those mentioned below are identified as potentially being impacted upon and any mitigation measures will be addressed in a proposed EIS. Potential impacts include:

Increased water diversion and/or changes in groundwater pressures in a Ramsar catchment:

<u>Required Water</u>
Water will be required for construction, dust mitigation, irrigation, drinking water and domestic purposes, no detail is given on required volumes. The referral states that the selection of water sources will depend on the identification of suitable sources and determined though detailed studies during the EIS (page 16 Attachment E Part B).

<u>Hydrogeological</u>
The referral suggests that the production of associated water has the potential to impact on the hydrogeological environment of the development area. Activities associated with the gas field that have the potential to impact groundwater quality include:
• Unplanned contaminant releases (predominantly associated with water spills); and
• Water seepage from evaporation ponds to underlying aquifers.
A detailed assessment of the potential impacts on groundwater will be undertaken as part of the EIS process. This will include risks to neighbouring users and ecosystems that may ensue from the development of the proposed gas fields. (Attachment E Part B page 33)

The Walloons Gasfields are principally situated in the Surat Basin a major sedimentary basin that forms an eastern limb of the Great Artesian Basin in Eastern Queensland). (Attachment E Part B pages 31, 32 and 33).

Areas of the wetland being destroyed or substantially modified

The action is not within the catchments of the Little Llangothlin Nature Reserve, Shoalwater and Corio Bays or the Gwydir Wetlands Ramsar Sites. It is therefore not likely that areas of these three Ramsar wetlands will be destroyed or substantially modified. It is within the catchment of the Narran Lakes Nature Reserve Ramsar site.

There is potential for the Narran Lakes Nature Reserve Ramsar system which is associated with flooding and precipitation to be impacted upon if the volume of water flow available to the site is reduced by depressurising aquifers and/or contamination of groundwater through coal stream gas extraction activities further upstream, therefore it is likely that the proposed action may result in areas of the Narran Lakes Nature Reserve Ramsar wetland being destroyed or substantially modified.

A substantial and measurable change in the hydrological regime of the wetland

Narran Lake Nature Reserve covers part of a large terminal wetland of the Narran River in New South Wales (NSW) at the end of the Condamine River system which flows from Queensland.

The Narran River flows intermittently as a result of heavy rainfall in Queensland and annual flows are highly variable. The Narran Lakes system receives water at lower flows than the lake beds further north along the Narran River and hence floods more often and holds water for longer periods. In moderate flows, water fills Clear Lake and then flows back into Narran Lake. The water level of Clear Lake can drop very quickly if flows are not large enough to keep water levels up in both Narran and Clear Lakes (NPWS, 1995).

Although there is a separation distance of approximately 251 klm from the Narran Lakes Nature Reserve Ramsar site, the proposed action will still occur within its catchment. The proposed action raises a question of cumulative effect based on the increasing amount of wells being sunk for coal seam gas extraction in the Surat basin and its potential effects on groundwater aquifers.

The RIS for the Narran Lakes Nature Reserve Ramsar site does not mention the role of groundwater in the hydrology of the site; it states that the hydrological regime of the Narran Lakes system is associated with flooding and precipitation. The role of groundwater in the hydrological regime for Narran Reserves is not fully understood as is stated in a CRC for Freshwater Narran Lakes Scoping Study undertaken in 2001 at page 70. (In a pers comm. 23/7/09 Neil Santilann of NSW DECC advised he is not aware of any further groundwater studies for the Narran Lakes Nature Reserve).

Derek White of Regional Water Initiatives Section in a personal comment has indicated that on page 32 of Attachment E Pt B of the supporting documentation to the referral it is stated that the **Walloon** coal measures "are not considered to represent a significant regional aquifer, nor are the units considered to be hydraulically connected to GAB aquifers". In the light of this statement he asks that the EIS provide clear evidence for such a statement, as depressurising an aquifer will have an impact on other aquifers if there is any such connection.

Given that the Narran Lakes Nature Reserve system is associated with flooding and precipitation and knowledge of the role of groundwater in the hydrology regime of the site has been identified as limited, there may be a potential impact on the volume of water flow available to the Ramsar site caused by depressurising aquifers further upstream. It is noted that that the scale of this action and rapid expansion in the region has given rise to concern at the potential for impact on groundwater and the lack of a clear understanding to inform this issues that warrants scientific investigation. Since such an investigation is planned it is prudent to consider the results in informing the decision maker.

Therefore, invoking the precautionary principle, there is considered to be a real chance or possibility that the proposed action may result in a substantial and measurable change in the hydrological regime of the wetland.

The habitat or lifecycle of native species dependant upon the wetland being seriously affected

The referral at page 28 outlines that the proposed activities have potential to impact upon species identified in the area and have identified that the proposed action is a controlled action at Sections 18 and 18A (Listed threatened species and communities) of the EPBC Act.

However because of the separation distance of approximately 251 klms from the Narran Lakes Nature Reserve Ramsar site it is not likely that the habitat or life cycle of a native species dependant upon the wetland will be seriously affected due to any direct impact of the proposed action. Indirect impacts due to changed hydrology are covered above.

Note: For additional information on migratory and/or threatened species impacts, please refer to separate supporting advice.

A substantial and measurable change in the physico-chemical status of the wetland

Although the separation distance of the proposed action and the Narran Lakes Nature Reserve Ramsar site is approximately 251 klms the action occurs within the Reserve's catchment.

This referral identifies that activities associated with the gas field have the potential to impact on groundwater quality including:
• Unplanned contaminant releases (predominantly associated with water spills); and
• Water seepage from evaporation ponds to underlying aquifers.
(Attachment E Part B at page 33)

The role of groundwater in the hydrology regime of the site has been identified in a CRC for Freshwater Narran Lakes Scoping Study as limited and as there may be a potential impact on the volume of water flow available to the Ramsar site caused by depressurising aquifers and potential contamination through the activities of the proposal it is therefore considered that there is a real chance or possibility that a substantial and measurable change in the physico-chemical status of the Narran Lakes Nature Reserve Ramsar wetland may occur as a result of the proposed action.

An invasive species that is harmful to the ecological character of the wetland being established or that may encourage the spread of existing invasive species

Because of the separation distance of approximately 251 Klms from the Narran Lakes Nature Reserve Ramsar site it is therefore not likely or expected that an invasive species which is harmful to the ecological character of the wetland will become established, or that the spread of existing invasive species will be encouraged.

Other characteristics and sensitivity of the receiving wetland potentially affected *(if relevant)*

The extent to which impacts can be predicted and managed *(this may include the degree of confidence with which the impacts of the action are known and understood or risk/consequence of impact)*

There are a number of potential impacts identified in the referral's supporting documentation however the proponent is seeking to have the proposal declared a "significant project" under the *State Development and Public Works Organisation Act, 1971* (SDPWO Act) and will follow the environmental impact statement (EIS) process defined by this Act. The SDPWO is accredited to meet the impact assessment requirements under the EPBC Act (page 7 of the referral).

There is a lack of understanding of the impacts of the proposal on groundwater and uncertainty about the role of groundwater in the hydrology regime of the Narran Lakes (refer

CRC for Freshwater Scoping Study of the Narran Lake), there is low confidence with which the impacts and their management can be predicted. Due to the scale of this action and the rapid expansion of the industry in the region in general the risk/consequence is such that further investigation is justified.

Conclusion (*Ecological character(s) and summary reasons why significant/not significant)*

Although there is a separation distance of approximately 251 klm from the Narran Lakes Nature Reserve Ramsar site the proposed action will still occur within its catchment. The proposed action raises a question of cumulative effect overtime based on the number of wells in this case 10,000 over 30 years being sunk for coal seam gas extraction in the Surat basin and its potential effects on groundwater aquifers.* (2008/4398 2,400 wells over 20 years).

In a Queensland government 2007/08 update on coal seam gas it outlines that the CSG industry has experienced remarkable growth over the last ten years and that production from the Walloon Coal Measures in the Surat Basin has become an important additional supply source. In particular there has been a surge of interest in using Qld coal seam gas resources to produce liquefied natural gas (LNG) and that several consortia were preparing EIS for their LNG proposals. (See page 3 for the number of operating, planning and under construction sites in the Surat Basin).

Derek White of Regional Water Initiatives Section in a personal comment has indicated that on page 32 of Attachment E Pt B of the supporting documentation to the referral it is stated that the **Walloon** coal measures "are not considered to represent a significant regional aquifer, nor are the units considered to be hydraulically connected to GAB aquifers". In the light of this statement he asks that the EIS provide clear evidence for such a statement, as depressurising an aquifer will have an impact on other aquifers if there is any such connection.

Past advice has considered the Narran Lakes Nature Reserve to rely on surface water flooding and therefore has not considered groundwater interactions to be important. However the CRC for Freshwater in a Scoping Study of the Narran Lakes in 2001 states that "little is known about the role of groundwater in the hydrological cycle of the Narran system" (at page 70). As the proposed action (up to 10,000 wells to be sunk over 30 years) is larger than a previous action considered (2,400 wells over 20 years) and that impacts are likely to be cumulative, it would be prudent to consider the results of a groundwater assessment before ruling out the possibility of serious impacts downstream.

Given that the Narran Lakes Nature Reserve system is associated with flooding and precipitation and knowledge of the role of groundwater in the hydrology regime of the site has been identified as limited there may be a potential impact if the volume of water flow available to the site is reduced by depressurising aquifers and/or contamination of groundwater through coal stream gas extraction activities further upstream, it is therefore considered that there is a real chance or possibility that the proposed action entitled the **Walloons Gas Fields development component** will result in a significant impact on the ecological character of the Narran Lakes Nature Reserve Ramsar Site.

Sources *(List any sources used, including pers comm.)*

Referral documentation

Ramsar Information Sheets for the Little Llangothlin Nature Reserve, Shoalwater and Corio Bays, Narran Lake Nature Reserve and the Gwydir Wetlands Ramsar Sites.

Referral and associated documentation

Narran Lakes Scoping Study - CRC for Freshwater Ecology 2001

Queensland's coal seam gas overview – Qld Department of Mines and Energy October 2008

<u>Pers Comms</u>

s. 47F(1) DECC NSW – 23 July 2009

s. 47F(1) , Director Regional Water Initiatives Section – 24 July 2009 (email attached)

*Queensland Department of Infrastructure and Planning has commissioned a study of the potential groundwater impacts resulting from the expansion of the Coal Seam Gas sector. This study is due to be completed late 2009 (pers comm. Megan Nash DPIP 22/7/09) A fact sheet outlining this study is attached.

Queensland Government

[redacted]

Search

Joint Statement:

Treasurer and Minister for Employment and Economic Development
The Honourable Andrew Fraser

Minister for Natural Resources, Mines and Energy and Minister for Trade
The Honourable Stephen Robertson

Friday, January 07, 2011

Government continues to work with mines affected by extreme flooding

The Bligh Government is continuing to work closely with mines across Queensland impacted by flooding.

Treasurer and Acting Climate Change and Sustainability Minister Andrew Fraser said around 40 mines are expected to be affected by the flooding and each mine is being individually case managed.

"Protecting the quality of the water for the communities surrounding flooding catchments is the priority," Mr Fraser said.

"That is why we are working closely with the mines to ensure authorised dewatering activities go ahead while there are high volumes of water to dilute the discharge and minimise the risk of environmental impact.

"When we foresaw that this was going to be one of the worst wet seasons on record, we worked closely with each individual mine to make sure they were well prepared to meet their environmental obligations.

"Any discharges that have occurred outside of licence conditions are being investigated by the Department of Environment and Resource Management (DERM) and appropriate action will be taken where necessary."

Mr Fraser said since 1 December, DERM has issued 11 Transitional Environmental Programs (TEPs) to coal mines to allow them to safely discharge water.

"DERM has ensured that the TEPs are strictly conditioned to protect the environment and has worked fast to assist mines, taking on average, less than 4 days to process the TEPs which provide the environmental oversight for dealing with the extra water," he said.

Mines Minister Stephen Robertson said the State's growing coal seam gas industry has so far weathered the state's widespread rain and flooding.

Only one CSG company – Australia Pacific Liquid Natural Gas (APLNG) – has been issued with a TEP for its operation at Spring Gully, north-east of Roma. However, the company advise they have not yet needed to activate any release.

"The minimal impact of the floods on CSG operations and the demonstrated ability of companies to handle these extreme weather conditions are a positive reflection of the rigorous environmental and safety conditions that we have put in place for CSG operations in Queensland," Mr Robertson said.

"The Department is aware of six potential breaches of environmental approvals as a result of the flood waters and heavy rain. All incidents will be investigated, but as with the cases at coal mines, the high volume of water in the systems has greatly reduced any risk of environmental impact.

"DERM is monitoring the situation and will undertake confirmatory testing on the sites as soon as access is possible. When the weather permits, aerial surveys and monitoring through satellite imagery will also occur.

"It's pleasing to see that there have been no spills from brine dams associated with CSG operations.

"We will continue to closely monitor the effects further heavy rain might have on CSG operations across the state and companies will continue to be required to report any breaches to government."

Coal mines issued with Transitional Environmental Programs since 1 December are:

Fitzroy Catchment: Ensham (Ensham Resources), Poitrel (BHP Mitsui), South Walker (BHP Mitsui), Isaac Plains (Vale), Cook (Cook Resource Mining), Callide (Anglo Coal), Moranbah North (Anglo Coal), Minerva (Yancoal Australia), Kestral (Rio Tinto), Carborough Downs (Vale)

Burdekin Catchment: Newlands (Xstrata)

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Our Ref: **PR101377**
Date: **9th June 2010**

Attn: s. 11C(1)(a)
Origin Energy
GPO Box 148
Brisbane, QLD 4001
s. 11C(1)(a)

Via: Email

Dear s. 11C(1)(a)

RE: PROPOSED APLNG WATER DISCHARGE AND IMAPCT ON NARRAN LAKES AND GWYDIR WETLANDS

As discussed previously, I understand that the Department of Environment, Water, Heritage and the Arts (DEWHA) have made a submission on the Australia Pacific Liquid Natural Gas (APLNG) Environmental Impact Statement (EIS). DEWHA have requested further information to substantiate that the Project will not impact on Narran Lakes and Gwydir Wetlands in northern NSW.

The RPS (formerly Conics) report titled *Hydrologic Modelling of Permeate Discharge to Condamine River,* which formed part of the APLNG EIS, modelled a number of Coal Seam Gas (CSG) water discharge scenarios associated with the proposed APLNG project. The results were detailed in the appendices. The maximum discharge scenarios modelled were for release of water at both Talinga and Condabri (Appendix C). This modelling showed that the Balonne River, immediately upstream of Beardmore Dam in Queensland (the model's geographic limit) currently has a Mean Annual Flow of 81% of pre-development flows. The maximum increase with APLNG CSG water discharge at Talinga and Condabri was to 83% of pre-development flows – an increase of 2% of Mean Annual Flow.

As the Condamine-Balonne River flows south-west through Beardmore Dam and past St George the river system breaks into multiple (and in some cases terminal) distributory streams across a wide geographic area. This complex floodplain system extends downstream well into northern NSW before coalescing into the Darling River.

The small modelled increase in flows at Beardmore Dam due to APLNG CSG water addition is unlikely to be volumetrically significant in dam releases for downstream irrigation extraction or for environmental flow purposes. Indeed, intra-annual variability in flows in the Condamine-Balonne River and inherent modelling error would suggest that the small increase in annual flows at the dam will not significantly influence quality or quantity at that point in the river system. For flows that are released downstream, hydrological certainty is difficult (due to the complex floodplain system and associated modelling difficulties) but there is a low likelihood of CSG water transmission through the eastern branches of the distributory system and beyond the Queensland border where it can affect Narran Lakes.

The Gwydir Wetlands are not on the same river system. These wetland areas will not be affected by any CSG water releases in the Condamine-Balonne River system.

RPS Australia East Pty Ltd ABN 44 140 292 762 A member of the RPS Group Plc

Based on the above, there is likely to be minimal (if any) flow of CSG water from the APLNG project (and hence no impact) into Narran Lakes and certainly not Gwydir Wetlands.

I trust this information is sufficient for your purposes, however should you require any further details or clarification, please do not hesitate to contact me.

Yours sincerely
RPS

s. 11C(1)(a)

s. 11C(1)(a)
PRINCIPAL - ENVIRONMENT

Australia Pacific LNG
Fauna Habitat Calculations for the Gas Fields

Q-LNG01-15-RP-0014

Rev	Date	Details	By	Check	Eng/QA	App
A	15.09.10	Issued for APLNG Review	JC	KJ	K Hill	K Horton
B	16.11.10	Issued for DSEWPaC Review	JC	KJ	K Hill	K Horton
C	25.11.10	Issued as final incorporating DSEWPaC comments	JC	KJ	RU	K Horton

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1. Introduction

The Australia Pacific LNG (APLNG) Project will result in the clearing of remnant and regrowth vegetation. The proponent is committed to providing a combination of direct and indirect offsets for impacts on threatened species across the Study Area.

The purpose of this report is to document the methodology used to calculate the area of fauna habitat likely to be cleared for significant fauna species in the gas fields for the Australia Pacific LNG Project.

The Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) Draft Policy Statement: *Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999* specifies that, wherever possible offsets should be targeted towards the specific environmental value being impacted by a development (e.g. foraging habitat for an endangered species). To this end, the Australia Pacific LNG Project will seek to offset impacts on the following species (hereafter referred to as the target species):

- Brigalow scaly-foot (*Paradelma orientalis*) (Vulnerable, *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Nature Conservation Act 1992* (NC Act));
- Dunmall's snake (*Furina dunmalli*) (Vulnerable, EPBC Act and NC Act); and
- Yakka skink (*Egernia rugosa*) (Vulnerable, EPBC Act and NC Act).

Calculating the direct habitat offset obligations for the Project, requires quantification of areas of habitat to be lost/disturbed for each of the target species in the gas fields. Estimates of vegetation loss associated with the Project have been calculated using regional ecosystem mapping. Initial calculations of potential habitat loss for each species have been calculated based on the broad habitat preferences of the target species being matched to individual regional ecosystems. Regional Ecosystems are a repeated combination of vegetation, geology and landform that occur at a landscape scale.

In recognition that threatened species are typically patchily distributed throughout the landscape, not all areas of potential habitat will contain the target species, and at the regional ecosystem level, not all patches should be considered of equal value. Some species will only be present where microhabitat elements such as rock outcrops or woody debris occur. The distribution of microhabitat elements can vary greatly within regional ecosystems.

This report estimates habitat loss for each of the target species in the gas fields based on the proportion of potential habitat which is actually suitable for those species, rather than the presence of potential habitat indicated by broad scale mapping of regional ecosystems.

1.1 Scope

The scope of this assessment is to:

- review existing ecological field data for the gas fields against the habitat preferences of the target species and discuss species preferences at the regional ecosystem level;
- discuss the potential association of species with particular regional ecosystems;
- determine the proportion of potential habitat in the gas fields which contains microhabitat elements known to be of importance to the target species, based on field assessment; and
- provide metrics to assist in estimates of habitat loss for each of the target species as a basis for calculating threatened species offset obligations for the gas fields.

1.2 Objectives

The objectives of the study are to:

- provide a summary of the extent of potential habitat for the target species across the gas fields;
- estimate the proportion of potential habitat in the gas fields which is actually likely to support the target species, based on field survey observations and available literature; and
- provide metrics to assist in the calculation of habitat loss across the spectrum of good quality to low quality habitat across the gas fields.

1.3 Definitions and abbreviations

In this document, the following definitions and abbreviations apply:

Term/Abbreviation	Meaning
Potential habitat	Regional Ecosystems known to be used by the target species throughout their range.
Target species	Near-threatened or threatened species discussed in Section 1.1 of this report.
RE	Regional Ecosystem
Australia Pacific LNG	Australia Pacific LNG Pty Limited
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
DERM	Queensland Department of Environment and Resource Management

2. Methodology

2.1 Review of potential impacts on habitat

The main traditional approach to assessing the occurrence of threatened species in any Study Area is to complete targeted field surveys over multiple seasons in a representative sample of regional ecosystems. Based on a combination of distributional (point location) data obtained during field surveys and habitat assessment, the location and extent of habitat for the target species would be mapped to allow an assessment of the magnitude of impact. The scale of development and the evolving nature of locating infrastructure does not allow for systematic fauna surveys over entire gas fields. As such, a conservative approach has been adopted using a combination of predictive analysis, field-based habitat assessment and existing knowledge to predict the distribution and extent of target species and their habitats in the gas fields.

A high level assessment of habitat for target species was completed using existing datasets and desktop assessment. In their recent predictive mapping exercise for threatened reptiles in the southern Brigalow Belt, Apan *et al* (in press) found that the Regional Ecosystem (RE) mapping was the most important predictive variable in the model. As such, regional ecosystems and their relationships with target species was selected as the starting point in the discussion of habitat loss.

Prior to assessing the suite of REs likely to be utilised by the target species, microhabitat elements important in determining occurrence were considered. These are well known for some species and not others. A summary of essential microhabitat elements for the target species is provided in Table 1 below.

Table 1 - Essential microhabitat elements for the target species

Species	Broad Habitat Preferences	Microhabitat Factors Limiting Distribution
Brigalow scaly-foot	Found on sandstone ridges, woodlands and vine thickets, including Brigalow. Shelters beneath sandstone slabs, logs dense leaf litter and in grass tussocks, also known to climb small trees (Wilson & Swan 2003). Found in open forests and woodlands, especially ironbark, cypress pine, brigalow, bull oak, spotted gum, vine scrubs and *Acacia falciformis* woodlands. On Boyne Island species were recorded in *Acacia falciformis* trees. Species appeared to only use the trunk and main branches, and climb to heights in excess of 2m (Tremul 2000).	• Under sandstone slabs, rocks, logs, coarse woody debris, leaf litter at tree bases.

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Fauna Habitat Calculations for the Gas Fields

Species	Broad Habitat Preferences	Microhabitat Factors Limiting Distribution
Yakka skink	Among dense ground vegetation, fallen timber or rock outcrops in open dry sclerophyll forest (ironbark) or woodland, brigalow forest, open shrub land, and lancewood forest on coarse gritty soils in the vicinity of low ranges, foothills and undulating terrain with good drainage (Cogger 2000; Ehmann 1992; Fitzgerald 1996a).; share communal burrow systems, often excavated in earth and timber that have been bulldozed into heaps; map also occupy disused rabbit warrens (Wilson 2008); deep rock crevices (Wilson 2005)	• Animals burrows • Large fallen timber • Stick rake piles • Artificial structures
Dunmall's snake	Open forest and woodland, particularly brigalow (*Acacia harpophylla*) forest and woodland, growing on floodplains of deep-cracking black clay and clay loam soils (Cogger et al 1993). Utilises fallen timber and possibly also leaf litter and earth cracks (Ehmann 1992). Under logs, in soil cracks and other deep cavities (Wilson 2008); vegetation communities including brigalow, belah and cypress pine, usually on heavy soil (Wilson 2005)	• Poorly known • Cracking black clays • Under coarse woody debris and ground litter

The occurrence of threatened species can be strongly correlated with RE types when essential habitat features are present.

BAAM (2010) provided a summary of the preferred habitats associated with the target species on an RE by RE basis.

Table 2 below identifies the range of potential habitats (REs) for the target species across the gas fields (after BAAM 2010).

AUSTRALIA PACIFIC LNG

Fauna Habitat Calculations for the Gas Fields

Table 2 - Potential Habitats for Target Species

Regional Ecosystem	Short Description	Brigalow scaly-foot	Yakka skink	Dunmall's snake
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	x	x	x
11.3.2	*Eucalyptus populnea* woodland on alluvial plains		x	
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains			
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains	x		
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	x	x	x
11.4.3	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains	x	x	x
11.4.7	*Eucalyptus populnea* with *Acacia harpophylla* and/or *Casuarina cristata* open forest to woodland on Cainozoic clay plains	x		
11.4.10	*Eucalyptus populnea* or *E. pilligaensis*, *Acacia harpophylla, Casuarina cristata* open forest to woodland on margins of Cainozoic clay plains	x	x	
11.4.12	*Eucalyptus populnea* woodland on Cainozoic clay plains	x	x	
11.9.4	Semi-evergreen vine thicket or *Acacia harpophylla* with a semi-evergreen vine thicket understorey on fine grained sedimentary rocks	x		
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	x	x	x
11.9.7	*Eucalyptus populnea*, *Eremophila mitchellii* shrubby woodland on fine-grained sedimentary rocks	x	x	
11.9.10	*Eucalyptus populnea*, *Acacia harpophylla* open forest on fine-grained sedimentary rocks	x		x
11.3.14	*Eucalyptus spp., Angophora spp., Callitris spp*. woodland on alluvial plains.	x	x	
11.3.18	*Eucalyptus populnea, Callitris glaucophylla, Allocasuarina luehmannii* shrubby woodland on alluvium	x	x	
11.3.19	*Callitris glaucophylla, Corymbia* spp. and/or *Eucalyptus melanophloia* open-forest to woodland on Cainozoic alluvial plains	x	x	
11.3.25	*Eucalyptus tereticornis or E. camaldulensis* woodland fringing drainage lines			x
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains			
11.3.27	Freshwater Wetlands			
11.3.39	*Eucalyptus melanophloia* +/- *E. chloroclada* open-woodland on undulating plains and valleys with sandy soils	x		

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Fauna Habitat Calculations for the Gas Fields

Regional Ecosystem	Short Description	Brigalow scaly-foot	Yakka skink	Dunmall's snake
11.5.1	*Eucalyptus crebra, Callitris glaucophylla, Angophora leiocarpa, Allocasuarina luehmannii* woodland on Cainozoic sand plains/remnant surfaces	x	x	x
11.5.4	*Eucalyptus crebra, Callitris glaucophylla, C. endlicheri, E. chloroclada, Angophora leiocarpa* on Cainozoic sand plains/remnant surfaces. Deep sands	x	x	x
11.5.5	*Eucalyptus melanophloia, Callitris glaucophylla* woodland on Cainozoic sand plains/remnant surfaces. Deep red sands	x		x
11.5.20	*Eucalyptus moluccana* and/or *E. microcarpa/ E. pilligaensis +/- E. crebra* woodland on Cainozoic sand plains	x	x	
11.5.21	*Corymbia bloxsomei +/- Callitris glaucophylla +/- Eucalyptus crebra +/- Angophora leiocarpa* woodland on Cainozoic sand plains/remnant surfaces	x		
11.7.1	*Acacia harpophylla* and/or *Casuarina cristata* and *Eucalyptus thozetiana* or *E. microcarpa* woodland on lower scarp slopes on Cainozoic lateritic duricrust	x	x	
11.7.2	*Acacia* spp. woodland on Cainozoic lateritic duricrust. Scarp retreat zone	x	x	
11.7.4	*Eucalyptus decorticans* and/or *Eucalyptus spp., Corymbia spp., Acacia spp., Lysicarpus angustifolius* on Cainozoic lateritic duricrust	x	x	
11.7.5	Shrubland on natural scalds on deeply weathered coarse-grained sedimentary rocks	x	x	
11.7.6	*Corymbia citriodora* or *Eucalyptus crebra* woodland on Cainozoic lateritic duricrust	x	x	
11.7.7	*Eucalyptus fibrosa subsp. nubila +/-* Corymbia spp. +/- Eucalyptus spp. on Cainozoic lateritic duricrust	x	x	
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	x		
11.10.1	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks	x	x	
11.10.7	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	x	x	
11.10.9	*Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	x	x	
11.10.11	*Eucalyptus populnea, E. melanophloia +/- Callitris glaucophylla* woodland on coarse-grained sedimentary rocks	x	x	

Table 3 below provides the number of REs known to provide potential habitat for each target species across the gas fields.

Table 3 - Tally of regional ecosystems providing habitat for target species

Species	No. of REs providing potential habitat in the gas fields
Brigalow scaly-foot	31
Yakka skink	24
Dunmall's snake	6

Not all potential habitat will be utilised by the target species. Habitat has therefore been ranked for suitability to re-caclculate the areas of likely habitat to be removed by development of the gas fields.

2.2 Ranking Habitat Suitability

2.2.1 Rationale

Each of the target species is restricted to a relatively small number of regional ecosystems, and within those ecosystems, potential habitat is limited by the presence or absence of key microhabitats. As such, suitable habitat for target species actually only occur in a small proportion of the landscape. The proportion of the broader landscape actually utilised by the target species is much lower than 100%. Indeed, if the target species occupied all potential habitat throughout their respective ranges they would be more likely identified as common species in a statutory sense.

Few published studies have attempted to quantify the proportion of potential habitat likely to be utilised by threatened species. However, a recently published study which focussed on predicted distributions of threatened Brigalow Belt reptiles provides an insight to the scarcity of high quality habitat across the landscape.

In their predictive habitat mapping Project for the Glenmorgan district of the Southern Brigalow Belt, (Apan *et al*, in press) found that of a total study area of approximately 377,283 hectares, only 4% (14,984 hectares) was considered as 'high predictive' for a suite of rare or threatened reptiles which mirrors the target species of this assessment. 'Moderate' and 'low' predictive areas correspond to 5% (20,617 hectares) and 82% (323,143), respectively. This indicated that only 9% of the total area has habitat attributes of high to moderate preferences for the reptiles.

With several models tested by Apan *et al* (in press), comprising a range of two to six predictor variables, it was a combination of 'regional ecosystems type', 'distance from water', 'soils', and 'distance from stream' which produced the highest accuracy of prediction of occurrence for threatened reptiles. The map of RE type differentiating vegetation communities into classes that depict vegetation type, composition, structure, and other site characteristics, was found to be the most important predictive variable in the model.

'Non-remnant vegetation' and reptile occurrences showed a negative spatial association, while other RE types had no spatial association with the reptile sightings data.

Spatial analysis is one method of predicting the occurrence of rare or threatened species in the landscape and is particularly efficient if a large number of location records are available for a study area. An alternative approach, adopted in this document, is to build a set of metrics (in order to approximate the proportion of the gas fields which contains suitable habitat) from field based observations. This approach is discussed below.

2.2.2 BAAM (2010) Habitat Suitability Ranking Methodology

Biodiversity Assessment and Management (BAAM) (2010) completed an assessment of the habitat suitability for the target species at 214 RE sample sites across the gas fields. Species-specific habitat assessment datasheets collected at those sites featured a list of the conservation significant fauna species considered likely to occur within the overall gas fields and habitat features considered influential for the likelihood of each species occurring at a survey site. At each survey site a quantitative rank from zero to five was assigned for each habitat characteristic for each species, as well as an overall habitat suitability rank for each species.

The overall habitat suitability ranking provided by BAAM for each target species at each fauna habitat assessment site provides a basis for determining the proportion of high and low quality habitat for the target species across the gas fields.

2.2.3 Proportion of high quality habitat

Field data from 214 sample sites was reviewed to determine the proportion (percentage) of all habitat assessment sites which were considered to be either of low (1-2), moderate (3-4) or good quality habitat (5), using overall habitat rankings, for each of the target species. The results are presented below in Table 4.

The characterisation of habitat suitability for each of the target species at each sample site was based around the qualitative definitions listed below. Habitat rankings were based on observation of both the quality and quantity of suitable microhabitat features which support each target species as follows:

0 (no habitat) – Microhabitat features completely absent;

1 to 2 (low quality habitat) – Limited, poor quality microhabitat features;

3 to 4 (moderate quality habitat) – Microhabitat features present with either limited abundance or quality; and

5 (good quality habitat) – Microhabitat features present with reasonable abundance and quality.

BAAM (2010) habitat assessment methodology identified habitat quality increases in a linear fashion from low to good, with the middle band representing "moderate" quality habitat.

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Fauna Habitat Calculations for the Gas Fields

Survey sites which are ranked as 1-4 overall by BAAM (2010) lacked some essential microhabitat elements or were considered sub-optimal for the target species by observers in the field. Whereas, sites ranked 5 overall were considered good quality habitats for the target species.

Sites ranked as "0" by BAAM were excluded from calculations of the proportion of sites within each overall habitat band as they were presumably located within RE types which were unsuitable or not in the suite of ecosystems considered potential habitat. Table 4 below lists the number of survey sites within each overall habitat ranking band, whilst Table 5 shows the relative percentage of all survey sites within each overall habitat ranking band for each species.

Table 4 - Number of habitat assessment sites in each overall habitat ranking band

Overall Habitat Ranking	Brigalow scaly-foot	Yakka skink	Dunmall's snake
1 (Low)	15	31	24
2	50	60	54
3	66	64	70
4	43	20	30
5 (Good)	23	2	13

Table 5 - Percentage of potential habitat in each overall habitat ranking band

Overall Habitat Ranking	Brigalow scaly-foot	Yakka skink	Dunmall's snake
1 (Low)	7.61%	17.51%	12.56%
2	25.38%	33.89%	28.27%
3	33.50%	36.15%	36.64%
4	21.82%	11.29%	15.70%
5 (Good)	11.67%	1.129%	6.80%

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The field observations of BAAM (2010) support a similar conclusion to the predictive habitat modelling of Apan *et al* (2010), with proportions of good quality habitat (overall habitat ranking 5) for each target species ranging from 1% to 12% of potential habitat across the gas fields.

By assessing the availability of essential microhabitats, the overall habitat suitability rankings of BAAM (2010) relate directly to the potential occurrence of the target species. Based on the factors outlined in section 2.2.1 it is anticipated that target species are only likely to occur where good quality habitat exists, consequently sites with a ranking of 5 are considered most likely to support target species with other rankings unlikely to support target species. Table 6 below provides a list of the proportion of good quality habitat for each target species in the gas fields.

Table 6 - Proportion of good quality habitat for the target species in the gas fields

Species	% of overall habitat considered to be good quality habitat
Brigalow scaly-foot	11.67%
Yakka skink	1.13%
Dunmall's snake	6.80%

The percentage of good quality habitat is used in the following section to estimate habitat loss of individual target species.

3. Estimating Habitat Loss

The habitat suitability rankings prepared by BAAM (2010) from field data have provided estimates of the proportion of potential habitat within the gas fields that is potentially good quality habitat for each target species. To calculate the area of potentially suitable habitat for each species the total area of each impacted RE was multiplied by the percentage of potential habitat for each species. Table 7 provides worked examples for Brigalow scaly-foot, Yakka skink and Dunmall's snake.

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Fauna Habitat Calculations for the Gas Fields

Table 7 - Worked examples for calculating habitat loss for Brigalow scaly-foot, Yakka skink and Dunmall's snake

Regional Ecosystem	**Total area of each RE impacted in the gas fields by the Project (ha)**	**Proportion of overall habitat considered to be good quality habitat for Brigalow scaly-foot** (11.67% or 0.1167)	**Net area of Brigalow scaly-foot good quality habitat impacted (ha)**	**Proportion of overall habitat considered to be good quality habitat for Yakka skink** (1.13% or 0.0113)	**Net area of Yakka skink good quality habitat impacted (ha)**	**Proportion of overall habitat considered to be good quality habitat for Dunmall's snake** (6.8% or 0.068)	**Net area of Dunmall's snake good quality habitat impacted (ha)**
11.10.1	53.07	0.1167	6.19	0.01129	0.60		
11.10.11	61.89	0.1167	7.22	0.01129	0.70		
11.10.7	206.36	0.1167	24.08				
11.10.9	161.97	0.1167	18.90				
11.3.1	0.40	0.1167	0.05	0.01129	2.33	0.068	0.03
11.3.14	66.26	0.1167	7.73	0.01129	1.83		
11.3.16	0.17	0.1167	0.02	0.01129			
11.3.17	18.08	0.1167	2.11	0.01129		0.068	1.23
11.3.18	7.57	0.1167	0.88				
11.3.2	76.58						
11.3.25	172.03					0.068	11.70
11.3.27	1.17						
11.3.3	1.24						
11.3.39	0.92	0.1167	0.11				
11.3.4	9.19	0.1167	1.07				
11.4.12	2.22	0.1167	0.26				
11.4.3	15.33	0.1167	1.79			0.068	1.04
11.4.7	0.21	0.1167	0.02	0.01129	0.75		
11.5.1	2085.12	0.1167	243.33			0.068	141.79
11.5.1a	396.19	0.1167	46.24	0.01129	0.20	0.068	26.94
11.5.20	171.41	0.1167	20.00	0.01129	0.09		
11.5.4	246.60	0.1167	28.78			0.068	16.77
11.5.4a	337.13	0.1167	39.34	0.01129	0.86	0.068	22.92
11.5.5	171.47	0.1167	20.01			0.068	11.66
11.7.1	1.67	0.1167	0.19				
11.7.2	255.10	0.1167	29.77				
11.7.4	762.09	0.1167	88.94				
11.7.5	187.08	0.1167	21.83				
11.7.6	38.73	0.1167	4.52				
11.7.7	702.45	0.1167	81.98				
11.9.10	7.45	0.1167	0.87	0.01129	0.03	0.068	0.51
11.9.4a	3.41	0.1167	0.40	0.01129	0.17		
11.9.4b	0.95	0.1167	0.11				
11.9.5	59.47	0.1167	6.94	0.01129	23.54	0.068	4.04
11.9.7	1.26	0.1167	0.15	0.01129	4.47		
Total area			**703.84**		**66.77**		**238.63**

Based on this methodology, the area of good quality habitat for each target species to be impacted in the gas fields by the Project is listed in Table 8 below.

Table 8 - Area of potentially good quality habitat for target species in the Study Area

Target species	Net area impacted (ha)
Brigalow Scaly-foot	703.84
Dunmall's Snake	238.63
Yakka Skink	66.77

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4. References

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EPBC GAB Springs[1]

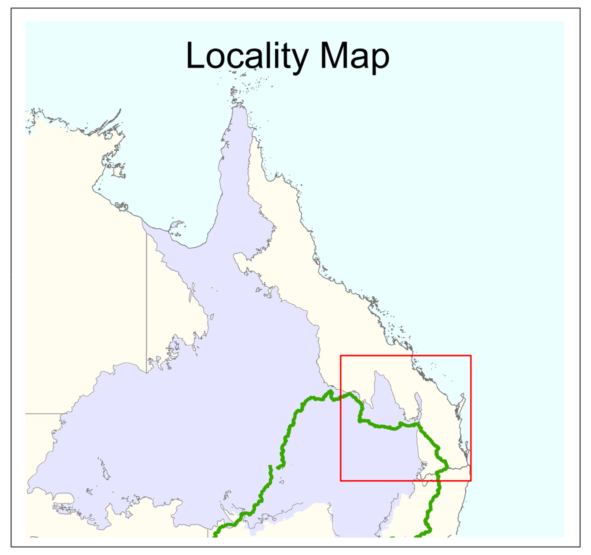
- Towns
- Major Roads
- Major Pipelines to Gladstone
- EPBC - Recovery Plan Springs Nov 2005
- Non EPBC - Recovery Plan Springs Nov 2005
- Qld Springs 2009
- 100km buffer of combined tenements
- 100km buffer of Australian Pacific LNG tenements
- 100km buffer of QGC/BG tenements
- 100km buffer of Santos/Petronas tenements
- Drainage Basins
- Spring Supergroups
- Murray Darling Basin (MDB)
- Great Artesian Basin (GAB)

Tenements referred

- Australian Pacific LNG
- QGC/BG
- Santos/Petronas

Data Sources:
Towns and Roads:
© Commonwealth of Australia, Geoscience Australia, 2006.
Great Artesian Basin:
© National Land & Water Resources Audit, 2000.
State and Territory Borders:
© Commonwealth of Australia, Geoscience Australia, 2004.
MDB Boundary:
© Commonwealth of Australia, Department of Sustainability, Environment, Water, Population and Communities, 2008.
GAB Boundary:
© Commonwealth of Australia, Geoscience Australia, 2001.
Drainage Basins:
© Commonwealth of Australia, Geoscience Australia, 2007.
Recovery Plan Springs:
© Queensland Herbarium, Environmental Protection Agency, 2005.
QLD Springs 2009:
© Queensland Department of Environment & Resource Management, 2009.
Proponent Tenements and Pipeline data:
Sourced from companies through AWD September 2010.
Spring Supergroups except Springsure region to be confirmed.
Springsure region in Spring Supergroups:
Environmental Resources Information Network (ERIN) created Springsure region boundary based on Spring Supergroups (to be confirmed) and Spring Supergroups data from Queensland Department of Environment and Resource Management (http://www.epa.qld.gov.au/wetlandinfo/resources/static/pdf/Profiles/p01718aa.pdf). The GAB boundary is used as external boundary control.

Caveats:
All data are presumed to be correct as received from data providers. No responsibility is taken by the Commonwealth for errors or omissions, and the Commonwealth does not accept responsibility in respect to any information or advice given in relation to, or as a consequence of anything contained herein.
Produced by ERIN, Australian Government, Department of Sustainability, Environment, Water, Population and Communities, 22 September 2010.
Geographic Coordinate System, GDA-94 Datum



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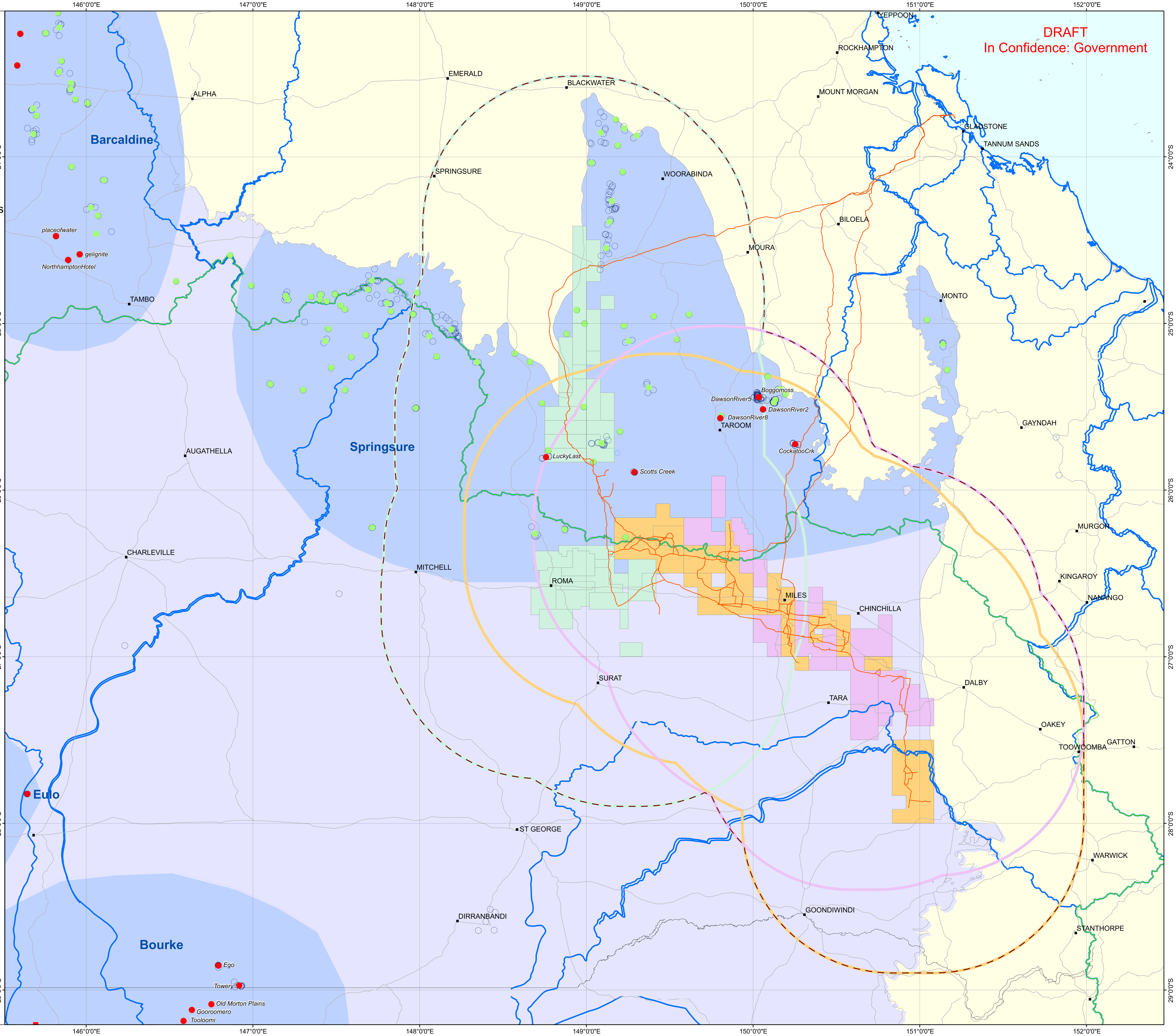
0 25 50 100 kms

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

[1] The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin



Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Attachment D

DEPARTMENTAL ADVICE

Gas pipeline activities associated with Australia Pacific LNG Project

EPBC 2009/4976

February 2011

TABLE OF CONTENTS

Definitions and abbreviations used in this advice

APLNG Project (the Project)	Australia Pacific LNG project
CG	Queensland Coordinator-General
CSG	Coal seam gas
Department	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EIS	Environmental Impact Statement
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LNG	Liquefied Natural Gas
MNES	Matters of national environmental significance, protected under Part 3 of the EPBC Act.
Proponent	Australia Pacific LNG Pty Ltd
Referral	The referral from APLNG for gas pipeline construction activities associated with the proposed APLNG Project (EPBC 2009/4976).
ROW	Pipeline Right of Way

DEPARTMENTAL ADVICE

(EPBC 2009/4976)

Overview

The proposal is for the design, construction, operation and decommissioning of a pipeline network to connect coal seam gas fields in the Surat Basin in south-central Queensland, to a proposed liquefied natural gas (LNG) and export facility on Curtis Island near Gladstone. The proposed pipeline route is indicated in Figure 1 below.

The proposal is one of three components of the Australia Pacific LNG Project (the Project). The other components of the Project are a proposed LNG Plant and associated onshore and marine facilities on Curtis Island (EPBC 2009/4977) and the proposed Walloon coal seam gas (CSG) fields (EPBC 2009/4974).

The proposal has been assessed under the bilateral agreement with the Queensland Government, with a single assessment process covering all components of the Project. The Project has been the subject of a report by the Queensland Coordinator-General, provided to the Commonwealth on 9 November 2010.

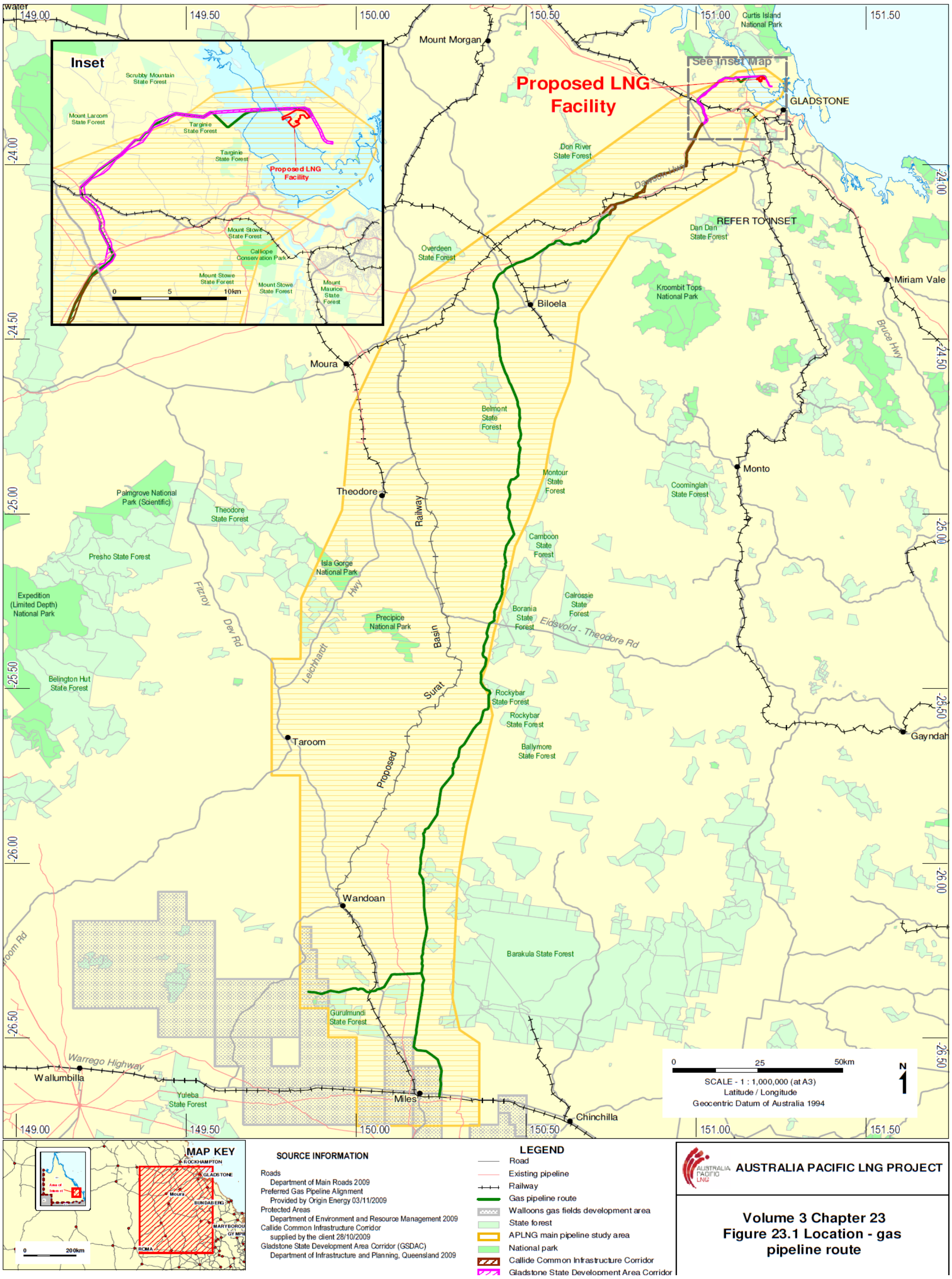
Recommendations

This advice recommends that the impacts of the proposal will not be unacceptable having regard to the proposed conditions, mitigation measures and offsets and therefore should be **approved** for the following controlling provisions of the EPBC Act:

Controlling Provisions for the action	**Recommendation**	
	Approve	**Refuse to Approve**
World Heritage properties (ss 12, 15A)	Approve	
National Heritage places (ss 15B, 15C)	Approve	
Listed threatened species and communities (ss 18, 18A)	Approve	
Listed migratory species (ss 20, 20A)	Approve	

Attachment D

Figure 1 - Proposed pipeline route including alternatives



Background

The proposed action

1. Australia Pacific LNG (the Proponent) is proposing to develop coal seam gas (CSG) resources in the Walloon gas fields to the north west of Dalby, Queensland. The CSG fields will supply gas for a proposed LNG export facility and associated marine facilities on Curtis Island, near Gladstone in Queensland. A high pressure gas transmission pipeline is proposed to be constructed to link the CSG fields to the LNG facility. These proposals are collectively referred as the Australia Pacific LNG Project.

2. In addition to the pipeline network which is the subject of this Departmental Advice, the Project includes the following separate but related referrals submitted by the proponent:

   - Development of coal seam gas fields (EPBC 2009/4974);
   - Construction of LNG plant on Curtis Island (EPBC 2009/4977).

   These two referrals are the subject of separate Departmental Advice.

3. The proposed gas transmission pipeline (the pipeline) will be approximately 450km long and will transport, dehydrated and compressed CSG from the gas fields to the LNG facility. The pipeline will span three local government areas, the Western Downs and Gladstone Regional Councils as well as the Banana Shire. The pipeline will include the following components:

   - a 44km lateral pipeline connecting the Condabri gas field development with the main pipeline;
   - a 38km lateral pipeline connecting the Woleebee gas field development with the main pipeline;
   - a 362km main transmission pipeline from the junction with the lateral pipelines (above) east of Wandoan to the proposed LNG facility on Curtis Island in the North.

Alternative pipeline routes

4. In its EIS, APLNG described multiple alternative routes for the gas pipeline. These include:

   - **Option 1:** Pipeline commences in the northern part of the Woleebee field, then tracks north towards Wandoan, before reaching the Peat and Scotia gas fields. The route then turns northwest and crosses the Surat Basin Railway line. It then circumvents the proposed Nathan Dam impoundment area and crosses the Dawson River and the mountain ranges west of Precipice National Park, adjacent to the Leichhardt Highway. South of Theodore the pipeline again crosses the Dawson River, tracking north towards the Queensland Gas Pipeline (QGP) route. After joining this corridor it would be roughly co-located in corridors containing the QGP and/or other potential gas pipelines through to Curtis Island.
   - **Option 2**: Designed to avoid the existing Xstrata mining tenements to the north of Woleebee field, the route commences at a proposed gas processing facility site, some 10km east of Miles. This route traverses around the township of Miles, tracks north and is co-located with the Peat lateral

pipeline corridor. Passing approximately 30km north of Wandoan, it then connects to the route as described in Option 1.

- **Option 3 (Preferred):** The gas pipeline bypasses Miles and tracks north towards Camboon, bypassing Barakula, Rockybar and Borania State Forests. Co-location opportunities were investigated with Arrow's Surat to Gladstone Pipeline (SGP). From Camboon, the route tracks north, parallel to the Crowsdale-Camboon Road, where it may be co-located with the QGP. After the Callide Range crossing, the central 'inland' route follows the Callide Infrastructure Corridor State Development Area. Several alternatives have been assessed to accommodate specific construction requirements such as watercourse crossings. Based on the preferred route, specialists conducting field surveys to assess engineering construction, social and environmental risk, Option 3 has been selected by the proponent.

5. The Proponent has assessed the impacts to MNES resulting from activities associated with the construction, operation and decommissioning of pipeline option three. Therefore this approval recommendation applies to option three only. The Department recommends that option one and two not be approved as the impacts on MNES have not been adequately assessed.

Likely environmental impacts

6. In its EIS, the proponent identified potential environmental impacts resulting from pipeline activities, including the alternatives. These impacts include:

- Direct loss of extent and distribution of ecological communities, habitats and items of cultural heritage;
- Indirect effects including dust and litter, fragmentation of remnants, introduction or spreading of weeds, root compaction and increased damage along pipeline alignment edges;
- Removing habitat such as mature vegetation, hollow-bearing trees and fallen logs and therefore loss of shelter, breeding, nesting, perching and foraging resources for any present MNES species;
- Disturbing fauna movement corridors and dry season fauna refuges predominantly associated with creeks and seasonal wetland/waterway areas;
- Unearthing burrowing fauna species during construction;
- Creating the potential for fauna to fall into, and become trapped in the open pipeline trench during construction;
- Potential operational impacts on freshwater aquatic ecological communities including sediment mobilisation and erosion from exposed areas, accidental spillages and altered low flow hydrology associated with road crossings;
- Disturbance such as fragmentation of the mangrove and wetland areas during gas pipeline construction across the inter-tidal area;
- Underwater noise generated by drilling or dredging activities to establish the horizontal directionally drilled pipeline;
- Loss of drilling fluid directly or indirectly into the marine environment;
- Disturbance of the sub-tidal seabed at any dredge locations;

- Creation of a turbid plume that will disperse into the broader Port Curtis marine environment.

Narrows crossing

7. The pipeline will transport CSG from the Walloon gas fields, north west of Dalby to a proposed LNG facility on Curtis Island. To achieve this, the proponent will need to construct the pipeline across the Narrows – one of only five narrow tidal passages separating large continental islands from mainland Australia. The Narrows lies within the Great Barrier Reef World Heritage Area which is also National Heritage listed. The Coordinator-General required proponents proposing to construct pipelines across the Narrows to work together on a combined crossing (bundled crossing).

8. The Department understands that APLNG has reached a commercial arrangement with British Gas/Queensland Gas Company (QGC) to co-locate pipeline infrastructure across the Narrows. In this instance, QGC will manage the construction and be responsible from an EPBC Act perspective as prescribed in the conditions of approval (EPBC 2008/4399). APLNG are also seeking approval for an independent crossing of the Narrows, in the event that the agreement with British Gas/QGC lapses.

9. To manage the likely impacts on MNES from the Narrows crossing and in the event that APLNG do not proceed with a bundled crossing, the proposed conditions require an Environmental Management Plan (EMP) to be approved by the Minister and be implemented before commencement of construction of the pipeline across the Narrows.

10. If a bundled crossing with British Gas/QGC is undertaken then the Department understands that British Gas/QGC will have responsibility for the crossing and will develop the EMP in accordance with its approval conditions for EPBC 2008/4399.

11. If APLNG pursue an independent crossing of the Narrows, the following will add to the cumulative impacts of development occurring in the area:
    - altered hydrology and hydrodynamics;
    - impacts from dredging and trenching;
    - turbidity impacts on seagrass;
    - impacts on listed fauna and flora from acid sulfate soils disturbance in the Kangaroo Island inter-tidal wetlands;
    - impacts on listed and migratory marine species from construction works in the channel.

12. If an independent crossing is undertaken, conditions have been proposed that would require the proponent to provide an EMP with a firm engineering solution for the Narrows crossing that minimises impacts on MNES and the environment. Based on available information and the Coordinator-General's assessment, the Department is confident that the strict conditions proposed would minimise impacts on MNES to a level that is not unacceptable.

Approval period

13. As the life of the APLNG project as a whole is expected to be at least 30 years, it is proposed that the approval and conditions attached to this Project would have effect until 22 February October 2060.

Description of the environment

Mainland

14. On the mainland, the gas pipeline is almost entirely located within the six million hectare Brigalow Belt South bioregion which stretches from Townsville in the north, to northern New South Wales in the south. The majority of this bioregion is used for agriculture, particularly cattle grazing in the rangelands. Many of the Brigalow remnants, of which only 2% are protected in reserves, are in marginal habitats such as steep, rocky slopes. Construction of the 40m right of way will disturb approximately 1,759 hectares of vegetation. Of this, approximately 24.6% (433 hectares) is remnant vegetation.

Curtis Island

15. Typical landforms on Curtis Island include moderate to steep wooded slopes, wooded alluvial plains, ephemeral watercourses, estuarine systems and fresh and saltwater wetlands. The gas pipeline is to be constructed primarily in the basin of a narrow fluvial valley. The valley is dominated by Eucalyptus and Corymbia woodlands on moderate to low slopes. Mangrove and saltmarsh communities are present within intertidal areas. The area displays disturbance consistent with a long history of land use that includes grazing, clearing, and selected timber felling. The presence of weeds and a history of fire have also impacted upon the ecological values of the site. Whilst the majority of the woodland is regrowth, mature trees are present, especially along the ephemeral creeks in the low-lying portions of the extended valley within which the gas pipeline is proposed.

Survey of the pipeline route

16. In its EIS and subsequent information, APLNG provide details of surveys undertaken along the pipeline route. There have been two major terrestrial surveys undertaken along the pipeline route. The first was undertaken during two separate periods in 2009, from 26 September to 6 October and 15 October and 30 October. They included investigations of the presence/absence (actual and likely) of EPBC-listed flora and fauna species and ecological communities identified from desktop assessments. Ground-truthing surveys were undertaken at 143 sites. Opportunistic significant species surveys were undertaken during ground-truthing exercises to identify populations and potential habitat areas with the study area. The second terrestrial survey was undertaken by WorleyParsons' botanists over eight days from 4 to 14 May 2010. The surveys involved a detailed walk through of three previously identified significant ecological areas (Rockybar, Fairylands, Callide Range and Calliope Range) to detect the presence and approximate densities of threatened flora species along the proposed pipeline route.

Coordinator-General's Assessment and public consultation

The assessment report

17. The Queensland Coordinator-General's report is an 'assessment report' which you must take into account under s.136 of the EPBC Act. The final report was provided to the Commonwealth on 9 November 2010. That report has been taken into account by the Department in providing advice and making recommendations on each proposal.

18. Matters relating to the assessment process for the APLNG project are also described in the brief to which this advice is attached. The assessment process included:

    - the initial assessment of the APLNG project for the purpose of a controlled action decision;
    - the assessment under the bilateral agreement with the Queensland Government and subsequent report by the Queensland Coordinator-General.

19. Under the bilateral agreement, the assessment was undertaken in accordance with the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act). Under that Act, on 27 March 2009 the project was declared to be a significant project for which an environmental impact statement (EIS) was required. APLNG prepared and submitted the EIS which was subsequently approved by the Coordinator-General and publicly advertised on 29 August 2009. Following the receipt and analysis of submissions made on the EIS, it was determined by the Queensland Coordinator-General that a supplementary report on the EIS (SEIS) was not required but instead a number of supplementary agency stakeholder workshops were held in July 2010.

20. The Coordinator-General states that APLNG have undertaken an assessment of impacts on MNES and concluded that no action related to pipeline activities would have a significant impact on the elements of the controlling provisions on the basis that proposed mitigation measures and offset measures are fully implemented. The Coordinator-General concurs with the APLNG assessment and in particular on the following conclusions:

    - There will be no significant impacts to EPBC listed ecological communities, including spring communities as well as threatened species;
    - There will be no impacts to wetlands of international importance as there is no occurrence in the vicinity of pipeline corridors;
    - Regarding impacts to EPBC listed migratory species, there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the operational period;
    - There will be no significant impacts to migratory marine fauna;
    - There will be no significant impacts to World Heritage and National Heritage values.

21. The Coordinator-General has specifically stated that impacts to MNES are not considered significant on the basis that offset measures will be fully implemented. The Department does not agree with this conclusion and approach for determining impact significance. Offsets cannot be used in the determination of significance. Offsets are a 'last resort' and used to compensate for the unavoidable impacts to MNES. The 'Assessment of impacts' section below considers the conclusions of the Coordinator-General and the Department's view of the acceptability of impacts to MNES.

22. Matters raised in public submissions are summarised in the brief to which this advice is attached. Relevant matters raised in the public submissions on the EIS relating particularly to the proposed pipeline included concerns about:

- Ensuring that wherever possible, co-location opportunities are identified and companies agree to bundle across the Kangaroo Island Wetlands and the Narrows;
- Possible impacts on infrastructure such as roads which may result in traffic management issues and road surface upgrade requirements;
- Social impacts resulting from pipeline activities on communities. This includes the need for more housing to manage the influx of construction workers. Concerns also included community safety and the need for policing resources to cope with the influx of workers;

23. Public comments were considered by the Queensland Coordinator-General when preparing his report and have been considered by the Department in preparing this advice and associated briefing.

Assessment of impacts

Overview

24. This assessment is limited to impacts on the controlling provisions for the proposed action: listed threatened species, listed migratory species, World Heritage properties; and National Heritage places, protected under Part 3 of the EPBC Act.

25. On the basis of the information available and the Coordinator-General's assessment, the Department has made the following conclusions in relation to the matters protected by the controlling provisions for the action. The Department recommends that the decision be made to approve the proposal for each controlling provision accordingly:

Controlling provision	**Acceptability of impacts**
World Heritage properties	Not unacceptable If the proponent is required to develop a robust Environmental Management Plan for the crossing of the Narrows, in accordance with the proposed conditions.
National Heritage places	Not unacceptable If the proponent is required to develop a robust Environmental Management Plan for the crossing of the Narrows, in accordance with the proposed conditions.
Listed threatened species	Not unacceptable If the proponent acts in accordance with the requirements of the proposed conditions. This includes developing species management plans, clearing within authorised disturbance limits and securing offsets where required.
Listed migratory species	Not unacceptable If the proponent acts in accordance with the proposed conditions. If a bundled crossing with British Gas/QGC is undertaken then the Department understands that British Gas/QGC will have responsibility for the crossing and will develop the EMP in accordance with its approval conditions for EPBC 2008/4399.

World Heritage listed properties (ss.12 and 15A)

26. The Coordinator-General's Report states that the Proponent's EIS identifies one World Heritage site within the pipeline area – the Great Barrier Reef World Heritage Area (GBRWHA). The gas transmission pipeline traverses the Narrows, a small passage connecting the Queensland mainland with Curtis Island. Below the mean low water mark, the marine environment is considered to be located within the GBRWHA. The EIS states that no other heritage sites of national or state significance occur along the pipeline route. The EIS states that construction of the gas transmission pipeline is likely to impact the World Heritage values, however impacts are likely to be temporary as they will be associated with construction rather than operation. The Coordinator-General concurs with APLNG, that construction impacts on World Heritage values are likely to be localised and temporary, limited to the construction period only. Based on available information and the Coordinator-General's assessment, the Department agrees with this conclusion.

27. The Department understands that APLNG has reached a commercial agreement with British Gas to cross the Narrows in a bundled crossing. If this occurs, the works associated with the APLNG crossing will be undertaken by British Gas, under their approval conditions (EPBC 2008/4399). In the event that APLNG undertake an independent crossing, these proposed conditions require APLNG to develop an Environmental Management Plan and a Dredge Management Plan for the pipeline crossing of the Narrows and the Kangaroo Island Wetlands. These plans are essential to preserve the World and National Heritage values of the Great Barrier Reef World Heritage Area. The Department considers that, if these plans are implemented, they will satisfactorily mitigate the impacts of an independent crossing on the GBR World Heritage Area. The table below is a determination of acceptability of impacts from an independent crossing on World Heritage values.

World Heritage Value	Determination of acceptability of impacts
Outstanding example representing a major stage of the earth's evolutionary history	There will be impacts to this criterion during construction of the pipeline crossing across the Narrows. However, these impacts will be temporary and once construction of the pipeline is complete there will be little to no impacts as the pipeline will be buried for its length.
Outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment	Trenching for pipeline construction will result in physical disturbance to sediments through dredging impacts. However, these impacts are not likely to impact geomorphic or physiographic features to the extent that they will significantly impact on this value.
Contain unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty	The construction of the pipeline will not impact directly on coral reefs or islands. Impacts on tidal flats and habitat for marine species have been discussed previously under listed threatened and migratory species.

World Heritage Value	Determination of acceptability of impacts
Provide habitats where populations of rare and endangered species of plants and animals still survive	Impacts on this value are assessed in the sections below. The crossing of the Narrows at the Kangaroo Island Wetlands could encounter suitable habitat for the Water Mouse (*Xeromys myoides*). Proposed conditions require a management plan to survey, quantify the disturbance on habitat, mitigate and to offset for unavoidable impacts.

National Heritage places (ss. 15B and 15C)

28. The GBR's National Heritage values are the same as the listed values for the GBR World Heritage Area. Those values that are present within Port Curtis and the surrounding area satisfy the following National Heritage listing criteria:

- Criterion B (possession of uncommon, rare or endangered aspects of Australia's natural or cultural history);
- Criterion C (potential to yield information that will contribute to an understanding of Australia's natural or cultural history); and
- Criterion E (importance in exhibiting particular aesthetic characteristics valued by a community or cultural group).

29. The Coordinator-General concludes that impacts to National Heritage values are unlikely to be significant, due to the temporary and localised nature of pipeline activities in the GBRWHA. Based on available information and the Coordinator-General's assessment, the Department considers that the likely impacts on the National Heritage values of the GBR are equally relevant to the impacts on the World Heritage values of the GBRWHA, discussed above. The table below is a determination of acceptability of impacts that may result from an independent crossing of the Narrows on Natural Heritage values.

National Heritage Value	Conclusion on acceptability of impacts
Importance in the course, or pattern, of Australia's natural or cultural history	There will be impacts to this criterion during construction of the pipeline crossing across the Narrows. However, these impacts will be temporary in nature and once construction of the pipeline is complete there will be little to no impacts as the pipeline will be buried for its length.
Possession of uncommon, rare or endangered aspects of Australia's natural or cultural history	Impacts on these aspects have been discussed previously under listed threatened and migratory species including impacts on mangroves and seagrass meadows.
Potential to yield information that will contribute to an understanding of Australia's natural or cultural history	There will be impacts to this criterion during construction of the pipeline crossing across the Narrows. However, these impacts will be temporary in nature and once construction of the pipeline is complete there will be little to no impacts as the pipeline will be buried for its length.

National Heritage Value	Conclusion on acceptability of impacts
importance in demonstrating the principal characteristics of: (i) a class of Australia's natural or cultural places; or (ii) a class of Australia's natural or cultural environments	There will be impacts to this criterion during construction of the pipeline crossing across the Narrows. However, these impacts will be temporary in nature and once construction of the pipeline is complete there will be little to no impacts as the pipeline will be buried for its length.
importance in exhibiting particular aesthetic characteristics valued by a community or cultural group	There will be impacts to this criterion during construction of the pipeline crossing across the Narrows. However, these impacts will be temporary in nature and once construction of the pipeline is complete there will be little to no impacts as the pipeline will be buried for its length.

*Note: The impacts described above are only likely to result from an independent crossing of the Narrows and Kangaroo Island Wetlands. If a bundled crossing of the Narrows is undertaken, there will be no additional impacts as this has been assessed and conditioned in the approval conditions for the British Gas project (EPBC 2008/4399).

Threatened Species and ecological communities (s18 & s18A) and Migratory Species (ss. 20 and 20A)

30. The Department's Environment Reporting Tool (ERT)* identified the following MNES (or controlling provisions) as potentially occurring within the project area:

- three listed threatened ecological communities;
- 18 listed animal species;
- 33 listed plant species; and
- 46 listed migratory species as potentially occurring within the project area.

*See the Attached controlling provisions table for the full list of species and ecological communities ('controlling provisions') potentially impacted.

31. The Coordinator-General's report concludes that no action related to the pipeline will have a significant impact on the elements subject to the relevant controlling provisions provided that mitigation and offset measures are implemented. The Department does not agree with the Coordinator-General's assessment approach that assesses the significance of impacts by reference to offset measures. For those MNES likely to be impacted by pipeline activities, a discussion of the acceptability of impacts is provided below. The controlling provisions table attached to this advice documents impacts on all species possibly occurring in the vicinity of the pipeline corridors (as identified by the Department's Environment Reporting Tool and in research and surveys undertaken by the Proponent).

32. Based on available information and the Coordinator-General's assessment, the Department believes that for most of these listed species the impacts from the Project will be negligible. This is because most listed flora are easily avoidable, as too are wetlands and watercourses important for listed migratory species. The majority of listed fauna utilise a broad range of habitat, widely available across the region. Only those species likely to be impacted, as identified in the EIS and other information and advice available to the Department are discussed further in this advice.

33. The Department has considered the potential impacts, including those listed above, for each species and ecological community potentially occurring along the ROW. Those species and ecological communities most likely to be impacted are discussed below. The Department is confident that the strict requirements of the proposed conditions set out in this report will ensure any impacts on MNES are not unacceptable.

Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community, *Endangered*

34. In its EIS, the proponent states that the alignment of the gas transmission pipeline has been designed to reduce the extent of clearing to this ecological community. Where there has been no practicable alternative route, degraded areas will be impacted in preference to areas of high ecological value. In the Environmental Offsets Strategy (16 November), APLNG state that approximately 13 hectares of this community will be impacted by the Project. The Proponent has proposed offsets for this unavoidable impact, although the details are still being finalised. The Coordinator-General concurs with the conclusion of APLNG that pipeline activities will not result in a significant impact on this community.

Conclusion

35. The Department has considered the Coordinator-General's assessment and proposed conditions to limit pipeline activity disturbance to the Brigalow ecological community to 13 hectares. Clearing in excess of 13 hectares is not covered by this proposed approval and would require a separate referral. It is therefore the responsibility of the proponent to ensure that the final pipeline route traverses no more than 13 hectares of the Brigalow ecological community. The Department considers the impact is not unacceptable as long as the Proponent acts in accordance with these conditions and proposes offsets in accordance with the approval conditions for EPBC 2009/4974. Due to the relatively minor clearing associated with pipeline activities, offset requirements for this unavoidable impact are incorporated into the proposed approval conditions for the expansion of the coal seam gas field referral (EPBC 2009/4974).

36. To ensure a consolidated and consistent approach, a provision for offsets for this unavoidable impact is considered in the gas field approval EPBC 2009/4974. All other proposed conditions and requirements are stated in this proposed approval. As an additional safeguard, the proposed conditions require the proponent to prepare a reconciliation of actual impacts with disturbance limits. Based on available information and the Coordinator-General's assessment the Department considers that the impacts on the Brigalow ecological community from pipeline activities will not be unacceptable.

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions ecological community, *Endangered*

37. In the Environmental Offset Strategy, the Proponent estimates that approximately 0.37 hectares of this ecological community will be cleared by pipeline activities. The Proponent has proposed offsets for this unavoidable impact, although details are still being finalised. The Coordinator-General concurs with the conclusion of APLNG that the relatively minor amounts of clearing, as well as the narrow configuration of clearing are unlikely to lead to an unacceptable impact on this community.

Conclusion

38. The Department has considered the Coordinator-General's assessment and proposed conditions and disturbance limits that restrict the Proponent to a maximum clearance of 0.37 hectares of SEVT. To ensure a consolidated and consistent approach, a provision for offsets for this unavoidable impact is considered in the gas fields approval (EPBC 2008/4059). The relatively minor amounts of clearing, as well as the narrow configuration of clearing are unlikely to lead to an unacceptable impact on this community. Based on information available and the Coordinator-General's assessment, the Department considers that the impacts on SEVT from pipeline activities will not be unacceptable.

Community of Native Species Dependent on the Natural Discharge of Groundwater from the Great Artesian Basin, *Endangered*

39. In EIS documentation, APLNG state that the project area is located within the Springsure Supergroup, a spring complex in the Great Artesian Basin (GAB). The nearest springs within this Supergroup are approximately 1.7km west of the proposed Cockatoo Creek pipeline crossing. APLNG state that spring communities close to the Cockatoo Creek crossing site include the EPBC Act listed *Eriocaulon carsonii* (Salt pipewort) and *Myriophyllum artesian* (Artesian Milfoil). The Coordinator-General's report states that these springs are recharge rather than discharge and therefore do not represent the EPBC Act listed community. In recognition of the ecological values in the Springsure Supergroup, APLNG have undertaken a significant impact analysis treating it the same way they would if the EPBC Act listed community was present. The Department is satisfied with this approach as it is possible that EPBC-listed species are present, even if the ecological community is not.

Conclusion

40. Based on available information and the Coordinator-General's report, the Department believes that pipeline activities associated with the crossing of Cockatoo Creek will not impact on this EPBC Act listed community. This is because the GAB springs 1.7km west of the Cockatoo Creek crossing do not constitute the listed ecological community. The Department is therefore confident that pipeline activities will have no impact on this ecological community.

Cycas megacarpa (Large-fruited Zamia), *Endangered*

41. This species is a small to medium sized plant that grows up to 3 metres tall. It is endemic to south-east Queensland where most populations are very small and fragmented. The Recovery Plan states that healthy viable populations generally have more than 500 adult plants, a diversity of individual size classes and obvious seedling recruitment. Land clearing, habitat degradation and genetic loss are identified in the Recovery Plan for this species as major threats. Erosion and sedimentation and introduction of weeds can also have a significant impact on the species.

42. The Callide and Calliope Ranges have significant populations of the endangered *Cycas megacarpa.* Surveys conducted for the Surat to Gladstone Pipeline (EPBC 2009/5029) identified approximately 14,000 plants in the Callide Range and 115,200 plants in the Calliope Range. The proposed APLNG pipeline will also traverse these ranges. The Proponent has indicated that a total of 23.5 hectares of habitat and 130 individual plants will be impacted by construction of the pipeline across these ranges. Other potential impacts from the proposed action include erosion and weed invasion.

43. There are also three other pipelines proposed to be constructed through the Calliope and Callide Ranges. The cumulative impacts on *Cycas megacarpa* include:

    - 117 individuals impacted by The Surat to Gladstone pipeline (EPBC 2009/5029).
    - 184 individuals impacted by QCLNG (EPBC 2008/4399), and
    - 665 individuals impacted by Santos (EPBC 2008/4096).

44. The Coordinator-General's report describes that impacts from pipeline activities are most likely to be habitat loss, degradation, fragmentation, loss of connectivity, the introduction and/or spread of invasive weeds or pests, leaching of pollutants or release of sediment, and dust emissions due to the physical clearing of vegetation. Mitigation and management measures are designed to limit these impacts on MNES. The Coordinator-General concurs with the conclusion of APLNG that there will be no significant impact to this species.

45. To compensate for the unavoidable impacts on this species, the Department has proposed conditions that require the proponent to offset no less than 780 individuals within an appropriate 141 hectare offset area. Conditions also require the Proponent to develop a management plan for this species. This plan must include information about proposed offsets including translocation and propagation methods as well as measures to ensure the protection of the offset in perpetuity.

Conclusion

46. Based on the information available and the Coordinator-General's assessment, the Department considers that the impacts from the proposed action on this species will not be unacceptable as long as the mitigation measures and offset requirements are implemented in accordance with the proposed conditions. The proposed conditions are consistent with recent approval decisions for the GLNG Project (EPBC 2008/4096), the QCLNG Project (EPBC 2008/4399) and the Surat to Gladstone Pipeline (EPBC 2009/5029). The Department is confident that compliance with the proposed conditions will ensure that the impacts on this species are not unacceptable.

Philotheca sporadica, Vulnerable

47. *Philotheca sporadica* is a small shrub that grows to 150cm high and has numerous branches. It is known from south-east Queensland, just north of Tara to approximately 12km east of Kogan in the Darling Downs Pastoral District. Populations often occur in small, discrete clusters (15-50 m in diameter) in open areas, including road verges. Although there is no quantitative data to indicate a declining population, a key threat to the species is loss of habitat. There are an estimated 64,000 plants in the wild.

48. APLNG has made no reference to *Philotheca sporadica* in EIS documentation. Although detailed pre-clearance surveys are required, the lack of assessment implies that the species will not be impacted. Based on information in EIS documentation of other proponents who are proposing similar gas pipelines, the Department is confident that this species will be encountered along the ROW. This is particularly the case where dense clusters are encountered that may be difficult to avoid. Due to the high degree of uncertainty in the estimated level of disturbance, the Department has proposed conditions that require a management plan prior to the commencement of pipeline activities. This plan must quantify impacts on the species as well as specify avoidance and mitigation measures. For unavoidable impacts, the Plan must specify appropriate offsets.

Conclusion

49. The proposed conditions require a management plan to be developed and implemented for *Philotheca sporadica* as well as pre-clearance surveys to be undertaken prior to the commencement of pipeline activities. The management plan must quantify disturbance, specify avoidance and mitigation measures and include details of suitable offsets. The proponent is required to submit this management plan for the Minister's approval prior to the commencement of pipeline activities. The proponent is required to submit this management plan for the Minister's approval prior to the commencement of pipeline activities. The impacts from the proposed action on this species will be not unacceptable provided the action is taken in accordance with the proposed conditions.

Cadellia pentasylis (Ooline), *Vulnerable*

50. Ooline is a semi-arid tree growing generally to 10 meters high. The species is found across Queensland, largely in the Darling Downs. The Brigalow-Ooline vegetation community supporting the species has largely been cleared and is now restricted to small scattered sites.

51. In EIS documentation, the Proponent has identified a population of approximately 10 individuals in a grazed paddock at the beginning of the Woleebee Lateral in the southern sections of the proposed gas transmission pipeline route. The population was observed in a non-remnant paddock at the base of a steep sandstone rise, which has helped it avoid previous mechanical clearing. The Proponent states that it is expected that the surrounding cleared area currently grazed would have historically contained numerous individuals. Database records also indicated Ooline presence at two locations within five kilometres from the proposed gas transmission pipeline route.

52. The Proponent has identified that impacts from pipeline activities will include the direct loss of plants within the right of way and associated infrastructure such as access tracks. The Proponent indicates that pre-clearance surveys will be undertaken to determine the location of individuals prior to construction. Threatened species management guidelines will also be developed. The Coordinator-General's report concurs with the conclusion of APLNG that pipeline activities will not result in a significant impact on this species. Because of the relatively minor amounts of clearing, the Department agrees with the Coordinator-General's conclusion, however there is a risk that suitable habitat elsewhere along the pipeline corridor might support other Ooline populations.

Conclusion

53. The Department considers it possible that large areas of suitable habitat exist along and in close proximity to the pipeline right of way. Although the Proponent only expects to impact 10 individuals, there is a risk that if the route of the gas transmission pipeline takes minor deviations, other populations of the species could be impacted. Therefore the proposed conditions impose a disturbance limit of 10 individuals and also require a management plan to be developed and implemented for this species. Based on the information available and the Coordinator-General's assessment, the Department considers that the impacts from the proposed action on this species will not be unacceptable provided the action is taken in accordance with the proposed conditions.

Rheodytes leukops (Fitzroy River Turtle), *Vulnerable*

54. This species is only found in the Fitzroy River and its tributaries. Threats include the loss and disturbance of habitat. The habitat for this species could be impacted during construction of the pipeline across waterways which could degrade riparian areas, increase erosion and sedimentation and impact on water quality. The Proponent states that the Fitzroy turtle is restricted to the waterways of the Fitzroy River Catchment, of which some tributaries are crossed by the proposed gas transmission pipeline. At the time of survey these tributaries were either dry, or contained shallow, turbid pools. The majority of waterways crossed by the gas transmission pipeline do not satisfy the species preference for high water clarity and the presence of pool-riffle systems.

However, recent research is showing that the species will venture up/downstream to inhabit, shallow, turbid pools where preferential habitat is unavailable. Proponent surveys must therefore also include this habitat.

55. The Coordinator-General's report does not specifically assess impacts on this species, although it does state that there will be no significant impact to EPBC listed species.

Conclusion

56. The proposed conditions require an Aquatic Values Management Plan to address potential impacts on the Fitzroy River Turtle. The plan must consider the use of horizontal directional drilling across water ways that may be habitat for this species. The Department is confident that if pipeline activities are undertaken in accordance with the proposed conditions, impacts on this species will be not unacceptable.

Xeromys myoides (Water Mouse), *Vulnerable*

57. The Proponent states that habitat suitable for this species within the right of way is restricted to the mangroves and associated mudflats either side of the Narrows. There are a number of important populations along the central and south-eastern Queensland coast. The project will involve clearing of 15.2 hectares of suitable habitat, however, the Proponent states that these ecosystems are subject to natural disturbance from events like cyclones. Therefore the impacts on this species are expected to be minimal, even if an important population was discovered at project sites.

58. The proposed conditions require the proponent to develop a management plan to address potential impacts of the crossing of the Kangaroo Island Wetlands and the Narrows on this species. This plan must quantify impacts on the species as well as specify avoidance and mitigation measures. The Coordinator-General's report does not specifically assess impacts on this species, although it does state that there will be no significant impact to EPBC listed species.

Conclusion

59. Based on available information and the Coordinator-General's assessment, the Department is confident that if pipeline activities are undertaken in accordance with the proposed conditions, impacts on this species will not be unacceptable.

Egernia rugosa (Yakka Skink), *Paradelma orientalis* (Brigalow Scaly-foot) and *Furina dunmalli* (Dunmall's snake), *Vulnerable*

60. The Brigalow Scaly-foot (*Paradelma orientalis*), Dunmall's Snake (*Furina dunmalli*) and the Yakka Skink (*Egernia rugosa*) are small, elusive reptiles distributed throughout the Brigalow Belt region in the south-eastern interior of Queensland. Suitable habitat exists for all three species within the ROW and scouting will be undertaken prior to commencement of pipeline activities. However, because these species are elusive, they are unlikely to be detected, even with targeted pre-clearance surveys. Therefore, a precautionary approach is recommended and species presence assumed where suitable habitat exists. The proposed conditions therefore require a management plan to be developed

for each of these species to determine the impact on suitable habitat, mitigation measures and offsets of unavoidable impacts.

61. The Coordinator-General's report does not specifically assess impacts on this species, although it does state that there will be no significant impact to EPBC listed species.

62. APLNG provided clarification to the Department on impacts to these species from pipeline activities (attached to this advice). They state that based on available information and studies there will be no significant impacts on these species associated with the development of the gas pipeline. Residual impacts on these species can be reduced to minor or negligible with the application of standard mitigation measures which will be detailed in species management plans. The Department has therefore proposed conditions that require APLNG to develop management plans for these three species.

Conclusion

63. The impacts from the proposed action on these species will not be unacceptable, provided that management plans, approved by the Minister, are implemented and the action is taken in accordance with the proposed conditions.

Eriocaulon carsonii (Salt Pipewort/Button Grass), Endangered

64. The proposed gas transmission pipeline route crosses Cockatoo Creek and the smaller creeks that drain into it, including Nine Mile Creek, Kennedy Creek and Rocky Creek. The proposed crossing site at Cockatoo Creek is within the Springsure Supergroup Spring Complex, one of 12 within the GAB. This supergroup is comprised of recharge springs and therefore does not support the '*the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin*'. However, these springs are still environmentally and ecologically sensitive areas that are known to support EPBC-listed threatened species including the endangered *Eriocaulon carsonii* (Salt Pipewort/Button Grass). The Proponent states that during surveys for the Surat-Gladstone Pipeline, the Salt Pipewort was observed in springs approximately 4.7km west of the APLNG proposed pipeline crossing of Cockatoo Creek.

65. The Proponent states that the alignment will avoid disturbance to threatened species, however in the unforseen and extremely unlikely event that disturbance to threatened species occurs, offsets will be negotiated with the Department.

66. The Department notes that the site of the proposed crossing of Cockatoo Creek is not through sensitive springs. The site is approximately 1.7km to the east of the nearest springs.

67. The Department therefore considers that the risk to the *Eriocaulon carsonii* (Salt Pipewort/Button Grass) is low, provided detailed surveys confirm the species is not present at the crossing site and within the impact zone (see note below).

Conclusion

68. The Department has proposed conditions that impose a zero disturbance limit for this species. The Proponent must ensure that the pipeline crossing of

Cockatoo Creek does not impact on EPBC-listed threatened species as disturbance is not covered by this approval. Proposed conditions also require the Proponent to undertake a comprehensive and detailed survey of the crossing site to confirm absence of EPBC-listed threatened species within the impact zone. If this species is located within the impact zone, the a management plan must be developed and implemented prior to commencement of activities that could potentially impact on this species. Based on the available information and the Coordinator-General's assessment, the Department is confident that impacts to this species will not be unacceptable, provided the proponent complies with the disturbance limits, management plan and survey requirements of the proposed conditions.

*Note: The impact zone includes the area of potential habitat that could be impacted by project activities associated with the crossing of Cockatoo Creek (i.e. the Right of Way and the areas downstream where EPBC-listed species could be impacted by crossing activities)

Other threatened species

69. The controlling provisions table attached to this advice, documents impacts on all species potentially occurring in the vicinity of the pipeline corridors (as identified by the Department's Environment Reporting Tool and discussed in the EIS).

70. Based on the available information, the Coordinator-General's assessment and clarification provided from APLNG (attached to this advice), the Department is confident that there are no other listed threatened species or ecological communities that are likely to be impacted by gas pipeline activities, noting that pre-clearance surveys are required as a precaution.

Migratory Species

Options for crossing the Kangaroo Island Wetlands and the Narrows.

71. APLNG has reached a commercial agreement with British Gas/QGC whereby works associated with the crossing of the Kangaroo Island Wetlands and the Narrows will be undertaken by British Gas/QGC under their approval conditions (EPBC 2008/4399). The impacts associated with this bundled crossing have been documented, assessed and conditioned in the approval decision made for the British Gas/QGC project EPBC 2008/4399. If British Gas/QGC construct the bundled crossing for APLNG there will be no additional impacts resulting from the APLNG project.

72. APLNG are, however, proposing to construct an independent crossing of the Kangaroo Island Wetlands and the Narrows if commercial arrangements with British Gas/QGC do not proceed. In this instance, there will be additional impacts associated with APLNG project as described in their EIS. Therefore the discussion below relates to the impacts of an independent crossing, as the bundled crossing will not result in any impacts not already considered in EPBC 2008/4399.

Terrestrial

73. In its EIS, APLNG state that desktop research and field surveys predict that up to 41 migratory bird species listed under the EPBC Act may occur in the study area. The following eight species were recorded during field surveys.

- *Egretta sacra* (Eastern Reef Egret);
- *Haliaeetus leucogaster* (White-bellied Sea-eagle);
- *Pluvialis fulva* (Pacific Golden Plover);
- *Numenius phaeopus* (Whimbrel);
- *Numenius madagascariensis* (Eastern Curlew);
- *Merops ornatus* (Rainbow Bee-eater);
- *Rhipidura rufifrons* (Rufous Fantail);
- *Myiagra cyanoleuca* (Satin Flycatcher).

74. Based on habitat preferences, APLNG predict that the following may also occur within the project area

White-throated Needletail	Fork-tailed Swift
Brown Booby	Eastern Great Egret
Glossy Ibis	Eastern Osprey
Grey Plover	Lesser Sand Plover
Latham's Snipe	Bar-tailed Godwit
Little Curlew	Terek Sandpiper
Common Sandpiper	Grey-tailed Tattler
Common Greenshank	Marsh Sandpiper
Wood Sandpiper	Great Knot
Red Knot	Red-necked Stint
Sharp-tailed sandpiper	Curlew Sandpiper
Broad-billed Sandpiper	Little Tern
Caspian Tern	Lesser Crested tern
Crested Tern	Oriental Cuckoo
Black-faced Monarch	Spectacled Monarch
Clamorous Reed-warbler	Bar Swallow

75. The proposed alignment of the gas transmission pipeline would require the clearing of 15.2 hectares of coastal wetland vegetation in the Port Curtis wetland area. Construction and operational activities associated with the Project have the potential to further impact on retained and adjacent coastal wetland vegetation through modification of tidal flows, increased boat traffic and boat wash, debris and dust emissions and erosion. The Proponent states that generally, the larger freshwater ephemeral systems transacted by the right of way predominantly exist as dry stream beds with occasional seasonal flooding inundating floodplains. According to the Queensland Wetland Mapping the proposed alignment intersects estuarine systems, river and creek channel riverine systems at Roche Creek, lacustrine systems at Dogwood Creek, plustrine (swamp and marsh) systems and many drainage line river systems. The more defined creek channel at Roche Creek was observed during field surveys

76. APLNG have stated that the Draft EPBC Act Policy Statement 3.21 *'Significant impact guidelines for 36 migratory shorebird species'* (attached to this advice) was used for the impact assessment of migratory bird species potentially occurring at the site. Applying the guidelines to the project site, APLNG conclude that it is likely that the Port Curtis area is an important site for migratory species as defined in the guidelines.

77. It is clear from the environmental assessments of other LNG proposals that the use of Curtis Island and surrounds by listed migratory birds is poorly understood. In an assessment of listed migratory bird impacts attached to the Santos EIS (and attached to this advice), it was concluded that:

- a greater understanding of migratory species' utilisation of the island habitats and the location of breeding sites is required to fully assess actual and/or potential impacts.

78. APLNG have reached a commercial agreement with British Gas/QCG whereby British Gas/QGC will construct the APLNG pipeline crossing of the Narrows. EPBC Act approval was granted to British Gas/QGC allowing them to construct a bundled crossing of the Narrows. If the projects are undertaken in accordance with the commercial agreement, the majority of the impacts to migratory species reported by APLNG will not eventuate. This is because the only impacts from the Narrows crossing will result from British Gas/QGC activities already assessed and approved under EPBC 2008/4399. APLNG however wish to retain the right to construct an independent crossing of the Narrows which would likely result in the impacts described in the EIS and would be in addition to those impacts resulting from British Gas/QGC activities. It is unclear what impacts are expected from both a bundled crossing and an independent crossing. Therefore conditions require a management plan be developed to describe the method for crossing the Narrows and to then fully document the impacts from this crossing and associated avoidance and mitigation measures.

79. The Coordinator-General's report states that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the operational period. The Coordinator-General has imposed a condition (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced. The Coordinator-General has also imposed a condition (Appendix 3, Part 2, Condition 21) that requires a full assessment of the potential impacts on environmental values associated with The Narrows pipeline crossing including cumulative impacts arising from dredging for the Port of Gladstone Western Basin Dredging Project.

Conclusion

80. In the event that a bundled crossing with British Gas/QGC is undertaken, the Department is confident that impacts on migratory species resulting from APLNG activities will not be unacceptable, if undertaken in accordance with these proposed conditions. In the event that an independent crossing is undertaken the Department is confident that because these listed species are highly mobile and there is an abundance of suitable breeding, foraging and roosting habitat on Curtis Island and surrounds, impacts from pipeline activities crossing the Kangaroo Island Wetlands and the Narrows are likely to be low. However, the use of Curtis Island and surrounds by migratory birds is poorly understood.

81. It is a requirement of these proposed conditions that if APLNG undertake an independent crossing of the Narrows, they must contribute at least $250,000 towards Gladstone Port Corporation's (GPC) migratory bird research study required by conditions for the Gladstone Western Basin Dredging and Disposal Project (EPBC 2009/4904), if this proposal is approved. This has been selected as an appropriate figure because the Kangaroo Island Wetlands and the

Narrows represents approximately one eighth of the overall area covered by the GPC's recommended two million dollar migratory bird study.

82. It is a requirement of these proposed conditions, that mitigation measures be developed for the EMP which must be approved by the Minister and implemented before pipeline activities across the Narrows can commence. This is a requirement irrespective of a bundled or independent crossing.

83. The Proponent states that gas pipeline activities will not impact any large inland waterbodies and therefore impacts on migratory terrestrial species will be negligible. The Department is confident that compliance with the proposed conditions will ensure impacts to terrestrial migratory species will not be unacceptable.

84. Based on available information and the Coordinator-General's assessment, the Department is confident that any impacts on listed migratory species will not be unacceptable as long as the Project is undertaken in accordance with the proposed conditions.

Marine

85. The Proponent states that it is known or considered likely that the following threatened and migratory marine species occur in the gas pipeline study area around Port Curtis:

- *Caretta caretta* (Loggerhead Turtle);
- *Chelonia mydas* (Green Turtle);
- *Eretmochelys imbricata* (Hawksbill Turtle);
- *Lepidochelys olivacea* (Olive Ridley Turtle);
- *Natator depressus* (Flatback Turtle);
- *Dugong dugon* (Dugong);
- *Sousa chinensis* (Indo-pacific Humpback Dolphin);
- *Orcaella heinsohni* (Australian Snubfin Dolphin), and

86. If a bundled crossing is undertaken in accordance with the approval conditions for the British Gas/QGC project (EPBC 2008/4399) then there will be no impacts on these species from APLNG activities that have not already been described, conditioned and approved in EPBC 2008/4399.

87. If APLNG undertake an independent crossing of the Narrows, then the following may impact on these species:

- disturbance and fragmentation of mangrove and salt marsh/saltpan habitat
- underwater noise from dredging
- disturbance of sub-tidal habitat and subsequent turbidity plumes from dredging.

88. The Coordinator-General's report states that pipeline activities are unlikely to have a significant impact on migratory marine fauna because impacts will be localised and temporary. The Coordinator-General has imposed a condition (Appendix 3, Part 2, Condition 21) that requires a full assessment of the potential impacts on environmental values associated with The Narrows pipeline crossing including cumulative impacts arising from dredging for the Port of Gladstone Western Basin Dredging Project.

89. The Department also considers the following as potential impacts from an independent crossing of the Narrows:

- sedimentation plumes;
- accidental hydrocarbon/chemical spills;
- vessel strikes and interactions with dredge equipment;
- entanglement of marine reptiles in mooring systems and temporary structures.

90. The proposed conditions require impacts on listed migratory marine species to be managed by the EMP for crossing the Narrows and the final Dredge Management Plan.

91. The final EMP must include mitigation measures for these species when undertaking pipeline activities across the Narrows. The proponent has stated that with mitigation measures implemented, there will be a negligible impact on these species. It is also a requirement of these proposed conditions that the proponent develops a Dredge Management Plan for approval by the Minister before commencement of pipeline activities across the Narrows.

Conclusion

92. Based on available information and the Coordinator-General's assessment, the Department is confident that impacts on marine migratory species will be temporary and localised. They will not be unacceptable as long as appropriate mitigation measures are included in an EMP approved by the Minister.

Cumulative Impacts

93. In addition to the proposed gas pipeline activities associated with the APLNG project, other LNG proposals identified below are expected to involve significant gas pipelines from respective gas fields in southern Queensland connecting to LNG facilities on Curtis Island. This includes construction of pipelines across the Narrows required by the following LNG proponents:

- British Gas/ QGC (EPBC 2008/4399) is proposing to construct and operate a 730km gas transmission pipeline network to link the gas fields in the Surat Basin and other nearby coal seam gas resources to an LNG facility on Curtis Island;

- Santos GLNG Project (EPBC 2008/4096) will involve a 430km gas transmission pipeline corridor closely aligned with the existing Queensland Gas Pipeline (QGP) for much of its length with the exception of the section north of Injune where the corridor will traverse the eastern side of Arcadia Valley. The pipeline will approach Gladstone from the south-west, entering the Gladstone State Development Area and crossing Port Curtis between Friend Point and Laird Point to Curtis Island;
- Surat Gladstone Pipeline Pty Ltd (2009/5029) is a subsidiary of Arrow Energy and has prepared an EIS for the 470km Surat to Gladstone pipeline connecting gas reserves in the Surat Basin to Gladstone;
- Shell CSG Project and Arrow Energy Surat Coal Seam Gas Project will utilise the Surat to Gladstone pipeline.

94. The Department understands that APLNG's preferred option is a bundled crossing of the Narrows, however, as a failsafe, a separate crossing route across the Kangaroo Island Wetlands and the Narrows is also proposed. If a bundled crossing does not proceed, it means that there are likely to be additional impacts on the Kangaroo Island Wetlands and the Narrows arising from multiple separate pipelines. The impacts associated with APLNG's independent crossing have been documented and assessed in this advice. The Department considers that the additional, cumulative impacts associated with APLNG's independent crossing of the Kangaroo Island Wetlands and the Narrows are not unacceptable, if there is compliance with the proposed conditions including management plans, mitigation measures and offsets.

95. The Department has had regard to the cumulative impacts of these other proposals in formulating this advice on the APLNG project. The Department has also had regard to the likelihood of the above projects proceeding. From discussions with the proponent and media reports, the Department is aware of recent commercial investments and agreements relating to the projects, including advice from the proponent and media reports of sales agreements between the proponent and overseas buyers of LNG.

96. References to cumulative impacts of other referrals for the APLNG Project are made separately in other attachments to the brief. Recommendations and information on the three proposals that comprise the APLNG Project have been provided at the same time, so that a decision on each separate proposal may have regard to the related impacts of each other proposal.

97. In formulating this advice, including the recommended conditions, the Department has also had regard to the proposed Western Basin Strategic Dredging and Disposal project (EPBC 2009/4904), proposed by the GPC. That proposed project includes a dredging program to deepen and widen existing channels and swing basins, and create new channels, swing basins and berth pockets. The purpose of that project is, in part, to accommodate the expected increases in shipping in and around the Port of Gladstone arising from various LNG projects. The Western Basin Strategic Dredging and Disposal Project (EPBC 2009/4904) has been the subject of separate briefing to you (B10/1863).

Mandatory Considerations

98. Under s.136 of the EPBC Act, in deciding whether or not to approve an action and what conditions to attach to the approval, you must consider the following matters, insofar as they are not inconsistent with any other requirement of Subdivision B, Division 1 of Part 9 of the EPBC Act:

Matters relevant to any matter protected by the controlling provisions (s.136(1)(a))

99. The proposed actions were assessed under the bilateral agreement with the Queensland Government, by a report by the Queensland Coordinator-General under Part 4 of the *State Development and Public Works Organisation Act 1971* (Queensland) and the *State Development and Public Works Organisation Regulation 1999*. This assessment process is used where the Queensland Coordinator-General declares, for the purposes of section 26 of the *State Development and Public Works Organisation Act 1971*, that the proposed action is a significant project for which an EIS is required. Chapter 10 of that report addresses impacts on matters of NES. The Queensland Coordinator-General's report has been considered in providing this advice and the associated briefing, including the proposed conditions.

100. While the Queensland Coordinator-General's report addressed impacts on matters of NES and summarised the relevant discussion in the EIS and SEIS, the report did not make any clear conclusions regarding the acceptability of these impacts. The Department has therefore provided you with a range of additional information, and further considered those impacts in this advice and the associated briefing.

Economic and social matters (s.136(1)(b))

101. Economic and social matters are discussed in the brief to which this advice is attached.

Factors to be taken into account

102. Regarding the mandatory considerations set out in s.136(1) of the EPBC Act (that is, economic and social matters, and matters relevant to the controlling provisions for each proposed action) you must take into account the following matters set out in s.136(2) of the Act:

Principles of ecologically sustainable development (ESD)

103. The Department considers that the proposals would be consistent with the principles of ESD if the conditions and mitigation measures are imposed as recommended. The principles of ESD are set out in s.3A of the EPBC Act.

104. The Department has considered both the impacts on the relevant controlling provisions for each action and the long-term and short-term economic and social benefits and costs of the proposal in making its recommendations to approve, with conditions, the proposed actions.

105. The proposed action is likely to have impacts on the relevant controlling provisions. Some of the impacts (e.g. to particular species) are difficult to predict with certainty. The Department does not consider that the likely impacts would, if properly managed and implemented according to the proposed conditions of approval, and if appropriately managed and conditioned by the State, create irreversible or serious environmental damage. In addition, the proponent is committed to avoiding impacts as far as possible through responsible environmental management.

106. There will be some impact on individual listed species but this would not constitute an adverse or unacceptable impact on the populations as a whole given the scale and duration of the proposed activities and the management and mitigation measures to be implemented. Uncertainties in relation to such impacts are also addressed by the proposed conditions.

107. The proposed conditions including proposed offsets for potential impacts will ensure that there is no net loss of biodiversity relevant to the matters protected under the EPBC Act. In this respect, the Department has also considered the related mitigation measures and offsets proposals for other referrals relating to the APLNG Project. By requiring offsets (both in relation to this and other referrals for the project), the conservation values lost as a result of the proposals has been costed and compensated.

Other information and comments

108. Section 136(2)(f) requires that you take into account any relevant comments received from another Minister in accordance with an invitation under section 131 or 131AA and 131A. In the brief to which this advice is attached, we have recommended that you write to relevant Ministers (and to the proponent) seeking comments on the proposed decision and conditions.

109. Section 136(2)(g) requires that you consider any information given in accordance with a request for further information under section 132. No request for further information under s.132 was made in relation to the proposed pipeline.

Precautionary principle (s. 391)

110. Under s.391(1) of the EPBC Act, you must consider the precautionary principle in making a decision whether or not to approve the taking of an action. You must therefore consider this principle in making a decision on whether to approve each of the referrals which are the subject of the APLNG Project. The precautionary principle means that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage. The Department considers that the proposed conditions are sufficient to manage and mitigate the relevant risks of environmental impacts associated with the referral to which this advice relates.

Person’s environmental history (s.136(4))

111. In accordance with section 136(4) of the EPBC Act, the Minister may also consider whether the person proposing to take the action is a suitable person to be granted an approval, having regard to the person’s history in relation to environmental matters and if the person is a body corporate, the history of its executive officers and if relevant, the history of the parent company and its executive officers in relation to environmental matters.

112. On the basis of the information available to the Department, APLNG or any associated company does not appear to be, or have been, subject to proceedings in relation to a conviction for an offence or ordered to pay a pecuniary penalty, under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of resources.

113. APLNG is a 50/50 joint venture between ConocoPhillips and Origin Energy. Both companies have a long history of conducting its activities in a way that avoids or minimises potential impacts on the environment. APLNG state that the construction of the gas transmission pipeline will be contracted to Origin. Origin’s successful environmental record is demonstrated in winning the Ethical Investor Magazine’s ‘Sustainable Company of the Year’ for 2007. Origin has also received the 2007 APPEA Environment Award for the implementation of the Coal Seam Gas Produced Water Treatment Facility at Spring Gully.

114. Origin operates in accordance with its Health Safety and Environment (HSE) Management System. The HSE management system provides a framework for Origin to continually improve management systems and ensure responsible management practices that minimise any adverse health, safety or environmental impacts arising from activities products or services. The gas transmission pipeline will be developed and operated under Origin’s management systems.

Minister not to consider other matters (s.136(5))

115. In deciding whether or not to approve the taking of an action, and what conditions to attach to an approval, you must not consider any matters that you are not required or permitted, by Subdivision B, Division 1, Part 9 of the EPBC Act, to consider. This Departmental Advice and the associated briefing, does not contain matters that you are not required or permitted to consider in making your decision.

Considerations in deciding on conditions (s.134(4))

116. In accordance with section 134(4) of the EPBC Act, in deciding whether to attach a condition to an approval, you must consider any relevant conditions that have been imposed, or you consider are likely to be imposed, under a law of a State or self-governing territory or another law of the Commonwealth on the taking of the action.

117. The Queensland Coordinator-General’s evaluation report on the APLNG project set out conditions at:

- Appendix 1 – relating to the whole of project;

- Appendix 2 – relating to the gas fields;
- Appendix 3 – relating to the gas transmission pipeline; and
- Appendix 4 – relating to the LNG facility.

118. Under section 134(4) of the EPBC Act, you must also consider information provided by APLNG. Documentation provided by the specified proponent includes the EIS and the SEIS. Other documentation provided by the proponent, as relevant to this proposal, is set out below (under the heading 'References') and is described in this advice, in the brief and in other attachments which this advice forms part of.

119. Under section 134(4) of the EPBC Act, the Minister must also consider the desirability of ensuring as far as practicable that the conditions are a cost effective means for the Commonwealth and the proponent to achieve the object of the conditions.

120. The Department believes the conditions are practicable and cost effective. In formulating the proposed conditions of approval, the Department has had regard to relevant conditions imposed by the Queensland Coordinator-General. The Department has also provided and/or discussed draft conditions, on which those proposed are based, with the proponent; the Queensland Department of Infrastructure and Planning, the Queensland Department of Environment and Resource Management; the Great Barrier Reef Marine Park Authority; and the Heritage and Marine Divisions and Water Group of the Department.

Duration of proposed approval

121. If approved, the proposed action is likely to commence in late 2010 or early 2011. Each of the two LNG trains which the pipeline will service has an operational life of at least 30 years, with both trains expected to commence operations in 2015. The proposed duration of the approval is 50 years (i.e. having effect until 22 February 2060). This timeframe will accommodate a longer production life for the two trains, and allow for any gas pipeline activity associated with a decommissioning and rehabilitation period.

Other considerations

122. Under ss. 137, 137A. 139 and 140 of the EPBC Act, in deciding whether or not to approve an action and its attached conditions, you must not act inconsistently with:

- Australia's obligations under the World Heritage Convention;
- the Australian World Heritage management principles;
- Australia's biodiversity obligations under the Biodiveristy Convention, Apia Convention and CITES;
- Australia's obligations under the Bonn Convention, CAMBA, JAMBA or an international agreement uner subsection 209(4);
- a plan prepared for the management of a declared World Heritage property;
- the National Heritage management principles;
- an agreement to which the Commonwealth is party in relation to a National Heritage place; or
- a plan prepared for the management of a National Heritage place.

123. The Department considers that, provided the proposed conditions are imposed, that an approval of this action will not be inconsistent with ss. 137 and 137A of the EPBC Act.

124. The Department considers that approval of the project would not be inconsistent with any recovery plan, threat abatement plan or approved conservation advice.

References

125. In formulating this advice, the Department has considered all relevant available documents. This includes, but is not limited to, the following:

- Controlling Provision Table for 2008/4096 (Attachment D1)
- Clarification of impacts to cryptic Brigalow reptiles (Attachment D2);
- GLNG Water Mouse and Migratory Wader Study (Attachment D3);
- Draft EPBC Act Policy Statement 3.21 'Significant impact guidelines for 36 migratory shorebird species' (Attachment D4)'
- the referral (EPBC 2009/4976) submitted by the proponent;
- the proponent's Environmental Impact Statement (including supplementary information);
- the Queensland Coordinator-General's Report relating to the APLNG Project (November 2010);
- conservation advice relating to the species mentioned in this advice; and
- Species Profile and Threats Database - SPRAT (DEWHA).

Consultation

126. In addition to the proponent, the Approvals and Wildlife Division of the Department (responsible for administering the EPBC Act assessment) has consulted with a number of government agencies in the process leading to the preparation of this advice and the associated briefing, including (as they were when the primary consultation phase occurred):

- the Commonwealth Department of Resources, Energy and Tourism (DRET);
- the Commonwealth Department of Industry, Transport and Resources (DITR);
- the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF);
- the Commonwealth Department of Climate Change and Energy Efficiency (DCCEE);
- the Commonwealth Treasury;
- the Great Barrier Reef Marine Park Authority;
- Geoscience Australia;
- other relevant divisions of the Department of Environment, Water, Heritage and the Arts, including the Water Group; the Heritage Division; the Strategic Policy Division (the Environmental Economics Unit); and the Marine Division;
- the Queensland Department of Industry and Planning (DIP); and
- the Queensland Department of Environment and Resources (DERM).

Conclusion

127. The proposed action and the proposed APLNG project as a whole, is of a substantial geographic and temporal scale, and will interact with a number of matters of national environmental significance. The proposed conditions are designed to ensure that any impacts on these matters will be limited, and, if unavoidable, mitigated and compensated.

128. The proponent is well-resourced, and experienced in dealing with regulatory requirements for major projects. Therefore, a high level of compliance with the conditions is expected.

129. The Department considers that, based on the available evidence and assessment, the impacts of the gas pipeline activities will not have unacceptable impacts on the relevant controlling provisions subject to compliance with the proposed conditions.

2009/4976 Australia Pacific LNG proposes to establish a major gas transmission pipeline(s) to connect APLNG's coal seam gas fields in southern and central Queensland to its proposed liquefied natural gas (LNG) plant within the Gladstone State Development Area (GSDA), Curtis Island, Gladstone.

Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
World Heritage properties (section 12 & 15A)	Great Barrier Reef	The significant impact guidelines provide further guidance through examples of actions likely to have a significant impact on natural heritage values. These examples are virtually identical for world and national heritage values and places. Those examples relevant to the ascribed values of the Great Barrier Reef are briefly described below: • Damage, modify, alter or obscure important geological formations in a World Heritage property or National Heritage place • Damage, modify, alter or obscure landforms or landscape features, for example, by excavation or infilling of the land surface in a World Heritage property or National Heritage place • Modify, alter or inhibit landscape processes, for example, by accelerating or increasing susceptibility to erosion, or stabilising mobile landforms, such as sand dunes, in a World Heritage property or National Heritage place • Divert, impound or channelise a river, wetland or other water body in a World Heritage property or National Heritage place • Substantially increase concentrations of suspended sediment, nutrients, heavy metals, hydrocarbons, or other pollutants or substances in a river, wetland or water body in a World Heritage property or National Heritage place. Modify or inhibit ecological processes in a World Heritage property or National Heritage place • Reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property or National Heritage place • Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property or National Heritage place • Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property or National Heritage place • Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property or National Heritage place. (page 172 Volume 3, Chapter 23)		The EIS assessed the proposed impact of the pipeline against the impacts on world heritage and national heritage values, concluding that impacts will be not be significant. The Coordinator-General concurs with this assessment, in particular, that impacts would be localised and temporary during the construction period only (Page 182 CG Report).
National Heritage places (section 15B & 15C)	Great Barrier Reef			

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
Wetlands of international significance (Ramsar sites)	Narran lake nature reserve	There are no Ramsar wetlands within or adjacent to the proposed gas pipeline route. The closest Ramsar wetlands are Corio Bay and Shoalwater Bay, which are approximately 150km north of the site (page 22, Volume 3 Chapter 23)		The Coordinator-General concurs with the EIS that no wetlands of international importance are present within the vicinity of the pipeline corridor and no Ramsar wetlands are present (Page 182 CG Report)..
Listed threatened species and communities (sections 18 & 18A)	**THREATENED COMMUNITIES**			
	Littoral Rainforest and Coastal Vine Thickets of Eastern Australia* **Critically Endangered**	Figure 23.7 map of distribution (Volume 3, Chapter 23 EIS)		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* **Critically Endangered**	Figure 23.7 map of distribution (Volume 3, Chapter 23 EIS)		
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* **Critically Endangered**			

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Brigalow (Acacia harpophylla dominant and co-dominant) **Endangered**	The major threat to Brigalow Belt ecological communities is considered to be clearing or severe modification of vegetation, because much of the landscape is eminently suitable for agriculture. Most of the natural vegetation has been cleared since the 1960s. Many of the Brigalow remnants are in marginal habitats such as steep, rocky slopes, or are in poor condition and highly degraded. Indirect effects on ecological communities, flora species and fauna habitat are likely to include increased localised areas of compaction through the use of heavy machinery, fragmentation of remnants, increased edge effects and damage along the existing edges caused by machinery, dust and litter and increased local disturbances through the creation of access tracks. (page 19 Volume 3 Chapter 23 EIS) Potential impacts of the Project on EPBC Act Listed Threatened Communities are most likely to be associated with physical clearing of vegetation for infrastructure development. Other potential impacts are introducing and/or spreading invasive weeds and pests, and leaching pollutants or releasing sediment into retained areas of vegetation. If unmanaged, edge effects and fragmentation can increase the prevalence of weed species in the vegetation adjacent to the right of way. This is due to canopy clearance, altered runoff patterns and increased exposure to foreign material carried into the study area on machinery and equipment (page 28 Volume 3 Chapter 23 EIS) Within the alignment, four regional ecosystems (11.9.1, 11.9.5, 11.9.6 and 11.12.21) analogous to this community were observed. The alignment of the gas pipeline has been designed to conserve this community wherever possible. Where there has been no practicable alternative route, degraded areas will be impacted in preference to areas of high ecological value. It is proposed that approximately 1.8ha of this community will be disturbed for the Project. It is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community. The offsets will be located outside the proposed right of way, and will compensate		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		for the impacts of the Project. Areas used for offsetting will be selected following consultation with DEWHA and DERM. In addition, the relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this community in the long term, provided that appropriated offsets are provided. The natural regeneration of 85% of the 40m wide clearing strip will also return most disturbed vegetation communities in the long term. (page 29, Volume 3 Chapter 23 EIS)		
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions** **Endangered**	Within the alignment one RE (11.11.19) analogous to semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions was observed. It is proposed that approximately 0.2ha of this community will be disturbed as part of the Project. It is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community. The offsets will be located outside the proposed gas pipeline right of way and will compensate for the impacts of the development. Areas used for offsetting will be selected following consultation DEWHA and DERM. In addition, the relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this community in the long term provided that appropriated offsets are provided (page 32, Volume 3 Chapter 23 EIS)	Two small patches of good quality semi-evergreen vine thicket communities exist within the RoW in areas currently mapped as high quality regulated regrowth. Whilst these small patches are not recognised as RE within the VMA framework they do exhibit the same floristic structure and composition of the EPBC listed endangered - Semi-evergreen vine thicket in the Brigalow Belt South and Nandewar bioregions Threatened Ecological Community (TEC) (Page 18 Pipeline – Terrestrial Ecology).	
	The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin** **Endangered**	The only wetlands of national importance known to occur in the vicinity of the gas pipeline corridor are the communities of native species dependent on natural discharge of groundwater from the Great Artesian Basin (GAB). These occur on the outer edge of the GAB in Queensland, NSW and South Australia. The GAB springs are characterised into twelve 'supergroups'. Each supergroup comprises smaller spring groups and spring complexes. The project area is located within the Springsure Supergroup, Brigalow Belt Complex (EPA 2005; Fairfax et al. 2007; Fensham et al. 2004). The community of native species dependent on the natural discharge of groundwater from		The EIS assessed the proposed pipeline against the significant impact criteria for the spring communities and concluded that there are no significant impacts predicted, given that the spring communities identified in the vicinity of the pipeline are recharge as opposed to discharge springs. The Coordinator-General concurs with this assessment (Page 182 CG Report).

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		the Great Artesian Basins is listed as an endangered community under the EPBC Act (1999). Figure 23.8 indicates the location of spring complexes in proximity to the study area. GAB Spring communities known to occur close to the gas pipeline right of way are in the vicinity of Cockatoo Creek. These communities contain Eriocaulon carsonii (salt pipewort or button grass) and Myriophyllum artesian (artesian milfoil) stands. The nearest mapped springs to the gas pipeline route are located 1.7km west of the Cockatoo Creek crossing (straight-line distance, equals 2.4km downstream along the creek channel). During surveys for the Surat-Gladstone Pipeline (AECOM 2009), the EPBC-listed plant salt pipewort was observed in springs near Cockatoo Creek 4.7km west of the Australia Pacific LNG gas pipeline crossing point (page 34, Volume 3 Chapter 23 EIS). These springs are not located on Cockatoo Creek itself, but are adjacent to a small tributary about 1.5km upstream from Cockatoo Creek. Artesian milfoil was also observed in these springs, but this plant is not listed under the EPBC Act. AECOM (2009) stated that these springs are recharge springs and therefore are not the EPBC-listed threatened ecological community, which is defined to comprise discharge springs. As such, there are no known artesian spring MNES species or communities within or in close proximity to the right of way at Cockatoo Creek (page 34, Volume 3 Chapter 23 EIS).		
	Weeping Myall Woodlands* **Endangered**	Weeping myall woodlands occur on arable land. Therefore much of the former range of the ecological community has been cleared for dryland /irrigated cropping or has been significantly modified by heavy grazing. Most sites still in good condition experience little grazing and are uncropped. This includes road reserves and travelling stock routes and reserves. These areas of structurally intact woodland tend to be relatively small and exist in a matrix of agricultural development with poor landscape connectivity (page 30 Volume 3, Chapter 23 EIS)		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		No areas with weeping myall were observed during the survey, so no areas that satisfy the EPBC Act criteria for the weeping myall woodlands endangered ecological community occur with the right of way (page 31 Volume 3, Chapter 23 EIS) Although almost all potential areas of this community were observed during the field visit, if any areas of weeping myall woodland are located within the right of way during the preclearing surveys, it is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community (page 31 Volume 3, Chapter 23 EIS)		pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	THREATENED SPECIES			
	BIRDS			
	Erythrotriorchis radiatus Red Goshawk **Vulnerable**	The study area has the potential to fall within the foraging range of the red goshawk. The mixed woodland is suitable as foraging habitat for this species. The gas pipeline right of way does not contain a permanent watercourse so these creeklines are unlikely to be utilised as breeding habitat. Desktop studies revealed records of red goshawk within the wider area of the gas pipeline right of way. However, the study area is generally not considered suitable as a breeding site for this species. A conservative approach has been adopted and the study area has been considered as part of the foraging range of the red goshawk. Given the extent of similar suitable foraging habitat within the wider area it is considered unlikely that the development of the Project will lead to a long term decrease in the size of a population (page 124 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	Geophaps scripta scripta Squatter Pigeon (southern)* **Vulnerable**	Only one terrestrial fauna species listed as vulnerable (EPBC Act) has been identified through field surveys along the gas pipeline right of way – the squatter pigeon (page 193 Volume 3 Chapter 23 EIS) There is currently no specific recovery plan for this species. No specific population has been identified as important to the long term survival of the species (DEWHA 2009d). The squatter pigeon mainly occurs in		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		grassy woodland and open forest dominated by eucalypts. They have been observed in grazed country and disturbed habitats, such as foraging along roads. They are commonly observed in habitats close to water bodies (DEWHA 2009c). The gas pipeline right of way contains open eucalypt woodland habitat, which is suitable habitat for this species. Within the wider area there is a large extent of similar habitat available. Squatter pigeons are considered locally nomadic and are classified as high mobility taxa (EPA 2006). Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decrease of a local population, whether or not the population is considered an important population. (page 122 Volume 3 Chapter 23 EIS).		
	Lathamus discolor Swift Parrot** **Endangered**	Occurs in woodlands, riparian vegetation and remnant patches of mature eucalypts in agricultural areas, though they prefer dry sclerophyll forest (Higgins 1999; NPWS 2003). It is infrequently, though possibly annually, recorded in south-eastern Queensland in winter (page 103 Volume 3 Chapter 23 EIS).		
	*Macronectes giganteus*** Southern Giant-Petrel **Endangered**	A marine bird that occurs in Antarctic to subtropical waters. It is wide spread throughout the Southern Ocean, most abundant around ice packs where penguins are breeding or over the continental shelf. Nests on off shore islands, shorelines south of Rockhampton, often near a steep drop or on slope (Marchant and Higgins 1990) (page 102 Volume 3 Chapter 23 EIS).		
	Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern)* **Endangered**	Occurs mainly in dense, damp grasslands bordering wetlands and watercourses, but also in open grassy woodlands that are near permanent water or are subject to regular inundation. Very few records in central Qld since 1990, centred on Rockhampton area. Probably extinct in the gas pipeline corridor area (Higgins et al. 2006) (page 103 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Pterodroma neglecta neglecta Kermadec Petrel (western)** **Vulnerable**	Pelagic species that forages at sea in tropical and subtropical waters of the South Pacific; nests on high islands among rocks and vegetation. Extremely rare visitor to the east coast of Queensland and New South Wales (Marchant and Higgins 1990) (page 102 Volume 3 Chapter 23 EIS).		
	Rostratula australis Australian Painted Snipe **Vulnerable**	The current population is considered to occur across much of eastern and northern Australia as a single, contiguous breeding population (Garnett and Crowley 2000). The gas pipeline right of way contains very little habitat considered suitable for this species. Within the wider area there is a large, (although patchy) extent of similar habitat available. Movement patterns are not well known, however the species is often recorded intermittently in suitable habitat, suggesting some nomadic dispersal patterns. Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decline of a local population (page 127 Volume 3 Chapter 23 EIS).		
	Turnix melanogaster Black-breasted Button-quail** **Vulnerable**	There is a current national recovery plan for this species. Three populations have been identified as important to the long term survival of the species, with smaller populations at Barakula State Forest and Palmgrove National Park also considered as important remnant populations. Black-breasted button-quail mainly occurs in SEVT and other dense scrubs with little ground cover (Mathieson and Smith 2009). The gas pipeline right of way contains very little habitat considered suitable for this species. Within the wider area there is a large (although patchy) extent of similar habitat available. Movement patterns are not well known, however the species is often recorded intermittently in suitable habitat, suggesting some nomadic dispersal patterns. Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decrease of any possible local population (page 129 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	FISH			
	Maccullochella peelii peelii Murray Cod, Cod, Goodoo** **Vulnerable**	Murray Cod are artificially maintained through stocking in the Condamine-Balonne River and may potentially occur in Dogwood Creek during significant flow events. The main impact during the construction phase is likely to be increased sediment delivery due to erosion in the development areas. Murray Cod are unlikely to be affected by short-term increases in sediment delivery as they are adapted to high levels of turbidity (DEWHA 2010a) (Page 142 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	Neoceratodus forsteri Australian Lungfish, Queensland Lungfish **Vulnerable**	Not predicted to occur or recorded from site surveys (page 141 Volume 3 Chapter 23 EIS).		
	MAMMALS			
	Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat **Vulnerable**	While there is potential for areas of cliffs and/or caves to occur near the gas pipeline right of way associated with sandstone areas within and adjacent to Gurulmundi State Forest, no cliffs or caves, and therefore no roosting habitat of this type, are likely to occur within the gas pipeline right of way. No major roosting site has been identified in the wider area. However, if tree hollows are utilised as roosts, then the gas pipeline right of way study area potentially provides roosting sites for a population. If this species is present within the wider area it may be impacted by loss of habitat within its foraging range (Page 137 Volume 3 Chapter 23 EIS)..		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and
	Dasyurus hallucatus Northern Quoll*** **Endangered**	The most significant threatening process for this species is the introduction of cane toads Rhinella marina into areas which the northern quoll utilises. Data suggests that local populations of northern quoll in the Northern Territory are usually extinct within a year of		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		the arrival of cane toads. Field surveys confirmed the presence of cane toads within the study area. However, there are populations of northern quolls persisting in Queensland in areas where cane toads are present. As such, it is assumed that a population(s) of northern quoll may persist along the gas pipeline route, particularly within the Callide/Calliope Range, the Rockybar/Fairyland sandstone area, and possibly the Gurulmundi State Forest area. given that cane toads and feral predators are already established within the wider study area, it is considered unlikely that development of the proposed facility would have a significant impact on the northern quoll or lead to a long-term decrease in the size of a population (Page 106 Volume 3 Chapter 23 EIS).		habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	Hipposideros semoni Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat** **Endangered**	Geological features such as cliffs, caves and rock overhangs are usually avoided during pipeline alignment selection due to construction issues associated with trench digging. It is considered unlikely that any areas of extensive caves would be located within the gas pipeline right of way. The most likely area the species may occur within the gas pipeline right of way may be the Callide/Calliope Range. While the Calliope Range was not able to be assessed during the field surveys, the Callide Range was assessed and this included two nights of ultrasonic bat detection surveys. This species is associated with moist, dense forests which do not occur within the gas pipeline right of way. If this species is present within the wider area, it may be impacted by loss of habitat within its foraging range (Page 109 Volume 3 Chapter 23 EIS). The proposed development is unlikely to disturb a major roost site for this species, as there is little suitable habitat on the gas pipeline right of way. Any roost site identified within the gas pipeline right of way would be avoided and buffered from gas pipeline activities. The loss of tree hollows and of potential foraging habitat is not considered likely to lead to a decrease in the size of a population of this species (Page 109 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Megaptera novaeangliae Humpback Whale** **Vulnerable**	Principally occurs in oceanic waters. Port Curtis is not a known feeding, resting or calving area for the species (Page 159 Volume 3 Chapter 23 EIS).		
	Nyctophilus timoriensis (South-eastern form) Eastern Long-eared Bat **Vulnerable**	*Note –described in EIS as Greater Long Eared Bat. No major roosting site has been identified in the wider area. Given the species known distribution and roosting habitat, the gas pipeline right of way potentially provides roosting and foraging habitat for a population(s), particularly west of the Callide/Calliope Ranges. If this species is present within the wider area, it may be impacted by loss of habitat within its range (Page 135 Volume 3 Chapter 23 EIS).		
	Xeromys myoides Water Mouse, False Water Rat **Vulnerable**	Habitat suitable for this species contained within the gas pipeline right of way is restricted to the mangroves and associated mudflats either side of the Narrows (north of Gladstone) on the mainland and Laird Point on Curtis Island (Page 139 Volume 3 Chapter 23 EIS).		
	Pteropus poliocephalus Grey-headed Flying-fox **Vulnerable**	No roosting sites are known or were recorded within the gas pipeline corridor area. It is considered unlikely that the proposed development in this area will affect roosting sites for this species (Page 131 Volume 3 Chapter 23 EIS).		
	OTHER			
	Adclarkia dawsonensis Boggomoss Snail, Dawson Valley Snail** **Critically Endangered**	Alluvial flats, riparian environments and boggomosses (small peat bogs formed by water from aquifers being pushed to the surface through mound springs). Known only from two populations on the Dawson River between Theodore and Taroom, at least 25km west of the alignment (Stanisic 2008) (Page 100 Volume 3 Chapter 23 EIS)..		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is
	Cycas megacarpa Large-fruited Zamia** **Endangered**	Known - Observed in numerous locations west of the Callide Range in the northern sections of the Project area mostly associated with spotted gum and open woodlands on rocky substrates. Over 100 individuals observed during field visits (Page 39 Volume 3 Chapter 23 EIS)..	Several small population of the endangered large-fruited zamia palm (Cycas megacarpa) were observed along both of the Callide and Calliope Ranges. This species was generally observed on ridges, steep hills and weather drainage lines. In A total of130 individuals were observed within the vicinity of the alignment. Individuals were generally grouped together in areas with a steep gradient groups generally contained between 5 and 30	

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
			individuals (Page 18 Pipeline – Terrestrial Ecology). The locations of individuals of the large-fruited zamia palm were collected using a hand held GPS unit. This information can be utilised for the planning the construction of the pipeline corridor and to narrow the corridor in areas containing this species. Knowing where this species occurs prior to the construction planning period will reduce the impact on this species. Where individuals cannot be avoided they will be translocated to nearby suitable habitat. For individuals and populations that cannot be avoided (Page 30 Pipeline – Terrestrial Ecology).	imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	*Cycas ophiolitica*** **Endangered**			
	REPTILES			
	Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink* **Vulnerable**	Unlikely to occur within pipeline alignment. Open grasslands on heavy cracking clay in the Darling Downs. Usually in soil under dead grass. Often on relict roadside verges (Richardson 2006) (Page 101 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report).
	Caretta caretta Loggerhead Turtle** **Endangered**	Globally, the loggerhead turtle is a circum-tropical species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. Nesting beach habitat will not be physically impacted by the proposed project. The gas pipeline will not disturb any major foraging habitat. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of loggerhead turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of loggerhead turtles is the Bundaberg coast. Pipeline construction activities will not result in a		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		change to the lighting regime that will disrupt the breeding cycle (Page 165 Volume 3 Chapter 23 EIS). .		
	Chelonia mydas Green Turtle** **Vulnerable**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. The green turtle is widely distributed throughout tropical and sub-tropical waters. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. Nesting beach habitat will not be physically impacted by the proposed project. Seagrass beds are the critical foraging habitat for the species, and the gas pipeline will not disturb any major seagrass beds. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of green turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of green turtles is the Capricorn-Bunker group of islands. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle (Page 162 Volume 3 Chapter 23 EIS).		
	Delma torquata Collared Delma* **Vulnerable**	The gas pipeline right of way contains habitat that may be considered suitable for this species. Given the current and historical distributions, the species may occur in the study area, particularly in the Callide and Calliope Ranges. Currently, the species is reliably known only from the Mt Crosby area (west of Brisbane) and the Bunya Mountains. There are historical records from Ulam Range west of Gladstone (DEWHA 2009b). The gas pipeline right of way transects a range of woodland types, many of which are considered suitable habitat for a population or populations of collared delma. Considering the extent of similar suitable habitat within the wider area and provided that effective pre-clearing surveys are conducted, it is considered unlikely that the		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		Project will lead to a long term decrease in the size of an important population. There is no known population within the vicinity of the gas pipeline study area. If a population is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population. Given the linear nature of the proposed works, post-construction rehabilitation of the right of way, and provided that effective pre-clearing surveys are conducted it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be negligible (page 112 Volume 3 Chapter 23 EIS).		
	Denisonia maculata Ornamental Snake **Vulnerable**	There is no listed important population for this species. The gas pipeline right of way transects a range of woodland types, some of which are considered suitable habitats for a population or populations of ornamental snake. Considering the extent of similar suitable habitat within the wider area and provided that effective pre-clearing surveys are conducted, it is considered unlikely that the Project will lead to a long term decrease in the size of an important population. Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. The alignment would also cause the loss of 1.2ha of mapped freshwater habitat and 2ha of brigalow/belah woodland, some of which is on cracking clay soils. Such areas may provide suitable resources important habitat for this species. If a population or populations of ornamental snake is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population or populations. However, given the linear nature of the proposed works, post-construction rehabilitation of the right of way and provided pre-clearing surveys are conducted by qualified fauna specialists it is considered that any impact that may occur on an important population (if		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		such exists within the gas pipeline right of way) is likely to be negligible (Page 118 Volume 3 Chapter 23 EIS).		
	Dermochelys coriacea Leathery Turtle, Leatherback Turtle, Luth** **Vulnerable**	Oceanic environments from the sea surface to the seabed. Nests on beaches but major nesting areas are overseas. No recorded nesting of the species in Queensland since 1996 (Page 159 Volume 3 Chapter 23 EIS).		
	Egernia rugosa Yakka Skink **Vulnerable**	Given the range of habitats in which the species is known to occur, it is considered likely to occur in areas throughout the gas pipeline right of way (Page 115 Volume 3 Chapter 23 EIS). There has been no population of yakka skink identified as an important population of this species. The region, in which this species mostly occurs (the Brigalow Belt) has been subject to extensive clearing for agriculture, which has resulted in increasing pressure on the whole population of yakka skink (Richardson 2006). Considering the habitat suitability within the study area and the secretive nature of this species, it is considered possible for a population or populations of yakka skink to occur within the gas pipeline right of way. The eucalypt woodland is the most suitable habitat within the study area for this species. However, given the linear nature of the gas pipeline footprint and the extent of similar suitable habitat within the wider study area and provided that pre-clearing surveys by qualified fauna personnel are conducted, it is considered unlikely that development along the gas pipeline right of way would lead to a decrease in the size of potential local populations, whether or not any such population would be considered an important population (Page 116 Volume 3 Chapter 23 EIS).		
	Eretmochelys imbricata Hawksbill Turtle** **Vulnerable**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. Globally, the hawksbill turtle is a widely distributed species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. The proposed project will not adversely impact the preferred foraging habitat for the species which is rocky and coral reefs (Page 165 Volume 3 Chapter 23 EIS)..		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Furina dunmalli Dunmall's Snake **Vulnerable**	This species is highly cryptic, extremely secretive and possibly scarce. Only a handful of records occur within any given decade, so the biology of the snake is virtually unknown. Most records appear in open forests and woodlands, particularly brigalow and woodlands growing on cracking black clay and clay loams (Cogger et al. 1993). However, the species has also been recorded from dry eucalypt forests and anecdotal evidence suggests it may even occur in vine thickets. Cogger et al. (1993) describes it as occurring from Yeppoon in the north to Oakey and Glenmorgan in the south. However, the species has also been recorded from around Emerald in central Queensland and in northern New South Wales (Wilson 2005). Given the distribution of the species it is considered likely to occur in suitable habitat within the gas pipeline right of way. There are no listed important populations for this species, however the species is poorly known. The gas pipeline right of way transects a range of woodland types, some of which are considered suitable habitats for a population or populations of Dunmall's snake. Considering the extent of similar suitable habitat within the wider area and provided that effective preclearing surveys are conducted, it is considered unlikely that the Project will lead to a long term decrease in the size of an important population. Narrow bands of floodplain eucalypt and brigalow/belah woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. Such areas may provide important habitat for this species. If Dunmall's snake is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population or populations. However, given the linear nature of the proposed works, post-construction rehabilitation of the right of way and provided pre-clearing surveys are conducted by qualified fauna specialists it is considered that any reduction in the area of occupancy of an important population (if such exists within the gas pipeline right of way) is likely to be negligible and short term (Page 120 Volume 3 Chapter 23 EIS).		

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	Lepidochelys olivacea Pacific Ridley, Olive Ridley** **Endangered**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. The Olive Ridley turtle is widely distributed throughout tropical and sub-tropical waters. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. The Olive Ridley turtle does not commonly feed in central Queensland, but suitable feeding habitats are found throughout Port Curtis and elsewhere in the central Queensland region (Page 163 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report).
	Natator depressus Flatback Turtle** **Vulnerable**	Impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in population size. The flatback turtle is widely distributed throughout tropical Australia and also occurs in Papua New Guinea. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle (Page 164 Volume 3 Chapter 23 EIS).		
	Paradelma orientalis Brigalow Scaly-foot* **Vulnerable**	Most records are from relatively undisturbed habitats but the species does also occur in two to three years old regrowth, heavily grazed areas (Kutt et al. 2003) and cultivated areas. This indicates it is resilient to disturbance (DEWHA 2009e). Fragments of invertebrates such as spiders and crickets have been recorded from scats. However, sap constitutes a significant proportion of this species diet, particularly sap from Acacia species (Tremul 2000). Given the range of habitats for this species, it is considered likely to occur in areas throughout the pipeline right of way. The gas pipeline right of way transects a range of woodland types, many of which are considered suitable habitats for a population or populations of brigalow scaly-foot. Considering the extent of similar suitable habitat within the wider area, the proposed natural regeneration of 85% of the 40m wide clearing strip and provided that effective pre-clearing surveys are conducted it is considered unlikely that the Project will		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		lead to a long term decrease in the size of an important population. If a population or populations is present within the wider area of the gas pipeline right of way then clearing for the proposed gas pipeline may reduce the area of occupancy for the species. However, given the linear nature of the proposed works and post-construction rehabilitation of the right of way it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be short term and negligible. Considering the extent of similar suitable habitat within the wider area, the habitat within the gas pipeline right of way area is not considered critical to the survival of this species (Page 114 Volume 3 Chapter 23 EIS).		
	Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle* **Vulnerable**	The gas pipeline right of way transects several smaller tributaries of the Fitzroy catchment, all of which were either dry or had intermittent shallow pools during the field surveys. The lack of permanent deep water at these areas suggests they are poor quality habitat for this species. The lack of suitable habitat within the gas pipeline right of way means it is considered unlikely that the Project will lead to a long term decrease in the size of any local population, whether or not such a population would be considered important. If a population is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population. Given the linear nature of the proposed works and post-construction rehabilitation of the right of way, it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be negligible. Considering the linear nature of the proposed works, post-construction rehabilitation of the right of way and the extent of suitable habitat outside of the development footprint, it is considered unlikely that the proposed works will result in the fragmentation of an		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		existing important population. Considering the extent of better quality habitat within the wider area, if a population of Fitzroy River turtle is present within the gas pipeline right of way it is considered unlikely that the loss of this habitat will result in the decline of this species. (Page 111 Volume 3 Chapter 23 EIS).		
	SHARKS			
	Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish* **Vulnerable**	Occur in shallow coastal and estuarine environments. Detailed records of the occurrence of the species from 1912 to 2004 identify that no individuals of the species have been recorded in the Port Curtis region during that period (Page 160 Volume 3 Chapter 23). There are only two threatened marine species that are not also migratory species. These two species are Green sawfish and whale shark. These species are not considered likely to be present in the area (Page 194 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report).
	Rhincodon typus Whale Shark** **Vulnerable**	Occurs in oceanic waters and do not generally frequent estuarine areas (Page 160 Volume 3 Chapter 23).		
	PLANTS			
	Acacia curranii Curly-bark Wattle* **Vulnerable**	Dry sclerophyll forests and semi-arid woodlands on rocky outcrops of isolated hills and ranges in skeletal soils of the Gurulmundi area in south and central Qld. Also recorded in central NSW (New South Wales National Parks and Wildlife Service (NSW NPWS) 2008 (Page 42 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment,

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Acacia grandifolia **Vulnerable**			avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report).
	Arthraxon hispidus Hairy-joint Grass* **Vulnerable**			
	*Atalaya collina** **Endangered**	Dry rainforest and SEVT communities in dark clay soils and on hillsides in the Yarwun–Miriam Value region of C and SE Qld (TSSC 2009a) (Page 42 Volume 3 Chapter 23 EIS)..		
	Bosistoa selwynii Heart-leaved Bosistoa* **Vulnerable**	This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area and small areas of suitable habitat are scattered throughout the alignment, particularly in the right of way. In addition, database records indicate that this species is known from eight locations with a distance of 5km from the alignment within the Mt Larcom area (Queensland Herbarium 2009). Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction. If this species is identified a species translocation plan and offsets program will be developed in consultation with DEWHA and DERM. If the species is identified and disturbance is unavoidable, an application to DEWHA for disturbance is recommended. The design and implementation of a translocation plan will be in according with the Australian Network for Plant Conservation (2004). Pre-clearing surveys will identify any populations of this species not observed during the initial field surveys. In addition, a threatened species management plan detailing species not known to occur within the right of way.will be submitted to all construction personnel. This is considered adequate to prevent a long-term decrease in the overall population of this species (Page 72 Volume 3 Chapter 23 EIS).		
	Bosistoa transversa Three-leaved Bosistoa* **Vulnerable**	Wet sclerophyll forest, dry sclerophyll forest and lowland subtropical rainforests of subtropical coastal regions to 300 m altitude (TSSC 2010) (Page 43 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Bulbophyllum globuliforme Miniature Moss-orchid* **Vulnerable**	Epiphyte on the scaly bark of the branches and upper trunk of mature hoop pine (Araucaria cunninghamii) trees of subtropical coastal ranges in SE QLD and NE NSW at 500-800m altitude (DNR 1999) (Page 39 Volume 3 Chapter 23 EIS).		
	Cadellia pentastylis Ooline* **Vulnerable**	A population of approximately 10 ooline was identified in a grazed paddock at the beginning of the Woleebee Lateral in the southern sections of the proposed gas pipeline route. All of the ooline observed were in a non-remnant paddock at the base of a sandstone jump-up. It appears these individuals have avoided historical mechanical clearing events due to the steep nature of the surrounding sandstone. It is expected that the surrounding cleared area currently grazed would have historically contained numerous ooline. Database records indicate that ooline is also present at two locations within a 5km distance from the proposed gas pipeline route (Gurulmundi – reserve 166) (QLD Herbarium 2009). Impacts from gas pipeline construction are likely to be limited to the direct loss of plants within the right of way and associated infrastructure (e.g. access tracks). The number of ooline that are likely to be removed by the proposed alignment is less than 10 individuals from a grazed paddock with scattered trees. Minor changes to the alignment, narrowing of the right of way and is likely to preserve the majority of individuals located within the right of way Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are discussed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly (Page 52 Volume 3 Chapter 23 EIS).		
	*Calytrix gurulmundensis** **Vulnerable**	Hummock grasslands with scattered shrubs or in tall shrublands with eucalypt emergents on low lateritised sandstone ridges in well-drained, usually shallow and either gravelly sandy clay or sandy soils of the Gurulmundi and Barakula areas in SE Qld (TSSC 2008c) (Page 43 Volume 3 Chaptet 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	*Commersonia argentea** **Vulnerable**	This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area. Suitable habitat for this species exists within the southern portion of the alignment. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15, and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach. The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species (Page 76 Volume 3 Chapter 23 EIS).		
	Cossinia australiana Cossinia* **Endangered**			
	Cupaniopsis shirleyana Wedge-leaf Tuckeroo*** **Vulnerable**	This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area. In addition database records indicate that the species occurs within 5km of the alignment within the Mt Larcom area (QLD Herbarium 2009). Suitable habitat does occur for this species along the wetter creek lines in the coastal areas near Gladstone. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance	One individual of the Wedge-leaf tuckeroo (Cupaniopsis shirleyana) was observed in a small but relatively good patch of semi-evergreen vine thicket located at KP 343.5 (Page 20 Pipeline – Terrestrial Ecology). Avoiding the removal of the vine thicket vegetation communities for the construction of the pipeline in the small areas of high quality vine thicket regrowth discussed in section 3.3.1.1 would be the best conservation outcome for this threatened flora species. In any case the control of weeds in regrowth areas is important for the conservation of this species (Page 31 Pipeline –	

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach (Page 77 Volume 3 Chapter 23 EIS).	Terrestrial Ecology)	
	Dichanthium queenslandicum King Blue-grass **Vulnerable**	This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the Project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach (Page 57 Volume 3 Chapter 23 EIS).		
	Digitaria porrecta Finger Panic Grass* **Endangered**	Tropical and subtropical rainforests and sub-humid woodlands of subtropical coastal regions of Qld and NSW (Sharp and Simon 2002) (Page 40 Volume 3 Chapter 23 EIS)..		
	Eriocaulon carsonii Salt Pipewort, Button Grass** **Endangered**	Active or flowing artesian mound springs or the margins of the Great Artesian Basin of inland regions of Qld, NSW and SA on fen soils (Botanic Gardens Trust 2008). Located in springs supergroup 1.7km west of Cuckatoo Creek crossing site (Page 40 Volume 3 Chapter 23 EIS).		
	*Eucalyptus beaniana** **Vulnerable**			

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	*Homopholis belsonii** **Vulnerable**	This species was not identified within the proposed alignment during field surveys. However, suitable habitate has been identified in the southern sections of the alignment. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach. The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species (page 61 Volume 3 Chapter 23 EIS).		
	*Homoranthus decumbens** **Vulnerable**	Mixed eucalypt - callitris woodlands and dry sclerophyll forests of S Qld in loose sands, red gravelly soils, stony sodic soils, deep brownish sands, shallow sands overlaying grey brown, silty clays and stony lateritic clays on undulating hills and plains and rarely on low sandstone plateaux (DNR 1999) (Page 45 Volume 3 Chapter 23 EIS). Possible occurrence- Suitable habitat throughout the alignment (Page 45 Volume 3 Chapter 23 EIS).		
	*Leucopogon cuspidatus** **Vulnerable**	Possible occurrence- Suitable habitat throughout the alignment (Page 45 Volume 3 Chapter 23 EIS).		
	*Parsonsia larcomensis** **Vulnerable**	Unlikely - Some suitable habitat scattered in small patches throughout the project area. However, this species is generally found at elevations greater than 350m (Page 46 Volume 3 Chapter 23 EIS)..		
	*Philotheca sporadica** **Vulnerable**			

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	*Polianthion minutiflorum** **Vulnerable**			
	Pterostylis cobarensis Cobar Greenhood Orchid* **Vulnerable**	This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the Project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species (Page 63 Volume 3 Chapter 23 EIS)..		
	Quassia bidwillii Quassia* **Vulnerable**	This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route. In addition, suitable habitat is present in coastal or riverine rainforest habitat located in the right of way. Database records indicate that it is present at two locations within 5km of the proposed alignment (Mt Larcom and south of the Dawson Highway) (Queensland Herbarium 2009). Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach. The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species (Page 91 Volume 3 Chapter 23 EIS).		
	Rhaponticum australe Austral Cornflower, Native Thistle* **Vulnerable**	Possible - Suitable habitat throughout the alignment. (Page 47 Volume 3 Chapter 23 EIS).		
	Sophora fraseri **Vulnerable**			
	Taeniophyllum muelleri Minute Orchid, Ribbon-root Orchid **Vulnerable**	Unlikely - Coastal rainforest habitat unlikely to be present within the right of way (Page 41 Volume 3 Chapter 21).		
	*Tylophora linearis** **Endangered**	Possible - Suitable habitat throughout the alignment (Page 47 Volume 3 Chapter 23 EIS).		
	*Westringia parvifolia** **Vulnerable**			
	*Xerothamnella herbacea** **Endangered**			
Listed migratory species (sections 20 & 20A)	**MIGRATORY TERRESTRIAL SPECIES**			
	BIRDS			
	Haliaeetus leucogaster White-bellied Sea-Eagle **Migratory**	Identified during site surveys White-throated needletail, fork-tailed swift and barn swallow are non-breeding aerial foragers. These species may potentially forage in air space over the study area. The needletail and swift may forage over all habitats including cleared land, open ocean		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for migratory birds and concluded that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the

2009/4976 Australia Pacific LNG proposes to establish a major gas transmission pipeline(s) to connect APLNG's coal seam gas fields in southern and central Queensland to its proposed liquefied natural gas (LNG) plant within the Gladstone State Development Area (GSDA), Curtis Island, Gladstone.				
Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		and infrastructure. Barn swallow is most likely to occur over cleared land, including cultivation. It is considered unlikely that these species will be impacted by the proposed development (Page 155 Volume 3 Chapter 23 EIS). Eastern osprey and white-bellied sea-eagle are large raptors associated with coastal environments and large inland waterbodies such as lakes, dams and large rivers (Page 155 Volume 3 Chapter 23 EIS)..		operational period. The Coordinator-General concurs with this assessment. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced (Page 182 CG Report)..
	Merops ornatus Rainbow Bee-eater **Migratory**	Identified during site surveys Rainbow bee-eater is a widespread and common species that can occur in a variety of habitats. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for this species (Page 156 Volume 3 Chapter 23 EIS). Of these species only rainbow bee-eater is likely to be significantly affected by invasive species, should breeding occur on site. Rainbow bee-eaters nest in burrows in soil and sand banks. Feral predators and cane toads, which are known to prey on eggs and nestlings (Boland 2004b), are already established in the study area. The control of foxes, cats and dogs has been identified as a management objective. Management of feral species should ensure that there is no increase in feral species activity in the Project site (Page 156 Volume 3 Chapter 23 EIS).		
	Myiagra cyanoleuca Satin Flycatcher **Migratory**	Identified during site surveys These species tend to prefer more heavily vegetated habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		
	Rhipidura rufifrons Rufous Fantail **Migratory**	Identified during site surveys These species tend to prefer more heavily vegetated		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		
	Hirundapus caudacutus White-throated Needletail **Migratory**	Project area may support habitat As these species are aerial foragers and may occur over heavily modified habitats it is considered that no important habitat for these species will be modified, destroyed or isolated by the Project. (Page 156 Volume 3 Chapter 23 EIS).		
	Hirundo rustica Barn Swallow **Migratory**	Project area may support habitat White-throated needletail, fork-tailed swift and barn swallow are non-breeding aerial foragers. These species may potentially forage in air space over the study area. The needletail and swift may forage over all habitats including cleared land, open ocean and infrastructure. Barn swallow is most likely to occur over cleared land, including cultivation. It is considered unlikely that these species will be impacted by the proposed development (Page 155 Volume 3 Chapter 23 EIS). As these species are aerial foragers and may occur over heavily modified habitats it is considered that no important habitat for these species will be modified, destroyed or isolated by the Project. (Page 156 Volume 3 Chapter 23 EIS).		
	Monarcha melanopsis Black-faced Monarch **Migratory**	Project area may support habitat These species tend to prefer more heavily vegetated habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Monarcha trivirgatus Spectacled Monarch **Migratory**	Project area may support habitat These species tend to prefer more heavily vegetated habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		
	MIGRATORY WETLAND SPECIES			
	BIRDS *(Species identified in the EIS but not the ERT)*			
	Sula leucogaster Brown Booby **Migratory**	This marine species is likely to be found within the gas pipeline corridor only as an occasional visitor to intertidal areas. No important habitat for the species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for migratory birds and concluded that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the operational period. The Coordinator-General concurs with this assessment. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced (Page 182 CG Report)..
	Pandion cristatus Eastern Osprey **Migratory**	Eastern osprey and white-bellied sea-eagle are large raptors associated with coastal environments and large inland waterbodies such as lakes, dams and large rivers (Page 155 Volume 3 Chapter 23 EIS). These species are largely coastal although both may occur further inland on larger rivers and water-bodies, particularly the white-bellied sea-eagle. The gas pipeline right of way will not impact any large inland waterbodies and coastal disturbance is minimal. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		
	Tringa glareola Wood Sandpiper **Migratory**	Known or expected to occur (Page 150 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Sterna caspia Caspian Tern **Migratory**	Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies. A lack of large freshwater waterbodies within the right of way means that the study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 155 Volume 3 Chapter 23 EIS).		
	Sterna bengalensis Lesser Crested Tern **Migratory**	Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies. A lack of large freshwater waterbodies within the right of way means that the study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 155 Volume 3 Chapter 23 EIS).		
	Thalasseus bergii Crested Tern **Migratory**	Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies. A lack of large freshwater waterbodies within the right of way means that the study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 155 Volume 3 Chapter 23 EIS).		
	Cuculus saturatus Oriental Cuckoo **Migratory**	Oriental cuckoo is a regular non-breeding summer migrant to coastal eastern and northern Australia. It occurs in a variety of habitats including rainforest, vine thicket, casuarina forest and eucalypt Woodland (Page 155 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		Oriental cuckoo does not occur very far inland and is an uncommon visitor to subtropical Australia. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for this species (Page 156 Volume 3 Chapter 23 EIS).		
	Acrocephalus stentoreus ClamorousReed-warbler **Migratory**	Generally the larger freshwater ephemeral systems transected by the right of way predominantly exist as dry stream beds with occasional and mainly seasonal flooding overtopping the channel into adjacent floodplains. According to the Queensland Wetland Mapping (DERM 2009b), the proposed alignment intersects a lacustrine (lake) system at Dogwood Creek but field survey in the vicinity of Dogwood Creek found no lacustrine system. The alignment would require the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for this species they are not considered to be important habitats. Suitable waterbodies are not known in brackish or saline parts of the alignment (Page 155 Volume 3 Chapter 23 EIS).		
	Plegadis falcinellus Glossy Ibis **Migratory**	Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The alignment would require the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for these species it is not considered to be important habitat (Page 154 Volume 3 Chapter 23 EIS).		
	Egretta sacra Eastern Reef Egret **Migratory**	Identified during site surveys Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Tringa nebularia Common Greenshank **Migratory**	Known or expected to occur (Page 150 Volume 3 Chapter 23 EIS).		
	BIRDS *(identified in the ERT)*			
	Charadrius bicinctus Double-banded Plover **Migratory**	Suitable habitat likely to be present		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for migratory birds and concluded that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the operational period. The Coordinator-General concurs with this assessment. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced (Page 182 CG Report).
	Actitis hypoleucos Common Sandpiper **Migratory**	Known or expected to occur (Page 150 Volume 3 Chapter 23 EIS). The alignment crosses a large expanse of intertidal saltpan habitat to the west of Friend Point, with several small bands of mangroves. These intertidal flats provide feeding habitat for a range of migratory waders and other shorebirds. Intertidal habitat on the southern side of the Friend Point area has been identified as a major shorebird feed site, while a major shorebird roost site has been identified just adjacent to the alignment on the tip of Friend Point (EPA 2003). The Curtis Island crossing point does not have the extensive saltpan habitat that occurs adjacent to Friend Point, but some migratory shorebirds have been recently recorded in this area. There will be a loss of 11.9ha of saltpan and saltmarsh and 3.3ha of mangroves. It is considered likely that this area may support 15 or more migratory shorebird species, which would make it important habitat. During construction of the proposed pipeline at the crossing of The Narrows a buffer zone of 200m would be maintained around identified major feeding and roosting sites for migratory shorebirds, to minimise potential disturbance if identified within the work area of the proposed crossing. Indirectly, disturbance from the construction of this gas pipeline may reduce the usability of the adjacent undisturbed habitat. This will be discussed below. Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. Such areas are not considered important habitat for these species. Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the		
	Calidris acuminata *Sharp-tailed Sandpiper* **Migratory**			
	Calidris canutus Red Knot, Knot **Migartory**			
	Calidris ferruginea Curlew Sandpiper **Migratory**			
	Calidris ruficollis Red-necked Stint **Migratory**		A total of 304 red-necked stints (Calidris ruficollis) were recorded utilising the neap tide roost on the Kangaroo Island claypan during surveys in early 2009 (Table 7, Sandpiper 2009b), just less than the 325 (0.1% flyway population threshold) required to qualify as important habitat for his species. This species is likely to use the clay-pans adjacent to Friend Point for foraging (Page 27 Pipeline – Terrestrial Ecology)	
	Calidris tenuirostris Great Knot **Migratory**			
	Tringa stagnatilis Marsh Sandpiper,			
	Charadrius mongolus Lesser Sand Plover, Mongolian Plover **Migratory**			

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Heteroscelus brevipes Grey-tailed Tattler **Migratory**	habitats within the 10km buffer of the alignment. The alignment would require the loss of 1.2ha of mapped freshwater habitats however these areas are ephemeral or at best semi-permanent and are degraded by livestock. Although this may be suitable at times for some of these species it is not considered to be important habitat for these species. Disturbance may result in a reduction of available foraging time and may cause shorebirds to expend energy which is required for migration. The habitat areas of most importance when considering potential disturbance levels are roosting sites and feeding grounds. Disturbance of roosting sites may result in unnecessary expenditure of energy to relocate to a safer location. Shorebirds have a limited opportunity to forage during the low tide times. Disturbance can prevent birds from foraging effectively (Bamford et al. 2008). Of the various forms, small aircraft and helicopter disturbance is seen as the most severe and long lasting. Close approaches from the water generally disturb more birds than approaches from the land. This is due to the majority of the shore birds being close to the water's edge when foraging or roosting. Disturbance from the land is generally a result of movement along the tidal flat which includes people and animals, particularly dogs (Davidson and Rothwell 1993). Studies undertaken on shorebirds in the Dutch Wadden Sea suggest that shorebirds are impacted by high sound levels with the threshold for noise impact considered to be 120 dB(A). Birds impacted by noise move away from the area (Smit and Visser 1993). Disturbance may occur during construction for the Project. The construction period potentially involves a high level of disturbance with increased activity on land and water. It is assumed that increased activity and potentially loud intermittent noise during construction may result disturbance. The impact may be minimised through timing of construction activities. Although there are shorebirds present year round, including some first year birds, for the migratory birds the area would be most significantly utilised from November through to March each year. Construction activity outside of this period would significantly lessen disturbance. Once operational, the gas pipeline should cause minimal		
	Limicola falcinellus Broad-billed Sandpiper **Migratory**			
	Limosa lapponica Bar-tailed Godwit **Migratory**			
	Pluvialis squatarola Grey Plover **Migratory**			
	Xenus cinereus Terek Sandpiper **Migratory**		105 terek sandpipers (Xenus cinereus) were recorded using a high tide roost on South Passage Island (Table 7, Sandpiper 2009b), more than the 60 threshold for important habitat for this species. Both of these species are likely to utilise the tidal mudflats adjacent to Friend Point for foraging (Page 27 Pipeline – Terrestrial Ecology).	
	Numenius minutus Little Curlew, Little Whimbrel **Migratory**			
	Numenius madagascariensis Eastern Curlew **Migratory**		Recent surveys of the Narrows and Curtis Island Industrial Precinct for the various LNG projects have found significant numbers of shorebirds utilising feeding habitat and the high tide and spring tide roosts on and adjacent to Friend Point and the Kangaroo Island wetlands. The highest species numbers recorded utilising the high tide roost at Friend Point at any one time during 2009 surveys were 299 whimbrels (Numenius phaeopus) and 56 eastern curlews (Numenius madagascariensis) (Table 7, Sandpiper 2009a, 2009b). The 0.1% flyway population thresholds for these two species are 100 for whimbrel and 38 for eastern curlew (DEWHA 2009b). Therefore, the Friend Point high tide	
	Numenius phaeopus Whimbrel **Migratory**			

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		direct disturbance, if any, to migratory shorebirds. A potential indirect impact of the gas pipeline is increased access to the area by feral predators. Feral dogs, cats and foxes have previously been recorded within the right of way and it is therefore considered likely that some level of disturbance of shorebirds due to pest species exists currently. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project (Page 151-152 Volume 3 Chapter 23 EIS).	roost meets the criteria for important habitat for these two listed migratory shorebirds under the draft EPBC guidelines (Page 27 Pipeline – Terrestrial Ecology).	
	Pluvialis fulva Pacific Golden Plover **Migratory**	A potential indirect impact of this gas pipeline is the increased access to the area by feral predators. Feral dogs, cats and foxes have previously been recorded within the right of way and it is therefore considered likely that some level of disturbance of shorebirds due to pest species exists currently. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project (Page 151-152 Volume 3 Chapter 23 EIS). The following species were also identified during site surveys: Eastern Curlew, Whimbrel, Pacific Golden Plover (Page 150 Volume 3 Chapter 23 EIS).		
	Rostratula benghalensis s. lat. Painted Snipe **Migratory**	Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The alignment would require the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for these species it is not considered to be important habitat (Page 154 Volume 3 Chapter 23 EIS).		
	Ardea alba Great Egret, White Egret **Migratory**	Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Ardea ibis Cattle Egret **Migratory**	Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		
	Gallinago hardwickii Latham's Snipe, Japanese Snipe **Migratory**	Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the gas pipeline corridor at the Calliope River and 11 creek systems. Such areas may provide suitable if variable resources but are not considered important habitat for this species. Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The right of way would cause the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semipermanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for this species it is not considered to be important habitat. Additional habitat may be created due to heavy rain events flooding paddocks but would be highly ephemeral. Foraging opportunities for the species would be very sporadic under such circumstances (Page 153 Volume 3 Chapter 23 EIS).		
	Arenaria interpres Ruddy Turnstone **Migratory**	Not expected to occur.		
	Charadrius leschenaultii Greater Sand Plover, Large Sand Plover **Migratory**			
	Limosa limosa Black-tailed Godwit **Migratory**			
	Tringa stagnatilis Little Greenshank **Migratory**			
	Nettapus coromandelianus albipennis Australian Cotton			

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Pygmy-goose **Migratory**			
	MIGRATORY MARINE BIRDS			
	Apus pacificus Fork-tailed Swift **Migratory**	White-throated needletail, fork-tailed swift and barn swallow are non-breeding aerial foragers. These species may potentially forage in air space over the study area. The needletail and swift may forage over all habitats including cleared land, open ocean and infrastructure. Barn swallow is most likely to occur over cleared land, including cultivation. It is considered unlikely that these species will be impacted by the proposed development (Page 155 Volume 3 Chapter 23 EIS). As these species are aerial foragers and may occur over heavily modified habitats it is considered that no important habitat for these species will be modified, destroyed or isolated by the Project. (Page 156 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for migratory birds and concluded that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the operational period. The Coordinator-General concurs with this assessment. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced (Page 182 CG Report).
	Ardea alba Great Egret, White Egret **Migratory**	Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		
	Ardea ibis Cattle Egret **Migratory**	Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		
	Macronectes giganteus Southern Giant-Petrel **Migratory**	Not expected to occur (Page 145 Volume 3 Chapter 23 EIS).		
	Sterna albifrons Little Tern **Migratory**	Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies. A lack of large freshwater waterbodies within the right of way means that the		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 155 Volume 3 Chapter 23 EIS).		
	MIGRATORY MARINE SPECIES			
	MAMMALS			
	Balaenoptera edeni Bryde's Whale **Migratory**			The EIS assessed the proposed impact of the pipeline against the significant impact criteria for the threatened migratory marine fauna species and concluded that there are no significant impacts predicted. The Coordinator-General concurs with this conclusion and, in particular, is satisfied that impacts would be localised and temporary during the construction period only. A condition is imposed (Appendix 3, Part 2, Condition 21) that requires a full assessment of the potential impacts on environmental values associated with The Narrows pipeline crossing including cumulative impacts arising from dredging for the Port of Gladstone Western Basin Dredging Project (Page 182 CG Report).
	Dugong dugon Dugong **Migratory**	The Dugong and various Dolphin species and their preferred habitats may be impacted by one or several of the gas pipeline construction and operation activities described below: • Disturbance and fragmentation of mangrove and saltmarsh/saltpan habitat (dredging and HDD) • Underwater noise (dredging) • Disturbance of sub-tidal habitat and subsequent turbidity plumes if dredging is undertaken (Page 157 Volume 3 Chapter 23 EIS). No important dugong habitat is being destroyed or isolated as a result of the proposed development (Page 166 Volume 3 Chapter 23 EIS).		
	Megaptera novaeangliae Humpback Whale** **Migratory**			
	Orcaella brevirostris Irrawaddy Dolphin **Migratory**	The Dugong and various Dolphin species and their preferred habitats may be impacted by one or several of the gas pipeline construction and operation activities described below: • Disturbance and fragmentation of mangrove and saltmarsh/saltpan habitat (dredging and HDD) • Underwater noise (dredging) • Disturbance of sub-tidal habitat and subsequent turbidity plumes if dredging is undertaken (Page 157 Volume 3 Chapter 23 EIS). No important dolphin habitat is being destroyed or		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		isolated as a result of the proposed development. While underwater noise associated with construction activities may disrupt dolphins, it is a temporary impact only that will not persist (Page 167 Volume 3 Chapter 23 EIS).		
	Orcinus orca Killer Whale, Orca **Migratory**	Unlikely to occur in area (Page 160 Volume 3 Chapter 23 EIS).		
	Sousa chinensis Indo-Pacific Humpback Dolphin **Migratory**	The Dugong and various Dolphin species and their preferred habitats may be impacted by one or several of the gas pipeline construction and operation activities described below: • Disturbance and fragmentation of mangrove and saltmarsh/saltpan habitat (dredging and HDD) • Underwater noise (dredging) • Disturbance of sub-tidal habitat and subsequent turbidity plumes if dredging is undertaken (Page 157 Volume 3 Chapter 23 EIS). No important dolphin habitat is being destroyed or isolated as a result of the proposed development. While underwater noise associated with construction activities may disrupt dolphins, it is a temporary impact only that will not persist (Page 167 Volume 3 Chapter 23 EIS).		
	REPTILES			
	Caretta caretta Loggerhead Turtle** **Migratory**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. Globally, the loggerhead turtle is a circum-tropical species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of loggerhead turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of loggerhead turtles is the Bundaberg coast. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle (Page 165 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for the threatened migratory marine fauna species and concluded that there are no significant impacts predicted. The Coordinator-General concurs with this conclusion and, in particular, is satisfied that impacts would be localised and temporary during the construction period only. A condition is imposed (Appendix 3, Part 2, Condition 21) that requires a full assessment of the potential impacts on environmental values associated with The Narrows pipeline crossing including cumulative impacts arising from dredging for the Port of Gladstone Western Basin Dredging Project (Page 182 CG Report).

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Chelonia mydas Green Turtle** **Migratory**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. The proposed project will not create any barriers to movement for green turtles. Nesting beach habitat will not be physically impacted by the proposed project. Seagrass beds are the critical foraging habitat for the species, and the gas pipeline will not disturb any major seagrass beds. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of green turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of green turtles is the Capricorn-Bunker group of islands. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle (Page 162 Volume 3 Chapter 23 EIS).		
	Crocodylus porosus Estuarine Crocodile, Salt-water Crocodile **Migratory**	Vagrant individuals do straggle as far south as Colosseum Inlet and Seven Mile Creek systems and have previously been seen in Gladstone. However, it is generally recognised that the Fitzroy River is the southern most extent of the estuarine crocodile's core habitat. Given that this area of The Narrows is located 40km south of the Fitzroy River, the southern extent of estuarine crocodile's core habitat. No important estuarine crocodile habitat is being destroyed or isolated as a result of the proposed development (Page 167 Volume 3 Chapter 23 EIS).		
	Dermochelys coriacea Leathery Turtle, Leatherback Turtle, Luth** **Migratory**	Unlikely to occur in project area (Page 159 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Eretmochelys imbricata Hawksbill Turtle** **Migratory**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. Globally, the hawksbill turtle is a widely distributed species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way (Page 165 Volume 3 Chapter 23 EIS).		
	Lepidochelys olivacea Pacific Ridley, Olive Ridley** **Migratory**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. The Olive Ridley turtle is widely distributed throughout tropical and sub-tropical waters. The proposed project will not reduce the area of occupancy in any ecologically meaningful way (Page 163 Volume 3 Chapter 23 EIS).		
	Natator depressus Flatback Turtle** **Migratory**	The flatback turtle is widely distributed throughout tropical Australia and also occurs in Papua New Guinea. The proposed project will not reduce the area of occupancy in any ecologically meaningful way.		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	SHARKS			
	Rhincodon typus Whale Shark** **Migratory**	There are only two threatened marine species that are not also migratory species. These two species are Green sawfish and whale shark. These species are not considered likely to be present in the area (Page 194 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for the threatened migratory marine fauna species and concluded that there are no significant impacts predicted. The Coordinator-General concurs with this conclusion and, in particular, is satisfied that impacts would be localised and temporary during the construction period only. A condition is imposed (Appendix 3, Part 2, Condition 21) that requires a full assessment of the potential impacts on environmental values associated with The Narrows pipeline crossing including cumulative impacts arising from dredging for the Port of Gladstone Western Basin Dredging Project (Page 182 CG Report).

NOTES
The Recovery Plan for the Salt Pipewort, Button Grass *(Eriocaulon carsonii)* is Recovery plan for the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.

LEGEND
* **Conservation Advice**
** **Recovery Plan**
*** **Both**

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
World Heritage properties (section 12 & 15A)	Great Barrier Reef	The significant impact guidelines provide further guidance through examples of actions likely to have a significant impact on natural heritage values. These examples are virtually identical for world and national heritage values and places. Those examples relevant to the ascribed values of the Great Barrier Reef are briefly described below: • Damage, modify, alter or obscure important geological formations in a World Heritage property or National Heritage place • Damage, modify, alter or obscure landforms or landscape features, for example, by excavation or infilling of the land surface in a World Heritage property or National Heritage place • Modify, alter or inhibit landscape processes, for example, by accelerating or increasing susceptibility to erosion, or stabilising mobile landforms, such as sand dunes, in a World Heritage property or National Heritage place • Divert, impound or channelise a river, wetland or other water body in a World Heritage property or National Heritage place • Substantially increase concentrations of suspended sediment, nutrients, heavy metals, hydrocarbons, or other pollutants or substances in a river, wetland or water body in a World Heritage property or National Heritage place. Modify or inhibit ecological processes in a World Heritage property or National Heritage place • Reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property or National Heritage place • Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property or National Heritage place • Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property or National Heritage place • Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property or National Heritage place. (page 172 Volume 3, Chapter 23)		The EIS assessed the proposed impact of the pipeline against the impacts on world heritage and national heritage values, concluding that impacts will be not be significant. The Coordinator-General concurs with this assessment, in particular, that impacts would be localised and temporary during the construction period only (Page 182 CG Report).
National Heritage places (section 15B & 15C)	Great Barrier Reef			

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Wetlands of international significance (Ramsar sites)	Narran lake nature reserve	There are no Ramsar wetlands within or adjacent to the proposed gas pipeline route. The closest Ramsar wetlands are Corio Bay and Shoalwater Bay, which are approximately 150km north of the site (page 22, Volume 3 Chapter 23)		The Coordinator-General concurs with the EIS that no wetlands of international importance are present within the vicinity of the pipeline corridor and no Ramsar wetlands are present (Page 182 CG Report)..
Listed threatened species and communities (sections 18 & 18A)	**THREATENED COMMUNITIES**			
	Littoral Rainforest and Coastal Vine Thickets of Eastern Australia* **Critically Endangered**	Figure 23.7 map of distribution (Volume 3, Chapter 23 EIS)		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland* **Critically Endangered**	Figure 23.7 map of distribution (Volume 3, Chapter 23 EIS)		
	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* **Critically Endangered**			

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Brigalow (Acacia harpophylla dominant and co-dominant) **Endangered**	The major threat to Brigalow Belt ecological communities is considered to be clearing or severe modification of vegetation, because much of the landscape is eminently suitable for agriculture. Most of the natural vegetation has been cleared since the 1960s. Many of the Brigalow remnants are in marginal habitats such as steep, rocky slopes, or are in poor condition and highly degraded. Indirect effects on ecological communities, flora species and fauna habitat are likely to include increased localised areas of compaction through the use of heavy machinery, fragmentation of remnants, increased edge effects and damage along the existing edges caused by machinery, dust and litter and increased local disturbances through the creation of access tracks. (page 19 Volume 3 Chapter 23 EIS) Potential impacts of the Project on EPBC Act Listed Threatened Communities are most likely to be associated with physical clearing of vegetation for infrastructure development. Other potential impacts are introducing and/or spreading invasive weeds and pests, and leaching pollutants or releasing sediment into retained areas of vegetation. If unmanaged, edge effects and fragmentation can increase the prevalence of weed species in the vegetation adjacent to the right of way. This is due to canopy clearance, altered runoff patterns and increased exposure to foreign material carried into the study area on machinery and equipment (page 28 Volume 3 Chapter 23 EIS) Within the alignment, four regional ecosystems (11.9.1, 11.9.5, 11.9.6 and 11.12.21) analogous to this community were observed. The alignment of the gas pipeline has been designed to conserve this community wherever possible. Where there has been no practicable alternative route, degraded areas will be impacted in preference to areas of high ecological value. It is proposed that approximately 1.8ha of this community will be disturbed for the Project. It is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community. The offsets will be located outside the proposed right of way, and will compensate		

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		for the impacts of the Project. Areas used for offsetting will be selected following consultation with DEWHA and DERM. In addition, the relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this community in the long term, provided that appropriated offsets are provided. The natural regeneration of 85% of the 40m wide clearing strip will also return most disturbed vegetation communities in the long term. (page 29, Volume 3 Chapter 23 EIS)		
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions** **Endangered**	Within the alignment one RE (11.11.19) analogous to semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions was observed. It is proposed that approximately 0.2ha of this community will be disturbed as part of the Project. It is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community. The offsets will be located outside the proposed gas pipeline right of way and will compensate for the impacts of the development. Areas used for offsetting will be selected following consultation DEWHA and DERM. In addition, the relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this community in the long term provided that appropriated offsets are provided (page 32, Volume 3 Chapter 23 EIS)	Two small patches of good quality semi-evergreen vine thicket communities exist within the RoW in areas currently mapped as high quality regulated regrowth. Whilst these small patches are not recognised as RE within the VMA framework they do exhibit the same floristic structure and composition of the EPBC listed endangered - Semi-evergreen vine thicket in the Brigalow Belt South and Nandewar bioregions Threatened Ecological Community (TEC) (Page 18 Pipeline – Terrestrial Ecology).	
	The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin** **Endangered**	The only wetlands of national importance known to occur in the vicinity of the gas pipeline corridor are the communities of native species dependent on natural discharge of groundwater from the Great Artesian Basin (GAB). These occur on the outer edge of the GAB in Queensland, NSW and South Australia. The GAB springs are characterised into twelve 'supergroups'. Each supergroup comprises smaller spring groups and spring complexes. The project area is located within the Springsure Supergroup, Brigalow Belt Complex (EPA 2005; Fairfax et al. 2007; Fensham et al. 2004). The community of native species dependent on the natural discharge of groundwater from		The EIS assessed the proposed pipeline against the significant impact criteria for the spring communities and concluded that there are no significant impacts predicted, given that the spring communities identified in the vicinity of the pipeline are recharge as opposed to discharge springs. The Coordinator-General concurs with this assessment (Page 182 CG Report).

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		the Great Artesian Basins is listed as an endangered community under the EPBC Act (1999). Figure 23.8 indicates the location of spring complexes in proximity to the study area. GAB Spring communities known to occur close to the gas pipeline right of way are in the vicinity of Cockatoo Creek. These communities contain Eriocaulon carsonii (salt pipewort or button grass) and Myriophyllum artesian (artesian milfoil) stands. The nearest mapped springs to the gas pipeline route are located 1.7km west of the Cockatoo Creek crossing (straight-line distance, equals 2.4km downstream along the creek channel). During surveys for the Surat-Gladstone Pipeline (AECOM 2009), the EPBC-listed plant salt pipewort was observed in springs near Cockatoo Creek 4.7km west of the Australia Pacific LNG gas pipeline crossing point (page 34, Volume 3 Chapter 23 EIS). These springs are not located on Cockatoo Creek itself, but are adjacent to a small tributary about 1.5km upstream from Cockatoo Creek. Artesian milfoil was also observed in these springs, but this plant is not listed under the EPBC Act. AECOM (2009) stated that these springs are recharge springs and therefore are not the EPBC-listed threatened ecological community, which is defined to comprise discharge springs. As such, there are no known artesian spring MNES species or communities within or in close proximity to the right of way at Cockatoo Creek (page 34, Volume 3 Chapter 23 EIS).		
	Weeping Myall Woodlands* **Endangered**	Weeping myall woodlands occur on arable land. Therefore much of the former range of the ecological community has been cleared for dryland /irrigated cropping or has been significantly modified by heavy grazing. Most sites still in good condition experience little grazing and are uncropped. This includes road reserves and travelling stock routes and reserves. These areas of structurally intact woodland tend to be relatively small and exist in a matrix of agricultural development with poor landscape connectivity (page 30 Volume 3, Chapter 23 EIS)		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission

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		No areas with weeping myall were observed during the survey, so no areas that satisfy the EPBC Act criteria for the weeping myall woodlands endangered ecological community occur with the right of way (page 31 Volume 3, Chapter 23 EIS) Although almost all potential areas of this community were observed during the field visit, if any areas of weeping myall woodland are located within the right of way during the preclearing surveys, it is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community (page 31 Volume 3, Chapter 23 EIS)		pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	THREATENED SPECIES			
	BIRDS			
	Erythrotriorchis radiatus Red Goshawk **Vulnerable**	The study area has the potential to fall within the foraging range of the red goshawk. The mixed woodland is suitable as foraging habitat for this species. The gas pipeline right of way does not contain a permanent watercourse so these creeklines are unlikely to be utilised as breeding habitat. Desktop studies revealed records of red goshawk within the wider area of the gas pipeline right of way. However, the study area is generally not considered suitable as a breeding site for this species. A conservative approach has been adopted and the study area has been considered as part of the foraging range of the red goshawk. Given the extent of similar suitable foraging habitat within the wider area it is considered unlikely that the development of the Project will lead to a long term decrease in the size of a population (page 124 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	Geophaps scripta scripta Squatter Pigeon (southern)* **Vulnerable**	Only one terrestrial fauna species listed as vulnerable (EPBC Act) has been identified through field surveys along the gas pipeline right of way – the squatter pigeon (page 193 Volume 3 Chapter 23 EIS) There is currently no specific recovery plan for this species. No specific population has been identified as important to the long term survival of the species (DEWHA 2009d). The squatter pigeon mainly occurs in		

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		grassy woodland and open forest dominated by eucalypts. They have been observed in grazed country and disturbed habitats, such as foraging along roads. They are commonly observed in habitats close to water bodies (DEWHA 2009c). The gas pipeline right of way contains open eucalypt woodland habitat, which is suitable habitat for this species. Within the wider area there is a large extent of similar habitat available. Squatter pigeons are considered locally nomadic and are classified as high mobility taxa (EPA 2006). Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decrease of a local population, whether or not the population is considered an important population. (page 122 Volume 3 Chapter 23 EIS).		
	Lathamus discolor Swift Parrot** **Endangered**	Occurs in woodlands, riparian vegetation and remnant patches of mature eucalypts in agricultural areas, though they prefer dry sclerophyll forest (Higgins 1999; NPWS 2003). It is infrequently, though possibly annually, recorded in south-eastern Queensland in winter (page 103 Volume 3 Chapter 23 EIS).		
	*Macronectes giganteus*** Southern Giant-Petrel **Endangered**	A marine bird that occurs in Antarctic to subtropical waters. It is wide spread throughout the Southern Ocean, most abundant around ice packs where penguins are breeding or over the continental shelf. Nests on off shore islands, shorelines south of Rockhampton, often near a steep drop or on slope (Marchant and Higgins 1990) (page 102 Volume 3 Chapter 23 EIS).		
	Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern)* **Endangered**	Occurs mainly in dense, damp grasslands bordering wetlands and watercourses, but also in open grassy woodlands that are near permanent water or are subject to regular inundation. Very few records in central Qld since 1990, centred on Rockhampton area. Probably extinct in the gas pipeline corridor area (Higgins et al. 2006) (page 103 Volume 3 Chapter 23 EIS).		

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	Pterodroma neglecta neglecta Kermadec Petrel (western)** **Vulnerable**	Pelagic species that forages at sea in tropical and subtropical waters of the South Pacific; nests on high islands among rocks and vegetation. Extremely rare visitor to the east coast of Queensland and New South Wales (Marchant and Higgins 1990) (page 102 Volume 3 Chapter 23 EIS).		
	Rostratula australis Australian Painted Snipe **Vulnerable**	The current population is considered to occur across much of eastern and northern Australia as a single, contiguous breeding population (Garnett and Crowley 2000). The gas pipeline right of way contains very little habitat considered suitable for this species. Within the wider area there is a large, (although patchy) extent of similar habitat available. Movement patterns are not well known, however the species is often recorded intermittently in suitable habitat, suggesting some nomadic dispersal patterns. Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decline of a local population (page 127 Volume 3 Chapter 23 EIS).		
	Turnix melanogaster Black-breasted Button-quail** **Vulnerable**	There is a current national recovery plan for this species. Three populations have been identified as important to the long term survival of the species, with smaller populations at Barakula State Forest and Palmgrove National Park also considered as important remnant populations. Black-breasted button-quail mainly occurs in SEVT and other dense scrubs with little ground cover (Mathieson and Smith 2009). The gas pipeline right of way contains very little habitat considered suitable for this species. Within the wider area there is a large (although patchy) extent of similar habitat available. Movement patterns are not well known, however the species is often recorded intermittently in suitable habitat, suggesting some nomadic dispersal patterns. Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decrease of any possible local population (page 129 Volume 3 Chapter 23 EIS).		

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	FISH			
	Maccullochella peelii peelii Murray Cod, Cod, Goodoo** **Vulnerable**	Murray Cod are artificially maintained through stocking in the Condamine-Balonne River and may potentially occur in Dogwood Creek during significant flow events. The main impact during the construction phase is likely to be increased sediment delivery due to erosion in the development areas. Murray Cod are unlikely to be affected by short-term increases in sediment delivery as they are adapted to high levels of turbidity (DEWHA 2010a) (Page 142 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	Neoceratodus forsteri Australian Lungfish, Queensland Lungfish **Vulnerable**	Not predicted to occur or recorded from site surveys (page 141 Volume 3 Chapter 23 EIS).		
	MAMMALS			
	Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat **Vulnerable**	While there is potential for areas of cliffs and/or caves to occur near the gas pipeline right of way associated with sandstone areas within and adjacent to Gurulmundi State Forest, no cliffs or caves, and therefore no roosting habitat of this type, are likely to occur within the gas pipeline right of way. No major roosting site has been identified in the wider area. However, if tree hollows are utilised as roosts, then the gas pipeline right of way study area potentially provides roosting sites for a population. If this species is present within the wider area it may be impacted by loss of habitat within its foraging range (Page 137 Volume 3 Chapter 23 EIS)..		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and
	Dasyurus hallucatus Northern Quoll*** **Endangered**	The most significant threatening process for this species is the introduction of cane toads Rhinella marina into areas which the northern quoll utilises. Data suggests that local populations of northern quoll in the Northern Territory are usually extinct within a year of		

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		the arrival of cane toads. Field surveys confirmed the presence of cane toads within the study area. However, there are populations of northern quolls persisting in Queensland in areas where cane toads are present. As such, it is assumed that a population(s) of northern quoll may persist along the gas pipeline route, particularly within the Callide/Calliope Range, the Rockybar/Fairyland sandstone area, and possibly the Gurulmundi State Forest area. given that cane toads and feral predators are already established within the wider study area, it is considered unlikely that development of the proposed facility would have a significant impact on the northern quoll or lead to a long-term decrease in the size of a population (Page 106 Volume 3 Chapter 23 EIS).		habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	Hipposideros semoni Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat** **Endangered**	Geological features such as cliffs, caves and rock overhangs are usually avoided during pipeline alignment selection due to construction issues associated with trench digging. It is considered unlikely that any areas of extensive caves would be located within the gas pipeline right of way. The most likely area the species may occur within the gas pipeline right of way may be the Callide/Calliope Range. While the Calliope Range was not able to be assessed during the field surveys, the Callide Range was assessed and this included two nights of ultrasonic bat detection surveys. This species is associated with moist, dense forests which do not occur within the gas pipeline right of way. If this species is present within the wider area, it may be impacted by loss of habitat within its foraging range (Page 109 Volume 3 Chapter 23 EIS). The proposed development is unlikely to disturb a major roost site for this species, as there is little suitable habitat on the gas pipeline right of way. Any roost site identified within the gas pipeline right of way would be avoided and buffered from gas pipeline activities. The loss of tree hollows and of potential foraging habitat is not considered likely to lead to a decrease in the size of a population of this species (Page 109 Volume 3 Chapter 23 EIS).		

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	Megaptera novaeangliae Humpback Whale** **Vulnerable**	Principally occurs in oceanic waters. Port Curtis is not a known feeding, resting or calving area for the species (Page 159 Volume 3 Chapter 23 EIS).		
	Nyctophilus timoriensis (South-eastern form) Eastern Long-eared Bat **Vulnerable**	*Note –described in EIS as Greater Long Eared Bat. No major roosting site has been identified in the wider area. Given the species known distribution and roosting habitat, the gas pipeline right of way potentially provides roosting and foraging habitat for a population(s), particularly west of the Callide/Calliope Ranges. If this species is present within the wider area, it may be impacted by loss of habitat within its range (Page 135 Volume 3 Chapter 23 EIS).		
	Xeromys myoides Water Mouse, False Water Rat **Vulnerable**	Habitat suitable for this species contained within the gas pipeline right of way is restricted to the mangroves and associated mudflats either side of the Narrows (north of Gladstone) on the mainland and Laird Point on Curtis Island (Page 139 Volume 3 Chapter 23 EIS).		
	Pteropus poliocephalus Grey-headed Flying-fox **Vulnerable**	No roosting sites are known or were recorded within the gas pipeline corridor area. It is considered unlikely that the proposed development in this area will affect roosting sites for this species (Page 131 Volume 3 Chapter 23 EIS).		
	OTHER			
	Adclarkia dawsonensis Boggomoss Snail, Dawson Valley Snail** **Critically Endangered**	Alluvial flats, riparian environments and boggomosses (small peat bogs formed by water from aquifers being pushed to the surface through mound springs). Known only from two populations on the Dawson River between Theodore and Taroom, at least 25km west of the alignment (Stanisic 2008) (Page 100 Volume 3 Chapter 23 EIS)..		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is
	Cycas megacarpa Large-fruited Zamia** **Endangered**	Known - Observed in numerous locations west of the Callide Range in the northern sections of the Project area mostly associated with spotted gum and open woodlands on rocky substrates. Over 100 individuals observed during field visits (Page 39 Volume 3 Chapter 23 EIS)..	Several small population of the endangered large-fruited zamia palm (Cycas megacarpa) were observed along both of the Callide and Calliope Ranges. This species was generally observed on ridges, steep hills and weather drainage lines. In A total of130 individuals were observed within the vicinity of the alignment. Individuals were generally grouped together in areas with a steep gradient groups generally contained between 5 and 30	

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			individuals (Page 18 Pipeline – Terrestrial Ecology). The locations of individuals of the large-fruited zamia palm were collected using a hand held GPS unit. This information can be utilised for the planning the construction of the pipeline corridor and to narrow the corridor in areas containing this species. Knowing where this species occurs prior to the construction planning period will reduce the impact on this species. Where individuals cannot be avoided they will be translocated to nearby suitable habitat. For individuals and populations that cannot be avoided (Page 30 Pipeline – Terrestrial Ecology).	imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report)..
	*Cycas ophiolitica*** **Endangered**			
	REPTILES			
	Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink* **Vulnerable**	Unlikely to occur within pipeline alignment. Open grasslands on heavy cracking clay in the Darling Downs. Usually in soil under dead grass. Often on relict roadside verges (Richardson 2006) (Page 101 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report).
	Caretta caretta Loggerhead Turtle** **Endangered**	Globally, the loggerhead turtle is a circum-tropical species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. Nesting beach habitat will not be physically impacted by the proposed project. The gas pipeline will not disturb any major foraging habitat. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of loggerhead turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of loggerhead turtles is the Bundaberg coast. Pipeline construction activities will not result in a		

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		change to the lighting regime that will disrupt the breeding cycle (Page 165 Volume 3 Chapter 23 EIS). .		
	Chelonia mydas Green Turtle** **Vulnerable**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. The green turtle is widely distributed throughout tropical and sub-tropical waters. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. Nesting beach habitat will not be physically impacted by the proposed project. Seagrass beds are the critical foraging habitat for the species, and the gas pipeline will not disturb any major seagrass beds. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of green turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of green turtles is the Capricorn-Bunker group of islands. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle (Page 162 Volume 3 Chapter 23 EIS).		
	Delma torquata Collared Delma* **Vulnerable**	The gas pipeline right of way contains habitat that may be considered suitable for this species. Given the current and historical distributions, the species may occur in the study area, particularly in the Callide and Calliope Ranges. Currently, the species is reliably known only from the Mt Crosby area (west of Brisbane) and the Bunya Mountains. There are historical records from Ulam Range west of Gladstone (DEWHA 2009b). The gas pipeline right of way transects a range of woodland types, many of which are considered suitable habitat for a population or populations of collared delma. Considering the extent of similar suitable habitat within the wider area and provided that effective pre-clearing surveys are conducted, it is considered unlikely that the		

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		Project will lead to a long term decrease in the size of an important population. There is no known population within the vicinity of the gas pipeline study area. If a population is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population. Given the linear nature of the proposed works, post-construction rehabilitation of the right of way, and provided that effective pre-clearing surveys are conducted it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be negligible (page 112 Volume 3 Chapter 23 EIS).		
	Denisonia maculata Ornamental Snake **Vulnerable**	There is no listed important population for this species. The gas pipeline right of way transects a range of woodland types, some of which are considered suitable habitats for a population or populations of ornamental snake. Considering the extent of similar suitable habitat within the wider area and provided that effective pre-clearing surveys are conducted, it is considered unlikely that the Project will lead to a long term decrease in the size of an important population. Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. The alignment would also cause the loss of 1.2ha of mapped freshwater habitat and 2ha of brigalow/belah woodland, some of which is on cracking clay soils. Such areas may provide suitable resources important habitat for this species. If a population or populations of ornamental snake is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population or populations. However, given the linear nature of the proposed works, post-construction rehabilitation of the right of way and provided pre-clearing surveys are conducted by qualified fauna specialists it is considered that any impact that may occur on an important population (if		

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		such exists within the gas pipeline right of way) is likely to be negligible (Page 118 Volume 3 Chapter 23 EIS).		
	Dermochelys coriacea Leathery Turtle, Leatherback Turtle, Luth** **Vulnerable**	Oceanic environments from the sea surface to the seabed. Nests on beaches but major nesting areas are overseas. No recorded nesting of the species in Queensland since 1996 (Page 159 Volume 3 Chapter 23 EIS).		
	Egernia rugosa Yakka Skink **Vulnerable**	Given the range of habitats in which the species is known to occur, it is considered likely to occur in areas throughout the gas pipeline right of way (Page 115 Volume 3 Chapter 23 EIS). There has been no population of yakka skink identified as an important population of this species. The region, in which this species mostly occurs (the Brigalow Belt) has been subject to extensive clearing for agriculture, which has resulted in increasing pressure on the whole population of yakka skink (Richardson 2006). Considering the habitat suitability within the study area and the secretive nature of this species, it is considered possible for a population or populations of yakka skink to occur within the gas pipeline right of way. The eucalypt woodland is the most suitable habitat within the study area for this species. However, given the linear nature of the gas pipeline footprint and the extent of similar suitable habitat within the wider study area and provided that pre-clearing surveys by qualified fauna personnel are conducted, it is considered unlikely that development along the gas pipeline right of way would lead to a decrease in the size of potential local populations, whether or not any such population would be considered an important population (Page 116 Volume 3 Chapter 23 EIS).		
	Eretmochelys imbricata Hawksbill Turtle** **Vulnerable**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. Globally, the hawksbill turtle is a widely distributed species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. The proposed project will not adversely impact the preferred foraging habitat for the species which is rocky and coral reefs (Page 165 Volume 3 Chapter 23 EIS)..		

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	Furina dunmalli Dunmall's Snake **Vulnerable**	This species is highly cryptic, extremely secretive and possibly scarce. Only a handful of records occur within any given decade, so the biology of the snake is virtually unknown. Most records appear in open forests and woodlands, particularly brigalow and woodlands growing on cracking black clay and clay loams (Cogger et al. 1993). However, the species has also been recorded from dry eucalypt forests and anecdotal evidence suggests it may even occur in vine thickets. Cogger et al. (1993) describes it as occurring from Yeppoon in the north to Oakey and Glenmorgan in the south. However, the species has also been recorded from around Emerald in central Queensland and in northern New South Wales (Wilson 2005). Given the distribution of the species it is considered likely to occur in suitable habitat within the gas pipeline right of way. There are no listed important populations for this species, however the species is poorly known. The gas pipeline right of way transects a range of woodland types, some of which are considered suitable habitats for a population or populations of Dunmall's snake. Considering the extent of similar suitable habitat within the wider area and provided that effective preclearing surveys are conducted, it is considered unlikely that the Project will lead to a long term decrease in the size of an important population. Narrow bands of floodplain eucalypt and brigalow/belah woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. Such areas may provide important habitat for this species. If Dunmall's snake is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population or populations. However, given the linear nature of the proposed works, post-construction rehabilitation of the right of way and provided pre-clearing surveys are conducted by qualified fauna specialists it is considered that any reduction in the area of occupancy of an important population (if such exists within the gas pipeline right of way) is likely to be negligible and short term (Page 120 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Lepidochelys olivacea Pacific Ridley, Olive Ridley** **Endangered**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. The Olive Ridley turtle is widely distributed throughout tropical and sub-tropical waters. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. The Olive Ridley turtle does not commonly feed in central Queensland, but suitable feeding habitats are found throughout Port Curtis and elsewhere in the central Queensland region (Page 163 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the significant impact criteria for EPBC-listed threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report).
	Natator depressus Flatback Turtle** **Vulnerable**	Impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in population size. The flatback turtle is widely distributed throughout tropical Australia and also occurs in Papua New Guinea. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle (Page 164 Volume 3 Chapter 23 EIS).		
	Paradelma orientalis Brigalow Scaly-foot* **Vulnerable**	Most records are from relatively undisturbed habitats but the species does also occur in two to three years old regrowth, heavily grazed areas (Kutt et al. 2003) and cultivated areas. This indicates it is resilient to disturbance (DEWHA 2009e). Fragments of invertebrates such as spiders and crickets have been recorded from scats. However, sap constitutes a significant proportion of this species diet, particularly sap from Acacia species (Tremul 2000). Given the range of habitats for this species, it is considered likely to occur in areas throughout the pipeline right of way. The gas pipeline right of way transects a range of woodland types, many of which are considered suitable habitats for a population or populations of brigalow scaly-foot. Considering the extent of similar suitable habitat within the wider area, the proposed natural regeneration of 85% of the 40m wide clearing strip and provided that effective pre-clearing surveys are conducted it is considered unlikely that the Project will		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		lead to a long term decrease in the size of an important population. If a population or populations is present within the wider area of the gas pipeline right of way then clearing for the proposed gas pipeline may reduce the area of occupancy for the species. However, given the linear nature of the proposed works and post-construction rehabilitation of the right of way it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be short term and negligible. Considering the extent of similar suitable habitat within the wider area, the habitat within the gas pipeline right of way area is not considered critical to the survival of this species (Page 114 Volume 3 Chapter 23 EIS).		
	Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle* **Vulnerable**	The gas pipeline right of way transects several smaller tributaries of the Fitzroy catchment, all of which were either dry or had intermittent shallow pools during the field surveys. The lack of permanent deep water at these areas suggests they are poor quality habitat for this species. The lack of suitable habitat within the gas pipeline right of way means it is considered unlikely that the Project will lead to a long term decrease in the size of any local population, whether or not such a population would be considered important. If a population is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population. Given the linear nature of the proposed works and post-construction rehabilitation of the right of way, it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be negligible. Considering the linear nature of the proposed works, post-construction rehabilitation of the right of way and the extent of suitable habitat outside of the development footprint, it is considered unlikely that the proposed works will result in the fragmentation of an		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		existing important population. Considering the extent of better quality habitat within the wider area, if a population of Fitzroy River turtle is present within the gas pipeline right of way it is considered unlikely that the loss of this habitat will result in the decline of this species. (Page 111 Volume 3 Chapter 23 EIS).		
	SHARKS			
	Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish* **Vulnerable**	Occur in shallow coastal and estuarine environments. Detailed records of the occurrence of the species from 1912 to 2004 identify that no individuals of the species have been recorded in the Port Curtis region during that period (Page 160 Volume 3 Chapter 23). There are only two threatened marine species that are not also migratory species. These two species are Green sawfish and whale shark. These species are not considered likely to be present in the area (Page 194 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment, avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report).
	Rhincodon typus Whale Shark** **Vulnerable**	Occurs in oceanic waters and do not generally frequent estuarine areas (Page 160 Volume 3 Chapter 23).		
	PLANTS			
	Acacia curranii Curly-bark Wattle* **Vulnerable**	Dry sclerophyll forests and semi-arid woodlands on rocky outcrops of isolated hills and ranges in skeletal soils of the Gurulmundi area in south and central Qld. Also recorded in central NSW (New South Wales National Parks and Wildlife Service (NSW NPWS) 2008 (Page 42 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed clearing for the pipeline ROW and other works against the threatened species and ecological communities and concluded that no significant impacts are predicted. The Coordinator-General concurs with this assessment. Condition 1 in Appendix 2, Part 3 specifies detailed impact assessment,

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Acacia grandifolia **Vulnerable**			avoidance and site rehabilitation measures to be included in the environmental management plan for the gas transmission pipeline. In addition, a condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all threatened species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected ecological communities is maintained or enhanced (Page 182 CG Report).
	Arthraxon hispidus Hairy-joint Grass* **Vulnerable**			
	*Atalaya collina** **Endangered**	Dry rainforest and SEVT communities in dark clay soils and on hillsides in the Yarwun–Miriam Value region of C and SE Qld (TSSC 2009a) (Page 42 Volume 3 Chapter 23 EIS)..		
	Bosistoa selwynii Heart-leaved Bosistoa* **Vulnerable**	This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area and small areas of suitable habitat are scattered throughout the alignment, particularly in the right of way. In addition, database records indicate that this species is known from eight locations with a distance of 5km from the alignment within the Mt Larcom area (Queensland Herbarium 2009). Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction. If this species is identified a species translocation plan and offsets program will be developed in consultation with DEWHA and DERM. If the species is identified and disturbance is unavoidable, an application to DEWHA for disturbance is recommended. The design and implementation of a translocation plan will be in according with the Australian Network for Plant Conservation (2004). Pre-clearing surveys will identify any populations of this species not observed during the initial field surveys. In addition, a threatened species management plan detailing species not known to occur within the right of way.will be submitted to all construction personnel. This is considered adequate to prevent a long-term decrease in the overall population of this species (Page 72 Volume 3 Chapter 23 EIS).		
	Bosistoa transversa Three-leaved Bosistoa* **Vulnerable**	Wet sclerophyll forest, dry sclerophyll forest and lowland subtropical rainforests of subtropical coastal regions to 300 m altitude (TSSC 2010) (Page 43 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Bulbophyllum globuliforme Miniature Moss-orchid* **Vulnerable**	Epiphyte on the scaly bark of the branches and upper trunk of mature hoop pine (Araucaria cunninghamii) trees of subtropical coastal ranges in SE QLD and NE NSW at 500-800m altitude (DNR 1999) (Page 39 Volume 3 Chapter 23 EIS).		
	Cadellia pentastylis Ooline* **Vulnerable**	A population of approximately 10 ooline was identified in a grazed paddock at the beginning of the Woleebee Lateral in the southern sections of the proposed gas pipeline route. All of the ooline observed were in a non-remnant paddock at the base of a sandstone jump-up. It appears these individuals have avoided historical mechanical clearing events due to the steep nature of the surrounding sandstone. It is expected that the surrounding cleared area currently grazed would have historically contained numerous ooline. Database records indicate that ooline is also present at two locations within a 5km distance from the proposed gas pipeline route (Gurulmundi – reserve 166) (QLD Herbarium 2009). Impacts from gas pipeline construction are likely to be limited to the direct loss of plants within the right of way and associated infrastructure (e.g. access tracks). The number of ooline that are likely to be removed by the proposed alignment is less than 10 individuals from a grazed paddock with scattered trees. Minor changes to the alignment, narrowing of the right of way and is likely to preserve the majority of individuals located within the right of way Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are discussed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly (Page 52 Volume 3 Chapter 23 EIS).		
	*Calytrix gurulmundensis** **Vulnerable**	Hummock grasslands with scattered shrubs or in tall shrublands with eucalypt emergents on low lateritised sandstone ridges in well-drained, usually shallow and either gravelly sandy clay or sandy soils of the Gurulmundi and Barakula areas in SE Qld (TSSC 2008c) (Page 43 Volume 3 Chaptet 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	*Commersonia argentea** **Vulnerable**	This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area. Suitable habitat for this species exists within the southern portion of the alignment. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15, and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach. The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species (Page 76 Volume 3 Chapter 23 EIS).		
	Cossinia australiana Cossinia* **Endangered**			
	Cupaniopsis shirleyana Wedge-leaf Tuckeroo*** **Vulnerable**	This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area. In addition database records indicate that the species occurs within 5km of the alignment within the Mt Larcom area (QLD Herbarium 2009). Suitable habitat does occur for this species along the wetter creek lines in the coastal areas near Gladstone. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance	One individual of the Wedge-leaf tuckeroo (Cupaniopsis shirleyana) was observed in a small but relatively good patch of semi-evergreen vine thicket located at KP 343.5 (Page 20 Pipeline – Terrestrial Ecology). Avoiding the removal of the vine thicket vegetation communities for the construction of the pipeline in the small areas of high quality vine thicket regrowth discussed in section 3.3.1.1 would be the best conservation outcome for this threatened flora species. In any case the control of weeds in regrowth areas is important for the conservation of this species (Page 31 Pipeline –	

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach (Page 77 Volume 3 Chapter 23 EIS).	Terrestrial Ecology)	
	Dichanthium queenslandicum King Blue-grass **Vulnerable**	This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the Project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach (Page 57 Volume 3 Chapter 23 EIS).		
	Digitaria porrecta Finger Panic Grass* **Endangered**	Tropical and subtropical rainforests and sub-humid woodlands of subtropical coastal regions of Qld and NSW (Sharp and Simon 2002) (Page 40 Volume 3 Chapter 23 EIS)..		
	Eriocaulon carsonii Salt Pipewort, Button Grass** **Endangered**	Active or flowing artesian mound springs or the margins of the Great Artesian Basin of inland regions of Qld, NSW and SA on fen soils (Botanic Gardens Trust 2008). Located in springs supergroup 1.7km west of Cuckatoo Creek crossing site (Page 40 Volume 3 Chapter 23 EIS).		
	*Eucalyptus beaniana** **Vulnerable**			

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	*Homopholis belsonii** **Vulnerable**	This species was not identified within the proposed alignment during field surveys. However, suitable habitate has been identified in the southern sections of the alignment. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach. The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species (page 61 Volume 3 Chapter 23 EIS).		
	*Homoranthus decumbens** **Vulnerable**	Mixed eucalypt - callitris woodlands and dry sclerophyll forests of S Qld in loose sands, red gravelly soils, stony sodic soils, deep brownish sands, shallow sands overlaying grey brown, silty clays and stony lateritic clays on undulating hills and plains and rarely on low sandstone plateaux (DNR 1999) (Page 45 Volume 3 Chapter 23 EIS). Possible occurrence- Suitable habitat throughout the alignment (Page 45 Volume 3 Chapter 23 EIS).		
	*Leucopogon cuspidatus** **Vulnerable**	Possible occurrence- Suitable habitat throughout the alignment (Page 45 Volume 3 Chapter 23 EIS).		
	*Parsonsia larcomensis** **Vulnerable**	Unlikely - Some suitable habitat scattered in small patches throughout the project area. However, this species is generally found at elevations greater than 350m (Page 46 Volume 3 Chapter 23 EIS)..		
	*Philotheca sporadica** **Vulnerable**			

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	*Polianthion minutiflorum** **Vulnerable**			
	Pterostylis cobarensis Cobar Greenhood Orchid* **Vulnerable**	This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the Project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment. Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species (Page 63 Volume 3 Chapter 23 EIS)..		
	Quassia bidwillii Quassia* **Vulnerable**	This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route. In addition, suitable habitat is present in coastal or riverine rainforest habitat located in the right of way. Database records indicate that it is present at two locations within 5km of the proposed alignment (Mt Larcom and south of the Dawson Highway) (Queensland Herbarium 2009). Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach. The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species (Page 91 Volume 3 Chapter 23 EIS).		
	Rhaponticum australe Austral Cornflower, Native Thistle* **Vulnerable**	Possible - Suitable habitat throughout the alignment. (Page 47 Volume 3 Chapter 23 EIS).		
	Sophora fraseri **Vulnerable**			
	Taeniophyllum muelleri Minute Orchid, Ribbon-root Orchid **Vulnerable**	Unlikely - Coastal rainforest habitat unlikely to be present within the right of way (Page 41 Volume 3 Chapter 21).		
	*Tylophora linearis** **Endangered**	Possible - Suitable habitat throughout the alignment (Page 47 Volume 3 Chapter 23 EIS).		
	*Westringia parvifolia** **Vulnerable**			
	*Xerothamnella herbacea** **Endangered**			
Listed migratory species (sections 20 & 20A)	**MIGRATORY TERRESTRIAL SPECIES**			
	BIRDS			
	Haliaeetus leucogaster White-bellied Sea-Eagle **Migratory**	Identified during site surveys White-throated needletail, fork-tailed swift and barn swallow are non-breeding aerial foragers. These species may potentially forage in air space over the study area. The needletail and swift may forage over all habitats including cleared land, open ocean		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for migratory birds and concluded that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		and infrastructure. Barn swallow is most likely to occur over cleared land, including cultivation. It is considered unlikely that these species will be impacted by the proposed development (Page 155 Volume 3 Chapter 23 EIS). Eastern osprey and white-bellied sea-eagle are large raptors associated with coastal environments and large inland waterbodies such as lakes, dams and large rivers (Page 155 Volume 3 Chapter 23 EIS)..		operational period. The Coordinator-General concurs with this assessment. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced (Page 182 CG Report)..
	Merops ornatus Rainbow Bee-eater **Migratory**	Identified during site surveys Rainbow bee-eater is a widespread and common species that can occur in a variety of habitats. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for this species (Page 156 Volume 3 Chapter 23 EIS). Of these species only rainbow bee-eater is likely to be significantly affected by invasive species, should breeding occur on site. Rainbow bee-eaters nest in burrows in soil and sand banks. Feral predators and cane toads, which are known to prey on eggs and nestlings (Boland 2004b), are already established in the study area. The control of foxes, cats and dogs has been identified as a management objective. Management of feral species should ensure that there is no increase in feral species activity in the Project site (Page 156 Volume 3 Chapter 23 EIS).		
	Myiagra cyanoleuca Satin Flycatcher **Migratory**	Identified during site surveys These species tend to prefer more heavily vegetated habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		
	Rhipidura rufifrons Rufous Fantail **Migratory**	Identified during site surveys These species tend to prefer more heavily vegetated		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		
	Hirundapus caudacutus White-throated Needletail **Migratory**	Project area may support habitat As these species are aerial foragers and may occur over heavily modified habitats it is considered that no important habitat for these species will be modified, destroyed or isolated by the Project. (Page 156 Volume 3 Chapter 23 EIS).		
	Hirundo rustica Barn Swallow **Migratory**	Project area may support habitat White-throated needletail, fork-tailed swift and barn swallow are non-breeding aerial foragers. These species may potentially forage in air space over the study area. The needletail and swift may forage over all habitats including cleared land, open ocean and infrastructure. Barn swallow is most likely to occur over cleared land, including cultivation. It is considered unlikely that these species will be impacted by the proposed development (Page 155 Volume 3 Chapter 23 EIS). As these species are aerial foragers and may occur over heavily modified habitats it is considered that no important habitat for these species will be modified, destroyed or isolated by the Project. (Page 156 Volume 3 Chapter 23 EIS).		
	Monarcha melanopsis Black-faced Monarch **Migratory**	Project area may support habitat These species tend to prefer more heavily vegetated habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Monarcha trivirgatus Spectacled Monarch **Migratory**	Project area may support habitat These species tend to prefer more heavily vegetated habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		
	MIGRATORY WETLAND SPECIES			
	BIRDS *(Species identified in the EIS but not the ERT)*			
	Sula leucogaster Brown Booby **Migratory**	This marine species is likely to be found within the gas pipeline corridor only as an occasional visitor to intertidal areas. No important habitat for the species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for migratory birds and concluded that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the operational period. The Coordinator-General concurs with this assessment. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced (Page 182 CG Report)..
	Pandion cristatus Eastern Osprey **Migratory**	Eastern osprey and white-bellied sea-eagle are large raptors associated with coastal environments and large inland waterbodies such as lakes, dams and large rivers (Page 155 Volume 3 Chapter 23 EIS). These species are largely coastal although both may occur further inland on larger rivers and water-bodies, particularly the white-bellied sea-eagle. The gas pipeline right of way will not impact any large inland waterbodies and coastal disturbance is minimal. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 156 Volume 3 Chapter 23 EIS).		
	Tringa glareola Wood Sandpiper **Migratory**	Known or expected to occur (Page 150 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Sterna caspia Caspian Tern **Migratory**	Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies. A lack of large freshwater waterbodies within the right of way means that the study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 155 Volume 3 Chapter 23 EIS).		
	Sterna bengalensis Lesser Crested Tern **Migratory**	Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies. A lack of large freshwater waterbodies within the right of way means that the study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 155 Volume 3 Chapter 23 EIS).		
	Thalasseus bergii Crested Tern **Migratory**	Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies. A lack of large freshwater waterbodies within the right of way means that the study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 155 Volume 3 Chapter 23 EIS).		
	Cuculus saturatus Oriental Cuckoo **Migratory**	Oriental cuckoo is a regular non-breeding summer migrant to coastal eastern and northern Australia. It occurs in a variety of habitats including rainforest, vine thicket, casuarina forest and eucalypt Woodland (Page 155 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		Oriental cuckoo does not occur very far inland and is an uncommon visitor to subtropical Australia. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for this species (Page 156 Volume 3 Chapter 23 EIS).		
	Acrocephalus stentoreus ClamorousReed-warbler **Migratory**	Generally the larger freshwater ephemeral systems transected by the right of way predominantly exist as dry stream beds with occasional and mainly seasonal flooding overtopping the channel into adjacent floodplains. According to the Queensland Wetland Mapping (DERM 2009b), the proposed alignment intersects a lacustrine (lake) system at Dogwood Creek but field survey in the vicinity of Dogwood Creek found no lacustrine system. The alignment would require the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for this species they are not considered to be important habitats. Suitable waterbodies are not known in brackish or saline parts of the alignment (Page 155 Volume 3 Chapter 23 EIS).		
	Plegadis falcinellus Glossy Ibis **Migratory**	Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The alignment would require the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for these species it is not considered to be important habitat (Page 154 Volume 3 Chapter 23 EIS).		
	Egretta sacra Eastern Reef Egret **Migratory**	Identified during site surveys Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Tringa nebularia Common Greenshank **Migratory**	Known or expected to occur (Page 150 Volume 3 Chapter 23 EIS).		
	BIRDS *(identified in the ERT)*			
	Charadrius bicinctus Double-banded Plover **Migratory**	Suitable habitat likely to be present		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for migratory birds and concluded that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the operational period. The Coordinator-General concurs with this assessment. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced (Page 182 CG Report).
	Actitis hypoleucos Common Sandpiper **Migratory**	Known or expected to occur (Page 150 Volume 3 Chapter 23 EIS). The alignment crosses a large expanse of intertidal saltpan habitat to the west of Friend Point, with several small bands of mangroves. These intertidal flats provide feeding habitat for a range of migratory waders and other shorebirds. Intertidal habitat on the southern side of the Friend Point area has been identified as a major shorebird feed site, while a major shorebird roost site has been identified just adjacent to the alignment on the tip of Friend Point (EPA 2003). The Curtis Island crossing point does not have the extensive saltpan habitat that occurs adjacent to Friend Point, but some migratory shorebirds have been recently recorded in this area. There will be a loss of 11.9ha of saltpan and saltmarsh and 3.3ha of mangroves. It is considered likely that this area may support 15 or more migratory shorebird species, which would make it important habitat. During construction of the proposed pipeline at the crossing of The Narrows a buffer zone of 200m would be maintained around identified major feeding and roosting sites for migratory shorebirds, to minimise potential disturbance if identified within the work area of the proposed crossing. Indirectly, disturbance from the construction of this gas pipeline may reduce the usability of the adjacent undisturbed habitat. This will be discussed below. Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. Such areas are not considered important habitat for these species. Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the		
	Calidris acuminata *Sharp-tailed Sandpiper* **Migratory**			
	Calidris canutus Red Knot, Knot **Migartory**			
	Calidris ferruginea Curlew Sandpiper **Migratory**			
	Calidris ruficollis Red-necked Stint **Migratory**		A total of 304 red-necked stints (Calidris ruficollis) were recorded utilising the neap tide roost on the Kangaroo Island claypan during surveys in early 2009 (Table 7, Sandpiper 2009b), just less than the 325 (0.1% flyway population threshold) required to qualify as important habitat for his species. This species is likely to use the clay-pans adjacent to Friend Point for foraging (Page 27 Pipeline – Terrestrial Ecology)	
	Calidris tenuirostris Great Knot **Migratory**			
	Tringa stagnatilis Marsh Sandpiper,			
	Charadrius mongolus Lesser Sand Plover, Mongolian Plover **Migratory**			

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
	Heteroscelus brevipes Grey-tailed Tattler **Migratory**	habitats within the 10km buffer of the alignment. The alignment would require the loss of 1.2ha of mapped freshwater habitats however these areas are ephemeral or at best semi-permanent and are degraded by livestock. Although this may be suitable at times for some of these species it is not considered to be important habitat for these species. Disturbance may result in a reduction of available foraging time and may cause shorebirds to expend energy which is required for migration. The habitat areas of most importance when considering potential disturbance levels are roosting sites and feeding grounds. Disturbance of roosting sites may result in unnecessary expenditure of energy to relocate to a safer location. Shorebirds have a limited opportunity to forage during the low tide times. Disturbance can prevent birds from foraging effectively (Bamford et al. 2008). Of the various forms, small aircraft and helicopter disturbance is seen as the most severe and long lasting. Close approaches from the water generally disturb more birds than approaches from the land. This is due to the majority of the shore birds being close to the water's edge when foraging or roosting. Disturbance from the land is generally a result of movement along the tidal flat which includes people and animals, particularly dogs (Davidson and Rothwell 1993). Studies undertaken on shorebirds in the Dutch Wadden Sea suggest that shorebirds are impacted by high sound levels with the threshold for noise impact considered to be 120 dB(A). Birds impacted by noise move away from the area (Smit and Visser 1993). Disturbance may occur during construction for the Project. The construction period potentially involves a high level of disturbance with increased activity on land and water. It is assumed that increased activity and potentially loud intermittent noise during construction may result disturbance. The impact may be minimised through timing of construction activities. Although there are shorebirds present year round, including some first year birds, for the migratory birds the area would be most significantly utilised from November through to March each year. Construction activity outside of this period would significantly lessen disturbance. Once operational, the gas pipeline should cause minimal		
	Limicola falcinellus Broad-billed Sandpiper **Migratory**			
	Limosa lapponica Bar-tailed Godwit **Migratory**			
	Pluvialis squatarola Grey Plover **Migratory**			
	Xenus cinereus Terek Sandpiper **Migratory**		105 terek sandpipers (Xenus cinereus) were recorded using a high tide roost on South Passage Island (Table 7, Sandpiper 2009b), more than the 60 threshold for important habitat for this species. Both of these species are likely to utilise the tidal mudflats adjacent to Friend Point for foraging (Page 27 Pipeline – Terrestrial Ecology).	
	Numenius minutus Little Curlew, Little Whimbrel **Migratory**			
	Numenius madagascariensis Eastern Curlew **Migratory**		Recent surveys of the Narrows and Curtis Island Industrial Precinct for the various LNG projects have found significant numbers of shorebirds utilising feeding habitat and the high tide and spring tide roosts on and adjacent to Friend Point and the Kangaroo Island wetlands. The highest species numbers recorded utilising the high tide roost at Friend Point at any one time during 2009 surveys were 299 whimbrels (Numenius phaeopus) and 56 eastern curlews (Numenius madagascariensis) (Table 7, Sandpiper 2009a, 2009b). The 0.1% flyway population thresholds for these two species are 100 for whimbrel and 38 for eastern curlew (DEWHA 2009b). Therefore, the Friend Point high tide	
	Numenius phaeopus Whimbrel **Migratory**			

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
		direct disturbance, if any, to migratory shorebirds. A potential indirect impact of the gas pipeline is increased access to the area by feral predators. Feral dogs, cats and foxes have previously been recorded within the right of way and it is therefore considered likely that some level of disturbance of shorebirds due to pest species exists currently. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project (Page 151-152 Volume 3 Chapter 23 EIS).	roost meets the criteria for important habitat for these two listed migratory shorebirds under the draft EPBC guidelines (Page 27 Pipeline – Terrestrial Ecology).	
	Pluvialis fulva Pacific Golden Plover **Migratory**	A potential indirect impact of this gas pipeline is the increased access to the area by feral predators. Feral dogs, cats and foxes have previously been recorded within the right of way and it is therefore considered likely that some level of disturbance of shorebirds due to pest species exists currently. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project (Page 151-152 Volume 3 Chapter 23 EIS). The following species were also identified during site surveys: Eastern Curlew, Whimbrel, Pacific Golden Plover (Page 150 Volume 3 Chapter 23 EIS).		
	Rostratula benghalensis s. lat. Painted Snipe **Migratory**	Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The alignment would require the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for these species it is not considered to be important habitat (Page 154 Volume 3 Chapter 23 EIS).		
	Ardea alba Great Egret, White Egret **Migratory**	Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Ardea ibis Cattle Egret **Migratory**	Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		
	Gallinago hardwickii Latham's Snipe, Japanese Snipe **Migratory**	Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the gas pipeline corridor at the Calliope River and 11 creek systems. Such areas may provide suitable if variable resources but are not considered important habitat for this species. Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The right of way would cause the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semipermanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for this species it is not considered to be important habitat. Additional habitat may be created due to heavy rain events flooding paddocks but would be highly ephemeral. Foraging opportunities for the species would be very sporadic under such circumstances (Page 153 Volume 3 Chapter 23 EIS).		
	Arenaria interpres Ruddy Turnstone **Migratory**	Not expected to occur.		
	Charadrius leschenaultii Greater Sand Plover, Large Sand Plover **Migratory**			
	Limosa limosa Black-tailed Godwit **Migratory**			
	Tringa stagnatilis Little Greenshank **Migratory**			
	Nettapus coromandelianus albipennis Australian Cotton			

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Pygmy-goose **Migratory**			
	MIGRATORY MARINE BIRDS			
	Apus pacificus Fork-tailed Swift **Migratory**	White-throated needletail, fork-tailed swift and barn swallow are non-breeding aerial foragers. These species may potentially forage in air space over the study area. The needletail and swift may forage over all habitats including cleared land, open ocean and infrastructure. Barn swallow is most likely to occur over cleared land, including cultivation. It is considered unlikely that these species will be impacted by the proposed development (Page 155 Volume 3 Chapter 23 EIS). As these species are aerial foragers and may occur over heavily modified habitats it is considered that no important habitat for these species will be modified, destroyed or isolated by the Project. (Page 156 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for migratory birds and concluded that there are potential significant impacts predicted on a temporary basis during the construction period; however, no significant long-term impacts are predicted for the operational period. The Coordinator-General concurs with this assessment. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where clearing of sensitive vegetation and habitat cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented to ensure the overall extent of affected migratory species habitat is maintained or enhanced (Page 182 CG Report).
	Ardea alba Great Egret, White Egre**t** **Migratory**	Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		
	Ardea ibis Cattle Egret **Migratory**	Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project (Page 154 Volume 3 Chapter 23 EIS).		
	Macronectes giganteus Southern Giant-Petrel **Migratory**	Not expected to occur (Page 145 Volume 3 Chapter 23 EIS).		
	Sterna albifrons Little Tern **Migratory**	Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies. A lack of large freshwater waterbodies within the right of way means that the		

2009/4976 Australia Pacific LNG proposes to establish a major gas transmission pipeline(s) to connect APLNG's coal seam gas fields in southern and central Queensland to its proposed liquefied natural gas (LNG) plant within the Gladstone State Development Area (GSDA), Curtis Island, Gladstone.

Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species (Page 155 Volume 3 Chapter 23 EIS).		
	MIGRATORY MARINE SPECIES			
	MAMMALS			
	Balaenoptera edeni Bryde's Whale **Migratory**			The EIS assessed the proposed impact of the pipeline against the significant impact criteria for the threatened migratory marine fauna species and concluded that there are no significant impacts predicted. The Coordinator-General concurs with this conclusion and, in particular, is satisfied that impacts would be localised and temporary during the construction period only. A condition is imposed (Appendix 3, Part 2, Condition 21) that requires a full assessment of the potential impacts on environmental values associated with The Narrows pipeline crossing including cumulative impacts arising from dredging for the Port of Gladstone Western Basin Dredging Project (Page 182 CG Report).
	Dugong dugon Dugong **Migratory**	The Dugong and various Dolphin species and their preferred habitats may be impacted by one or several of the gas pipeline construction and operation activities described below: • Disturbance and fragmentation of mangrove and saltmarsh/saltpan habitat (dredging and HDD) • Underwater noise (dredging) • Disturbance of sub-tidal habitat and subsequent turbidity plumes if dredging is undertaken (Page 157 Volume 3 Chapter 23 EIS). No important dugong habitat is being destroyed or isolated as a result of the proposed development (Page 166 Volume 3 Chapter 23 EIS).		
	Megaptera novaeangliae Humpback Whale** **Migratory**			
	Orcaella brevirostris Irrawaddy Dolphin **Migratory**	The Dugong and various Dolphin species and their preferred habitats may be impacted by one or several of the gas pipeline construction and operation activities described below: • Disturbance and fragmentation of mangrove and saltmarsh/saltpan habitat (dredging and HDD) • Underwater noise (dredging) • Disturbance of sub-tidal habitat and subsequent turbidity plumes if dredging is undertaken (Page 157 Volume 3 Chapter 23 EIS). No important dolphin habitat is being destroyed or		

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Controlling Provision	Provision Trigger	EIS References	SEIS Reference	CG Report
		isolated as a result of the proposed development. While underwater noise associated with construction activities may disrupt dolphins, it is a temporary impact only that will not persist (Page 167 Volume 3 Chapter 23 EIS).		
	Orcinus orca Killer Whale, Orca **Migratory**	Unlikely to occur in area (Page 160 Volume 3 Chapter 23 EIS).		
	Sousa chinensis Indo-Pacific Humpback Dolphin **Migratory**	The Dugong and various Dolphin species and their preferred habitats may be impacted by one or several of the gas pipeline construction and operation activities described below: • Disturbance and fragmentation of mangrove and saltmarsh/saltpan habitat (dredging and HDD) • Underwater noise (dredging) • Disturbance of sub-tidal habitat and subsequent turbidity plumes if dredging is undertaken (Page 157 Volume 3 Chapter 23 EIS). No important dolphin habitat is being destroyed or isolated as a result of the proposed development. While underwater noise associated with construction activities may disrupt dolphins, it is a temporary impact only that will not persist (Page 167 Volume 3 Chapter 23 EIS).		
	REPTILES			
	Caretta caretta Loggerhead Turtle** **Migratory**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. Globally, the loggerhead turtle is a circum-tropical species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of loggerhead turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of loggerhead turtles is the Bundaberg coast. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle (Page 165 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for the threatened migratory marine fauna species and concluded that there are no significant impacts predicted. The Coordinator-General concurs with this conclusion and, in particular, is satisfied that impacts would be localised and temporary during the construction period only. A condition is imposed (Appendix 3, Part 2, Condition 21) that requires a full assessment of the potential impacts on environmental values associated with The Narrows pipeline crossing including cumulative impacts arising from dredging for the Port of Gladstone Western Basin Dredging Project (Page 182 CG Report).

2009/4976 Australia Pacific LNG proposes to establish a major gas transmission pipeline(s) to connect APLNG's coal seam gas fields in southern and central Queensland to its proposed liquefied natural gas (LNG) plant within the Gladstone State Development Area (GSDA), Curtis Island, Gladstone.				
Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Chelonia mydas Green Turtle** **Migratory**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. The proposed project will not create any barriers to movement for green turtles. Nesting beach habitat will not be physically impacted by the proposed project. Seagrass beds are the critical foraging habitat for the species, and the gas pipeline will not disturb any major seagrass beds. Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of green turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of green turtles is the Capricorn-Bunker group of islands. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle (Page 162 Volume 3 Chapter 23 EIS).		
	Crocodylus porosus Estuarine Crocodile, Salt-water Crocodile **Migratory**	Vagrant individuals do straggle as far south as Colosseum Inlet and Seven Mile Creek systems and have previously been seen in Gladstone. However, it is generally recognised that the Fitzroy River is the southern most extent of the estuarine crocodile's core habitat. Given that this area of The Narrows is located 40km south of the Fitzroy River, the southern extent of estuarine crocodile's core habitat. No important estuarine crocodile habitat is being destroyed or isolated as a result of the proposed development (Page 167 Volume 3 Chapter 23 EIS).		
	Dermochelys coriacea Leathery Turtle, Leatherback Turtle, Luth** **Migratory**	Unlikely to occur in project area (Page 159 Volume 3 Chapter 23 EIS).		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	Eretmochelys imbricata Hawksbill Turtle** **Migratory**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. Globally, the hawksbill turtle is a widely distributed species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way (Page 165 Volume 3 Chapter 23 EIS).		
	Lepidochelys olivacea Pacific Ridley, Olive Ridley** **Migratory**	The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. The Olive Ridley turtle is widely distributed throughout tropical and sub-tropical waters. The proposed project will not reduce the area of occupancy in any ecologically meaningful way (Page 163 Volume 3 Chapter 23 EIS).		
	Natator depressus Flatback Turtle** **Migratory**	The flatback turtle is widely distributed throughout tropical Australia and also occurs in Papua New Guinea. The proposed project will not reduce the area of occupancy in any ecologically meaningful way.		

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Controlling Provision	**Provision Trigger**	**EIS References**	**SEIS Reference**	**CG Report**
	SHARKS			
	Rhincodon typus Whale Shark** **Migratory**	There are only two threatened marine species that are not also migratory species. These two species are Green sawfish and whale shark. These species are not considered likely to be present in the area (Page 194 Volume 3 Chapter 23 EIS).		The EIS assessed the proposed impact of the pipeline against the significant impact criteria for the threatened migratory marine fauna species and concluded that there are no significant impacts predicted. The Coordinator-General concurs with this conclusion and, in particular, is satisfied that impacts would be localised and temporary during the construction period only. A condition is imposed (Appendix 3, Part 2, Condition 21) that requires a full assessment of the potential impacts on environmental values associated with The Narrows pipeline crossing including cumulative impacts arising from dredging for the Port of Gladstone Western Basin Dredging Project (Page 182 CG Report).

NOTES
The Recovery Plan for the Salt Pipewort, Button Grass *(Eriocaulon carsonii)* is Recovery plan for the community of native species dependent on natural discharge of groundwater from the Great Artesian Basin.

LEGEND
* **Conservation Advice**
** **Recovery Plan**
*** **Both**

From: s. 11C(1)(a)
Sent: Tuesday, 18 January 2011 12:01 PM
To: s. 22(1)(a)(ii) s. 11C(1)(a)
Cc: s. 22(1)(a)(ii)
Subject: RE: Clarification of Pipeline Impacts on Cryptic Brigalow Reptiles [SEC=UNCLASSIFIED]

Hi s. 22(1)(a)(ii)

When assessing potential impacts of the APLNG Project a fauna habitat methodology was developed specifically for the gasfields to deal with the uncertainty associated with the development.

For the gas pipeline (i.e. main transmission pipeline outside the gasfields) the footprint of the infrastructure is well defined and there have been adequate studies to assess potential impacts on species. These studies found that there will be no significant impacts on cryptic reptiles associated with the development of the gas pipeline. Residual impacts for these species can be reduced to minor or negligible with the application of standard mitigation measures which will be detailed in species management plans.

Let me know if you require any further info.

Cheers

s. 11C(1)(a)

s. 11C(1)(a)
Senior Environmental Advisor
Upstream EIS Co-ordinator

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Together we can make a difference.™

From: s. 22(1)(a)(ii)
Sent: Saturday, 15 January 2011 11:56 AM
To: s. 11C(1)(a)
Cc: s. 22(1)(a)(ii)
Subject: Clarification of Pipeline Impacts on Cryptic Brigalow Reptiles [SEC=UNCLASSIFIED]

Hi Katherine,

How are you? Hope you guys are going ok with the floods up there.

Following on from an email you sent to s. 22(1)(a)(ii) on 4 January, I was hoping to clarify the following relating to impacts from pipeline activities.

1) Impacts to cryptic Brigalow reptiles (scaly-foot, yakka skink and Dunmall's Snake)

Reading your Draft Offsets Strategy (16 Nov) the calculation of impacts on these species is clear. However it only relates to the gas fields and not the pipeline. Does this mean that you do not believe pipeline activities will result in any impacts on these three species? Or are the figures stated under Gas Fields (Table 1 of Draft Offset Strategy) a whole of project impact?

Grateful if you provide some clarification on this.

Regards,

s. 22(1)(a)(ii)

Mining Section
Environment Assessment Branch
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From: s. 11C(1)(a)
Sent: Tuesday, 4 January 2011 10:23 PM
To s. 22(1)(a)(ii)
Cc: s. 11C(1)(a)
Subject: Information in relation to APLNG impacts on Weeping Myall and SEVT

Hi s. 22(1)(a)(ii)

Happy New Year!

Please find information below in relation to the APLNG impacts on Weeping Myall and SEVT:

<u>Impacts to Weeping Myall</u>

Weeping Myall woodland does occur in APLNG tenements in the gasfields. However almost all of the Weeping Myall woodland is within roadsides/stock routes and as such will be avoided.

No weeping myall woodland occurs along the mainline or Condabri or Woleebee lateral pipelines.

Weeping myall may be present (low likelihood) along some of the HP lateral pipelines, but typical presence as small patches means that it will be avoided by realignment.

Therefore APLNG does not need to offset Weeping Myall woodland as any patches present will be avoided.

<u>Impacts to SEVT</u>

SEVT does occur in APLNG tenements in the gasfields. However due to infrastructure relocation and avoidance of SEVT, approximately only 4.36ha of SEVT will be impacted in the gasfields (compared with the original prediction of 13ha in the EIS).

The pipelines are also expected to impact approximately 0.37ha of SEVT.

Therefore APLNG has proposed to offset 4.73ha of SEVT due to unavoidable impacts.

Hopefully the above information is sufficient.

If you require any further info please do not hesitate to contact me.

I will be back in the office on Tuesday 11.01.11 but will be checking email regularly this week.

Cheers

s. 11C(1)(a)

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Gladstone LNG Plant and Pipeline
Curtis Island

Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations

Report prepared for URS Australia

Biodiversity Assessment
AND MANAGEMENT PTY LTD

FAUNA AND HABITAT SPECIALISTS

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Project Manager: Adrian Caneris

Client: URS Australia

Project Title: Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations

Project Author/s: Brett Taylor and Adrian Caneris

Project Summary: To investigate the potential occurrence of Water Mouse, Powerful Owl and wader/shorebird species on the south-western extent of Curtis Island in relation to the proposed Gladstone LNG Plant and pipeline.

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Signed on behalf of Date: 21/01/09

Biodiversity Assessment and Management Pty Ltd

Managing Director

Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations

Gladstone LNG Plant and Pipeline, Curtis Island

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List of Abbreviations

BAAM -	Biodiversity Assessment and Management Pty Ltd
BPA -	Biodiversity Planning Assessment
DEWHA -	Commonwealth Department of Environment, Water, Heritage and the Arts
DPIF -	Queensland Department of Primary Industries and Fisheries
EPA -	Queensland Environmental Protection Agency
EPBC Act -	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EVR -	Endangered, Vulnerable or Rare
IPA	Queensland *Integrated Planning Act 1997*
LP Act -	Queensland *Lands Protection (Pest and Stock Route Management) Act 2002*
NC Act-	Queensland *Nature Conservation Act 1992*
NRW -	Queensland Department of Natural Resources and Water
RE -	Regional Ecosystem
SEQ -	South-east Queensland
VM Act-	Queensland *Vegetation Management Act 1999*

1.0 INTRODUCTION

This report has been prepared for URS Australia for the purpose of providing an independent, targeted assessment of the potential occurrence of, and habitat values for, Powerful Owl *Ninox strenua*, Water Mouse *Xeromys myoides* and migratory wading birds of properties located on the south-west portion of Curtis Island.

It is understood that the assessment is to focus on all suitable coastal habitats within the study area for Water Mouse and wading birds, while assessment of Powerful Owl habitat values will focus on the area of the proposed construction of a 100 m pipeline easement.

The specific aims of the assessments are to provide:

- An evaluation and comment on the presence or absence of Water Mouse, Powerful Owl and migratory wader species within the study area and the implications of such for the proposed development;
- An assessment and comment on significant terrestrial faunal habitats suitable for Water Mouse, Powerful Owl and wading bird species within the study area and the implications of such for the proposed development; and
- Identification of potential impacts on Water Mouse, Powerful Owl and wading bird species and associated habitat, and recommendations for impact mitigation and management, including the need for further, more detailed assessments.

Nomenclature used in this report follows Clayton *et al.* (2006).

All following observations and recommendations are based on a review of available literature and site investigations undertaken by Adrian Caneris and Brett Taylor on 15 to 17 December 2008 (inclusive).

2.0 STUDY AREA DESCRIPTION

2.1 LOCATION

The study area is situated on Curtis Island, located adjacent to the coast 5 km to the north of Gladstone. The study area is centred on the south-western portion of the island (**Figure 2.1**) and comprises approximately 14 km^2 of freehold land contained in Lots 11DS220, 27DS220, 10DS220, 28DS220, 7DS220 (Mark J. Graving, Ross W. Graving and Colin G. Graving); 9DS220 (Santos P/L); 2RP602284 (Central Queensland Ports Authority); and 1RP602284 (Kemsip P/L).

2.2 LAND USE AND TERRESTRIAL FEATURES

The vegetation in the study area is dominated by older regrowth, having been cleared in the past. Open eucalypt forest dominates the study area with marine plains and mangrove communities along much of the shoreline. The site is situated on undulating land rising from sea level to a maximum of approximately 140 m elevation in the eastern extent of the study area. A number of ephemeral creeks/gullies drain the site, generally flowing west. The few man-made structures on the site are restricted to grazing infrastructure. The study area is bordered to the north by Graham Creek, a wide estuarine creek, and to the east by a low range. The south-west shoreline of the island borders the remainder of the study area.

Current landuse in the study area is restricted to low intensity cattle grazing. Much of the island north of Graham Creek is contained in conservation reserves. The Garden Island Conservation Park lies east of the southern tip of the study area. The closest settlement is South End, located on the south-east tip of the island.

2.3 PROPOSED ACTIVITIES

The proposed activities will involve the construction of a Liquefied Natural Gas (LNG) plant on the southern portion of the study area. A gas pipeline and road including a 100 m cleared corridor will extend approximately 8.2 km from Laird Point in the north-west to the site of the LNG plant in the south of the study area.

0 1.25 2.5km
Scale 1:100 000 (A4)
Datum : GDA94

Gas Transmission Pipeline Corridor
LNG Facility Site Boundary
General Study Area

Base map courtesy of URS

Biodiversity Assessment AND MANAGEMENT PTY LTD

FIGURE 2.1
STUDY AREA LOCATION
Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations
Gladstone LNG Project

3.0 ECOLOGICAL PLANNING FRAMEWORK

The primary ecological planning framework for the study area incorporates legislation at the Commonwealth and State levels. In addition, planning for this area should have regard for the intent of regional and local statutory planning instruments.

3.1 COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects the environment, particularly matters of National Environmental Significance (Protected Matters). It streamlines national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places.

The EPBC Act, administered by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA), is designed to provide for the conservation of biodiversity through the protection of threatened species and ecological communities, migratory, marine and other protected species listed under the Act.

In planning for the study area, there may be a requirement for a referral to DEWHA in accordance with the EPBC Act Policy Statement 1.1: Significant Impact Guidelines, Matters of National Environmental Significance (DEH 2006) for assessment against the EPBC Act. A requirement for Commonwealth referral in relation to terrestrial vertebrates will be dependant on the species of conservation significance and their associated habitats that are recorded in the study area, and the likelihood of those species and habitats being significantly impacted by the project.

3.2 QUEENSLAND NATURE CONSERVATION ACT 1992

Planning for the study area must address the guidelines and provisions of Queensland's *Nature Conservation Act 1992* (NC Act). The NC Act is the principal legislation for the conservation and management of the State's native flora and fauna and is administered by the Queensland Environmental Protection Agency (EPA). The key goal of the NC Act is the preservation of Endangered, Vulnerable and Rare (EVR) species of flora and fauna as listed under the *Nature Conservation (Wildlife) Regulation 1994*.

The NC Act (Section 68) states that:

> 'Protected wildlife is to be managed to—
>
> (a) conserve the wildlife and its values and, in particular to—
>
> (i) ensure the survival and natural development of the wildlife in the wild; and
>
> (ii) conserve the biological diversity of the wildlife to the greatest possible extent; and
>
> (iii) identify, and reduce or remove, the effects of threatening processes relating to the wildlife; and
>
> (iv) identify the wildlife's critical habitat and conserve it to the greatest possible extent; and …'.

Protected wildlife is linked to the Queensland *Vegetation Management Act 1999* through the mapping of Remnant Vegetation and associated Essential Habitat contained therein.

3.3 QUEENSLAND VEGETATION MANAGEMENT ACT 1999

The purpose of the *Vegetation Management Act 1999* (VM Act) is to regulate the clearing of native vegetation (i.e. Remnant Vegetation mapped as Regional Ecosystems (REs) that are: Endangered, Of Concern and Not of Concern) to maintain ecological processes, ensure there is no loss of biodiversity or increase in land degradation from vegetation clearing and manage the effects of clearing. In addition, some areas of remnant vegetation are further classified as Essential Habitat under the VM Act with specific reference to conservation significant species listed under the NC Act.

The VM Act is administered by the Queensland Department of Natural Resources and Water (NRW) certified mapping of Remnant Vegetation and Essential Habitat. Clearing of native vegetation mapped as REs and/or Essential Habitat is subject to assessment by the NRW against the Regional

Vegetation Management Code for Coastal Bioregions (NRW 2006).

3.4 QUEENSLAND LANDS PROTECTION (PEST AND STOCK ROUTE MANAGEMENT) ACT 2002

The main purpose of the *Lands Protection (Pest and Stock Route Management) Act 2002* (LP Act) legislation is to provide pest management for agricultural lands. The LP Act lists several species of flora and fauna that are considered Class 1, 2 or 3 pests under the Act.

In addition, there may be environmental weeds that are not listed under the LP Act may be present within the study area.

Future planning in the study area should incorporate appropriate weed and pest management.

3.5 QUEENSLAND COASTAL PROTECTION AND MANAGEMENT ACT 1995

The main objective of the State Coastal Management Plan as required under the Queensland *Coastal Protection and Management Act 1995* is to provide for coastal management policy direction and define how these directions should be implemented by government, industry and the community. The State Coastal Plan has the effect of a State planning policy under the Queensland *Integrated Planning Act 1997* (IPA) and is therefore a matter of State interest.

The State Coastal Plan is one of the matters that are coordinated and integrated into new planning schemes during their preparation, with regard to and for impact assessment applications, and considered in Ministerial community infrastructure designations.

In areas where a regional coastal management plan has not yet been prepared, erosion prone areas previously designated under the now repealed *Beach Protection Act 1968* are taken to be the default coastal management districts.

The erosion prone area is the width of the coast that is considered to be vulnerable to coastal erosion and tidal inundation over a 50-year planning period. Where no regional coastal management plan has been prepared, an area within a designated Erosion Prone Area is taken to be a coastal management district under Section 168 of the Coastal Act. Calculation of the erosion prone area is based on:

- a short-term erosion component from extreme storm events;
- a long-term erosion component where gradual erosion is occurring;
- a shoreline recession component due to sea level rise associated with climate change; and
- a dune scarp component, where slumping of the scarp face occurs following erosion.

3.6 QUEENSLAND FISHERIES ACT 1994

The Queensland *Fisheries Act 1994* states that its main purpose is to 'provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats …' in an ecologically sustainable manner.

Future planning for the study area must have regard for the presence of marine plants in terrestrial environments. There is a requirement for a permit from the Department of Primary Industries and Fisheries' Queensland Fisheries Service (QFS) prior to any disturbance to or removal of marine plants.

The *Fisheries Act 1994* (Section 8) defines marine plants as:

(1) Marine plant includes the following—

(a) a plant (a tidal plant) that usually grows on, or adjacent to, tidal land, whether it is living, dead, standing or fallen;

(b) material of a tidal plant, or other plant material on tidal land;

(c) a plant, or material of a plant, prescribed under a regulation or management plan to be a marine plant.

(2) Marine plant does not include a plant that is a declared pest under the *Land Protection (Pest and Stock Route Management) Act 2002.*

QFS policy requires that works or activities associated with applications for marine plant permits or development approvals have zero or minimal adverse impact on marine plants or fish habitats. All such works or activities are assessed against criteria that aim to meet the objective of protection and enhancement of fish habitats, including marine plants. Unavoidable permitted impacts will require compensation.

3.7 Biodiversity Planning Assessment

The EPA has prepared Biodiversity Planning Assessments (BPAs) for a number of Queensland Bioregions (as defined under the VM Act) in order to provide broadscale ecological data to advise a range of planning and decision-making processes.

The BPAs are based on the Biodiversity Assessment and Mapping Methodology (EPA 2002) using vegetation mapping data generated by the Queensland Herbarium. The methodology identifies areas with various levels of significance for biodiversity reasons, such as threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetland or other types of habitat important for the maintenance of biodiversity or ecological processes.

The BAMM assigns three levels of Biodiversity Significance:

State Significance – Areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales;

Regional Significance – Areas assessed as being significant for biodiversity at the sub-bioregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance; and

Local Significance and Other Values – Areas assessed as not being significant for biodiversity at State or Regional scales. Local values are of significance at the local government scale.

The methodology uses seven diagnostic criteria: Habitat for EVR taxa; Ecosystem value; Tract size; Relative size of Regional Ecosystem; Condition; Ecosystem diversity; and Context and connection, utilizing Queensland Herbarium RE mapping and buffered EVR flora and fauna records. Three supplementary criteria refine the mapped information by incorporating local knowledge and expert opinion. These are: Essential and general habitat for priority taxa; Special biodiversity values; and Corridors. Expert Panel Reports are compiled to document the decision-making process for assessing the supplementary criteria.

4.0 STUDY METHODOLOGY

4.1 Desk Top

Prior to the field survey, public databases were searched in order to provide background information regarding the terrestrial vertebrate fauna known from the region and local area. Where deemed necessary, expert opinion was consulted regarding the target species involved.

Information gained from this phase of the study was used to:

- Ensure that survey methods were designed to detect the target species of significance known from the study area; and
- Determine the likelihood of the target species occurring if suitable habitat was located within the study area. Those species known from recent, nearby records are considered more likely to occur if suitable habitat is located.

4.2 Field Survey

4.2.1 Survey Effort and Site Selection

The field program involved a site investigation conducted over two days and two nights in order to assess the extent and quality of wildlife habitat and to determine the presence, or likely presence, of the target at-risk species known from, or predicted to occur, within the local area. This was undertaken in accordance with the EPA's Queensland Parks and Wildlife Service's Scientific Purposes Permit No. WISP02791605 and Queensland Department of Primary Industries and

Fisheries' (DPIF) Animal Ethics Committee Certification No. CA 2005/10/81.

The general survey approach was to visit and sample representative faunal habitats over the study area, recording the target fauna species by observations of actual animals, recognition of characteristic vocalisations, and/or identification of animal signs. Where no animal observations/signs were recorded, habitat was assessed for suitability of the target species occurrence. This involved the following specific techniques:

4.2.2 Survey Techniques

Diurnal Habitat Searches and Assessment

Active diurnal searches for traces of Water Mouse activity (nesting mounds and feeding areas) were undertaken in suitable habitat (mangroves with adjacent saltmarsh). In addition, wading birds were recorded in the area throughout the study period.

Searches of suitable habitat were conducted for traces of Powerful Owl activity (owl pellets) and suitable tree hollows for roosting.

Nocturnal Surveys

A combination of high-powered spotlights and head torches was used to search for Powerful Owl individuals as well as nocturnal mammals, an important prey item for the species.

During the spotlighting sessions, searches for Powerful Owl were assisted by the use of call playback.

Incidental (Opportunistic) Records

During the survey period, fauna observations were continuous and species records were obtained outside of the systematic methodology of the survey. All of the incidental vertebrate fauna species observed during the field survey are listed in **Appendix 1**.

5.0 RESULTS AND RECOMMENDATIONS

5.1 Essential Habitat Mapping

The 'essential habitat' associated with RE mapping under the VM Act is shown in **Appendix 2**. Essential habitat, as mapped by the EPA, is vegetation in which a species has been known to occur, or is predicted to occur, that is Endangered, Vulnerable, Rare or threatened under the NC Act. The essential habitat mapped for the study area is for two species: Beach Stone-curlew *Esacus magnirostris* and Koala *Phascolarctos cinereus*.

<u>Beach Stone-curlew</u>

Under the VM Act, essential habitat for the Beach Stone-curlew (listed as Vulnerable) is described as:

> "All types of undisturbed beaches and littoral habitat, both surf and sheltered exposure on mainland and islands, especially near river mouths and mangrove-backed areas. Nest at back of beach/sandbank (occasionally among sparse grass or shingle with plant debris) or on coral ridge above high tide mark, often near creek or estuary"

Essential habitat for Beach Stone-curlew has been mapped under the VM Act in remnant habitat outside of the study area, in shoreline habitat along the south-eastern coastline. The essential habitat includes all REs along ecotones with beaches. Although the essential habitat mapping is based on a single record, it is likely the species would be found in suitable habitat along all coastal sections of the study area.

The Beach Stone-curlew generally occurs singularly or in pairs, and occasionally in small groups. The species inhabits sandy beaches, especially where sandflats, mudflats or reefs are exposed at low tide. Adult birds appear to be sedentary.

It should be noted that two adult birds were observed foraging along the coastline at South End during the field survey (**Section 5.2.3**).

Koala

Under the VM Act essential habitat for the Koala (listed as Vulnerable within the SEQ bioregion) is described as:

> "Open (structurally complex with mixture young/mature/old growth, especially 30-80 cm dbh), mixed (rich in number and species diversity of food trees) eucalypt forest and woodland at lower altitude in undulating country on relatively deep and usually high nutrient soil (main species - *Eucalyptus tereticornis, E. fibrosa, E. propinqua; E. umbra, E. grandis, E. microcorys, E. tindaliae, E. resinifera, E. populnea; E. robusta, E. nigra, E. signata*)."

Patches of essential habitat for Koala have been mapped under the VM Act throughout the northern and central portions of the study area. REs classified as essential habitat in the study area include: RE12.3.3; RE12.3.7; and RE12.3.11. There is no WildNet database record of this species in the study area or surrounds.

5.2 TARGET SPECIES

In general, there is little literature based in the region encompassing the study area and surrounds regarding the target species. The following sections on each target species present a summary of information obtained from a desktop review of available information, followed by the results of the field investigation and subsequent recommendations for further detailed assessment and mitigating potential impacts.

5.2.1 Water Mouse *Xeromys myoides*

General Profile

Status: NC Act Vulnerable; EPBC Act Vulnerable.

Historical occurrence within the study area: There is no database record for this species on the study area or surrounding area.

Ecology and Habitat: The Water Mouse (or False Water Rat) is a nocturnal, terrestrial carnivore and is one of Australia's most poorly known rodents. They require relatively large areas of intertidal flats over which to forage, together with suitable adjacent areas for nest sites. Home ranges of around 0.7 ha have been recorded and individuals are known to cover distances of up to 2.9 km within these areas. Food for this species primarily consists of marine crustaceans, bivalves and other invertebrates. Small amounts of plant material have been found in their stomachs, though this is thought to have originated from their ingested prey (Van Dyck 1996; Gynther and Janetzki 2008).

The species builds termitarium-like mounds up to 60 cm high and digs tunnels. The nests, regardless of type or structure, primarily serve as diurnal refuges and reproductive sites. Nests often occupy naturally elevated ground and utilise the bases of fallen trees or logs for support of the nest structure (Van Dyck 1996; Gynther and Janetzki 2008).

Distribution and Breeding: The Water Mouse is patchily distributed in the Northern Territory, and from the Gold Coast to Proserpine in Queensland (Menkhorst and Knight 2004).

Generally, there is only one sexually active male present in a nest and nests may be used by successive generations over a number of years. Once constructed, nests are continuously added to, with the larger mounds or nests having potential to provide significant historical information about populations and habitats over time (Van Dyck 1996).

Threats: The species is threatened by swamp and mangrove reclamation, feral predators, changes to water tables, and offshore pollution (Gynther and Janetzki 2008).

Field Survey Results

A total of 12 sites were assessed within the study area for Water Mouse suitability. A search of each site was conducted to look for signs of Water Mouse activity (nesting mounds, feeding middens) and general habitat suitability. The locations of habitat assessment sites are shown on **Figure 5.1**. GPS locations for each site and site habitat assessment results and recommendations for further assessment are listed in **Table 5.1**.

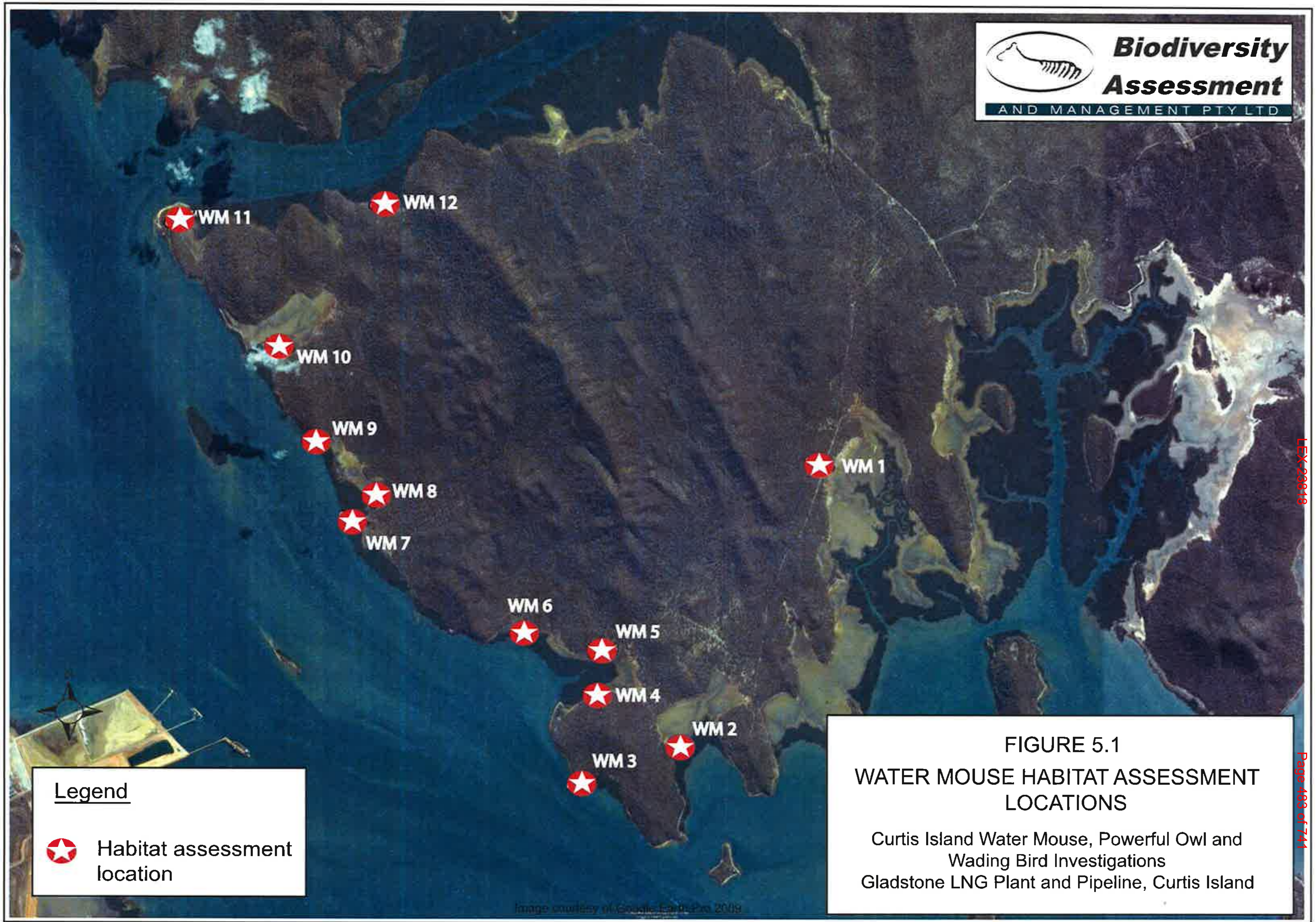

FIGURE 5.1
WATER MOUSE HABITAT ASSESSMENT LOCATIONS

Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigations
Gladstone LNG Plant and Pipeline, Curtis Island

Table 5.1 Water Mouse Habitat Assessment Site Results

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM1	23.766015 S 151.239388 E	This site lies outside of the study area, although close to the current access road. Habitat is generally poor for Water Mouse at this location.	
WM2	23.790056 S 151.224626 E	There are good habitat values for Water Mouse within the mangrove community in this area. Suitable and abundant food resources (crustaceans) were observed during habitat assessment.	
		Transitional areas along the mangrove edge are considered less suitable, with much evidence of feral animal disturbance (pig, horse, dog/fox) noted.	
WM3	23.793449 S 151.215634 E	This area is a small bay that is comparatively exposed. The coarse substrate here is generally less suitable for Water Mouse nesting and foraging (low occurrence of crustaceans). Habitat values are generally low and it is considered unlikely that Water Mouse occurs in this area.	

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM4	23.785429 S 151.216038 E	This area has been subject to high levels of disturbance with abundant rubbish and feral animal disturbance. There are moderate habitat values for Water Mouse within the mangrove area.	
		An access track has disturbed the key transitional zone (marine couch/mangrove interface).	
WM5	23.782492 S 151.215740 E	Habitat less disturbed than WM4. Food resources outside of mangrove area are generally low. Moderate habitat values for Water Mouse within mangroves.	
		Two Eastern Curlews *Numenius madagascariensis* observed foraging in mudflat area.	

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM6	23.780124 S 151.209032 E	Habitat in transitional zone (marine couch/mangrove flat interface) has been recently disturbed by vehicles using access track. Low-moderate habitat values for Water Mouse in mangrove area, but low values outside.	
WM7	23.770879 S 151.192943 E	Largely undisturbed transition zone between mangrove and marine couch habitat. Excellent habitat values for Water Mouse.	
WM8	23.769301 S 151.193960 E	Adjacent to previous assessment site. Access track along marine couch area not affecting mangrove area at this stage. Excellent habitat values for Water Mouse. What may be a disused Water Mouse nest site was observed.	 

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM9	23.763815 S 151.189256 E	Mangrove area provides moderate values for Water Mouse. Evidence of pig presence/damage on edges of mangroves. Coarse substrate in area adjacent to mangroves less suitable for Water Mouse.	 
WM10	23.755714 S 151.185700 E	Wide claypan/mudflat area behind mangrove habitat. Food resources generally less abundant than in other areas. Generally low habitat values for Water Mouse at this location. Wading birds including Eastern Reef Egret *Egretta sacra* observed foraging in area.	 

Point	Lat/Long	Water Mouse Habitat Values	Photos
WM11	23.744946 S 151.173784 E	Mangrove habitat at Laird Point in the north-western extent of study area. Mangroves along western edge of Laird Point restricted to thin strip adjacent to coastline with low habitat values for Water Mouse. Mangrove/marine couch transition zone east of Laird Point subject to some disturbance adjacent to existing access road. Moderate habitat values for Water Mouse in mangroves. Eastern Curlew and Whimbrel *Numenius phaeopus* observed foraging on sand flats at Point.	
WM12	23.743176S 151.193913E	Large areas of mangrove habitat. Abundant food resources observed during survey. Moderate habitat values for Water Mouse in mangroves.	

No distinctive signs of current Water Mouse activity were observed during the December 2008 survey. However, given the brief nature of the survey and the large size of the study area, the results are not considered conclusive. Portions of the marine habitats of the study area hold relatively large tracts of potential habitat and would provide suitable foraging resources.

No known targeted trapping surveys for Water Mouse have been conducted on Curtis Island or the adjacent mainland (Van Dyck, pers comm.). Water Mouse has been detected to the south of the study area on the Fraser Coast (Van Dyck, pers comm.) and targeted surveys have detected the species in North Queensland between Proserpine and Cape Palmerston (Ball 2004). Water Mouse captured near Proserpine were often in very similar habitat to that found in the study area and population densities were found to be low compared to populations further south. Ball (2004) states it is 'highly likely' the species range will be extended from its' known distribution with further targeted surveys.

Recommendations

It is recommended that intensive targeted trapping surveys be conducted to confirm the presence/absence of Water Mouse within suitable habitats proposed for disturbance by the project (**Table 5.1**).

A minimum survey effort should be 300 trap nights / site (i.e. 100 Elliott traps X 3 nights or 150 Elliott traps X 2 nights). Two nights is a minimum survey effort. The trapping should be conducted so as to coincide with tidal events where high tide is in later part of the afternoon to allow for extended trapping time during nocturnal period, prior to incoming tide requiring trap removal from site for animal ethics reasons.

It is also recommended that the project managers seek to ensure feral species management planning and active control within any habitats found to support Water Mouse.

5.2.2 Powerful Owl *Ninox strenua*

General Profile

Status: NC Act Vulnerable.

Historical occurrence within the study area: There is one WildNet database record of this species from the general area, however this search was based on a 15 km radius centred on the study area and is therefore likely to have been from the mainland. A further seven records were shown with a wider search radius of 25 km. One individual Powerful Owl was observed in the study area by a URS Australia employee during a May 2008 fauna survey (GPS coordinates: 23.760062 S; 151.208312 E).

Ecology and Habitat: Pairs of Powerful Owls occupy large, probably permanent, home ranges of about 1,000 ha (Higgins 1999; Garnett and Crowley 2000), although in Victoria ranges larger than 4000 ha have been recorded (Soderquist and Gibbons 2007). Their principle prey is medium-sized mammals, particularly possums and gliders, which often represent more than 50% of their diet, but which also includes other birds, flying-foxes, rats and insects (Webster *et al.* 1999; Higgins 1999).

Adult birds roost in a variety of tree species, including exotics. Commonly, the roost tree has thick vegetation in which the owl can escape from the mobbing activities of smaller avian species. During breeding, adults usually roost in close proximity to the nest tree (Webster *et al.* 1999). The species occurs in mountain rainforests, gullies and forest margins, sparser hilly woodlands, coastal forests, woodlands, scrubs, exotic pine plantations and large trees in private/public gardens (Pizzey and Knight 2003). Powerful Owls are most likely observed at sites with mature dry forest, many live hollow-bearing trees, diverse habitats within 2 km, and not much pure regrowth within 5 km (Loyn *et al.* 2001).

Distribution and Breeding: This species is found in south-eastern Australia from Victoria north to Eungella, Queensland, and it is most common on the eastern slopes of the Great Dividing Range (Garnett and Crowley 2000).

Powerful Owls breed once per year from May to August. Nests are located in large tree hollows, usually at a considerable height above the ground (10-40 m) (Beruldsen 2003). Consequently, the presence of large hollow-bearing trees is important for breeding as well as smaller hollows for the persistence of its prey species.

Threats: Widespread clearing of Powerful Owl habitat has reduced the amount of available habitat by almost half. However the species is still persistent and stable in remaining habitats (Garnett and Crowley 2000). Forestry practices have the potential to impact this species through the removal of hollow bearing trees that provide suitable nesting locations or shelter for prey species. However, most logging on mainland Australia now occurs in a mosaic pattern consisting of logged and unlogged areas, and studies have suggested that the Powerful Owl can persist in such mosaics by nesting in unlogged areas and foraging in logged or regrowth areas (Kavanagh *et al.* 1995).

Field Survey Results

No Powerful Owl was detected during the December field survey, however given the brevity of the survey it cannot be concluded that the species does not occur in the study area. During two nights of spotlighting and call playback, only Southern Boobook *Ninox boobook* was recorded, the species being common across the study area. No arboreal mammals were detected (important prey for Powerful Owls).

As much of the study area has undergone logging in the past, particularly in the east and south, eucalypts of a suitable age with large hollows were not abundant. Larger trees with hollows capable of supporting nesting Powerful Owls and arboreal mammals were sparsely scattered throughout the eastern and southern sections of the study area. In the north-east and western edge of the study area larger hollow-bearing trees were more abundant. However, the brevity of this survey did not allow for a detailed assessment of this area, particularly the western portion of the study area that follows a low ridgeline and is relatively inaccessible.

Overall, habitat in the study area is considered to be marginal for the Powerful Owl. There is generally a lack of suitably sized hollow-bearing trees for nesting purposes or prey species (arboreal mammals). There are no records of arboreal mammal species from a WildNet database search for the area, although glider species were recorded by URS Australia employees during a May 2008 fauna survey. The study area may be used seasonally, or occasioned by individual Powerful Owls normally residing on the mainland, but the species is unlikely to be a permanent resident within the study area.

Recommendations

It is understood that much of the area considered by this survey to be more suitable for the species (i.e. the central, western and north-eastern sections of the study area) will be retained outside of the proposed works. The path of the proposed pipeline and road is likely to require the removal of some large trees suitable for Powerful Owl and its prey.

In order to minimise impacts on the Powerful Owl it is recommended:

- Wherever possible, the proposed width of the pipeline/road corridor should be minimised to reduce the amount of vegetation to be cleared.
- Wherever possible, the path of the pipeline/road corridor should be adjusted to avoid areas containing large hollow-bearing trees.
- In areas where large hollow-bearing trees cannot be avoided, suitable nest boxes should be deployed for both Powerful Owls and arboreal mammals to offset habitat loss.
- If any vegetation clearance is to be undertaken during the species' breeding season (May to August), those habitats should be thoroughly checked one day prior to the works through active searching in daytime hours and spotlighting and call playback during the evening prior. If breeding is identified within an area to be disturbed, this should be postponed until the young have left the nesting hollow.
- Wherever vegetation removal is required, all large trees should be checked for the presence of owls by registered fauna spotters.

Overall, there is only an extremely low likelihood of any direct impact and only low potential for secondary impacts (i.e. reduction in prey, loss of nest hollows) as a result of the project.

5.2.3 Wader and Shorebird Species

All wader and shorebird species recorded within or nearby the study area are included in this report, although a greater number of species would be likely to be recorded in a more extensive survey.

A total of 22 wader and shorebird species were identified within or near the study area during the December 2008 survey (**Table 5.2**). Eleven of these species are considered as Migratory species under the EPBC Act and three species are considered to be EVR under state legislation.

EVR species

Beach Stone-curlew *Esacus magnirostris*

Status: NC Act Vulnerable

The Beach Stone-curlew generally occurs singly or in pairs, and occasionally in small groups. The species inhabits sandy beaches, especially where sandflats, mudflats or reefs are exposed at low tide. Adult birds appear to be sedentary. The species feeds predominately on crabs and other marine invertebrates in the intertidal zone (Marchant and Higgins 1993).

A pair of Beach Stone-curlews was observed foraging along the beach near South End, approximately 10 km east of the study area. Essential habitat for this species has been mapped adjacent to the south-eastern boundary of the study area (EPA 2003). The species mainly shelters in beach scrub, but is likely to utilise much of the shoreline habitat periodically for foraging. It is considered unlikely the proposed works will significantly impact local populations in the study area given the area of suitable habitat.

However, a greater understanding of the species' utilisation of the island habitats and the location of breeding sites is required to fully assess actual and/or potential impacts on this species.

Table 5.2. Wader and shorebird species observed in or near the study area

Scientific Name	Common Name	NC Act Status	EPBC Act Status
Butorides striata	Striated Heron	Least Concern	
Egretta intermedia	Intermediate Egret	Least Concern	
Egretta sacra	Eastern Reef Egret	Special Least Concern	Migratory
Pelecanus conspicillatus	Australian Pelican	Least Concern	
Phalacrocorax melanoleucos	Little Pied Cormorant	Least Concern	
Phalacrocorax varius	Pied Cormorant	Least Concern	
Pandion haliaetus	Osprey	Special Least Concern	Migratory
Esacus magnirostris	Beach Stone-curlew	Vulnerable	
Haematopus longirostris	Pied Oystercatcher	Least Concern	
Haematopus fuliginosus	Sooty Oystercatcher	Rare	
Vanellus miles	Masked Lapwing	Least Concern	
Charadrius ruficapillus	Red-capped Plover	Least Concern	
Numenius phaeopus	Whimbrel	Special Least Concern	Migratory
Numenius madagascariensis	Eastern Curlew	Rare	Migratory
Tringa nebularia	Common Greenshank	Special Least Concern	Migratory
Xenus cinereus	Terek Sandpiper	Special Least Concern	Migratory
Actitis hypoleucos	Common Sandpiper	Special Least Concern	Migratory
Heteroscelus brevipes	Grey-tailed Tattler	Special Least Concern	Migratory
Calidris ruficollis	Red-necked Stint	Special Least Concern	Migratory
Larus novaehollandiae	Silver Gull	Least Concern	
Sterna bergii	Crested Tern	Special Least Concern	Migratory
Sterna hirundo	Common Tern	Special Least Concern	Migratory

Sooty Oystercatcher *Haematopus fuliginosus*

Status: NC Act Rare

This species is restricted to marine shoreline habitats, with a preference for rocky substrates, coral reefs, headlands and sandy beaches near intertidal mudflats and rocky areas (Marchant and Higgins 1993).

One individual was observed on a rocky islet near South End 10 km east of the study area. Sooty Oystercatcher generally prefers to forage on rocky substrates, but will occasion sand flats/salt pans. The habitats within the study area hold generally low value and potential and it is considered unlikely any significant detrimental impacts would result from proposed actions.

Eastern Curlew *Numenius madagascariensis*

Status: NC Act Rare; EPBC Act Migratory

Eastern Curlews occur on sheltered coasts, and are often recorded in saltmarsh and on mudflats within mangroves. They mainly forage on intertidal mudflats and sandflats, and roost on sandy spits and islets, in mangroves and saltmarsh, and along the high water mark on beaches (Higgins and Davies 1996).

The Eastern Curlew breeds in eastern Siberia during the northern hemisphere summer. Adults vacate breeding areas around June and migrate through Asia on their way to Australia and New Zealand, mostly arriving in eastern Australia by late August and September. The Australian Eastern Curlew population is estimated at 19,000 and numbers have fallen significantly in some southern areas.

During the December 2008 survey this species was commonly observed at low tide on sandflats/mudflats at South End, 10 km east of the study area. Within the study area a pair of Eastern Curlews were observed foraging at WM5 (**Figure 5.1**) and another pair were observed on sandflats at Laird Point. The species is likely to periodically utilise much of the shoreline habitat, and nearby mudflats within the study area, during low tide periods. Impacts on populations of this species from the proposed works are considered to be minor and are restricted to reduction of foraging and possible roosting habitat within the study area. The preferred foraging habitat in the local area appeared to be low-tide marine plains adjacent to South End.

Other wader/shorebird species

Migratory species (EPBC Act)

Whimbrel and Eastern Reef Egret are species found in a variety of coastal habitats including tidal flats, estuaries and mangroves. Whimbrel was relatively common throughout the study area and was observed or heard calling in some of the mangrove sites during the Water Mouse survey and was observed foraging at Laird Point. An Eastern Reef Egret was observed foraging at Water Mouse survey site WM10. Impacts on populations of these species from the proposed works are considered to be minor and are restricted to reduction of foraging and roosting habitat within the study area.

Terek Sandpiper and Grey-tailed Tattler are known to forage on tidal mudflats, estuaries and mangroves. Both species were observed foraging on beach habitat near South End. Impacts on populations of either species from the proposed works are considered to be minor and are restricted to a reduction of foraging habitat within the study area.

Common Greenshank, Common Sandpiper and Red-necked Stint are listed as Migratory species. These are common species and all may be found in a variety of saline and freshwater habitats. These species are unlikely to be significantly impacted by the proposed works. Common Tern, Crested Tern and Osprey are wide-ranging species that are unlikely to be significantly impacted by the proposed works.

The remaining wader/shorebird species are not listed under legislation. Striated Heron and Pied Oystercatcher are essentially coastal species that will forage in a variety of habitats. The remaining species are all common and may be found in a variety of saline and freshwater habitats. None of these species are likely to be significantly impacted by the proposed works.

Recommendations

Wader/shorebird species were observed in relatively low numbers within the study area. Habitat values appeared to be low for many species due to low foraging potential. There is abundant existing habitat elsewhere on Curtis Island and surrounds. The majority of the observed waders, both in terms of species and number of individuals, were recorded foraging on more suitable habitat (sand/mudflats) 10 km to the east of the study area at South End. As such, recommendations are as follows:

- a more detailed study be conducted to ascertain the use of the study area by wader species, particularly in regards to use of the area for roosting at high tide;
- the proposed works should at all times minimise disturbance to the foreshore/intertidal zone within the study area; and
- it is considered that no referral under the EPBC Act is necessary in relation to these species in the areas investigated for this study.

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Appendix 1:
Terrestrial Vertebrate Species List

Curtis Island LNG plant study area: Species list derived from BAAM December 2008 survey

Status Abbreviations: EPBC Act: M = Migratory. **NC Act:** V = Vulnerable; R = Rare; S = Special Least Concern (Migratory); LC = Least Concern; I = Introduced. **BAMM (Biodiversity Assessment and Mapping Methodology):** X = Non-EVR priority species for the SEQ bioregion (EPA 2002).

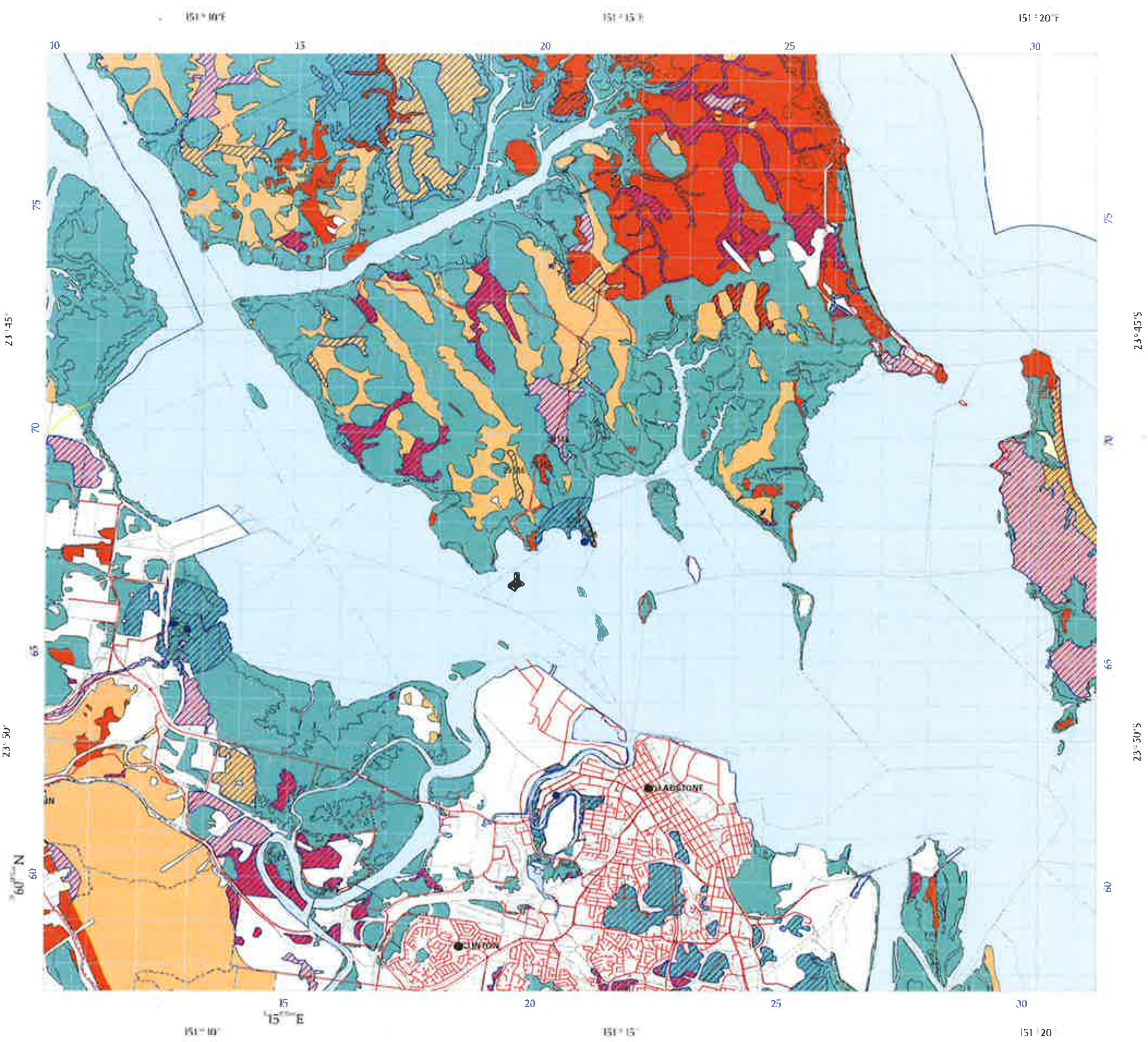
Unless otherwise noted, this table follows the nomenclature provided by the CSIRO List of Australian Vertebrates (Clayton *et al.* 2006) as it provides a single point of reference for all terrestrial vertebrate groups. Any notable variations in common and/or scientific names of conservation significant species are identified in the report text and as footnotes hereunder. With the exception of alterations due to subsequent taxonomic revision, species reported by sources other than BAAM are accepted at face value.

Family Genus Species	Common Name	NC Act	EPBC Act	BAMM
FROGS				
MYOBATRACHIDAE				
Crinia deserticola	Desert Froglet	LC		X
Uperoleia fusca	Dusky Toadlet	LC		
HYLIDAE				
Litoria caerulea	Green Tree Frog	LC		
Litoria fallax	Eastern Dwarf Tree Frog	LC		
Litoria gracilenta	Dainty Green Tree Frog	LC		
Litoria inermis	Peters' Frog	LC		X
Litoria latopalmata	Broad-palmed Frog	LC		
Litoria nasuta	Rocket Frog	LC		
Litoria rothii	Roth's Tree Frog	LC		X
Litoria rubella	Desert Tree Frog	LC		
BUFONIDAE				
Bufo marinus	Cane Toad	I		
REPTILES				
GEKKONIDAE				
Diplodactylus vittatus	Wood Gecko	LC		
Hemidactylus frenatus	House Gecko	I		
SCINCIDAE				
Carlia munda	Shaded-litter Rainbow-Skink	LC		
Cryptoblepharus litoralis	Supralittoral Shinning-Skink	LC		
Cryptoblepharus virgatus	Cream-striped Shinning-Skink	LC		
Ctenotus taeniolatus	Copper-tailed Skink	LC		
COLUBRIDAE				
Dendrelaphis punctulata	Common Tree Snake	LC		
Tropidonophis mairii	Freshwater Snake	LC		
BIRDS				
PHASIANIDAE				
Coturnix ypsilophora	Brown Quail	LC		
ANATIDAE				
Chenonetta jubata	Australian Wood Duck	LC		
PODICIPEDIDAE				
Tachybaptus novaehollandiae	Australasian Grebe	LC		
ARDEIDAE				
Butorides striata	Striated Heron	LC		
Egretta intermedia	Intermediate Egret	LC		
Egretta sacra	Eastern Reef Egret	S	M	
PELECANIDAE				
Pelecanus conspicillatus	Australian Pelican	LC		
PHALACROCORACIDAE				
Phalacrocorax melanoleucos	Little Pied Cormorant	LC		
Phalacrocorax varius	Pied Cormorant	LC		
ACCIPITRIDAE				
Pandion haliaetus	Osprey	S	M	

Haliastur sphenurus	Whistling Kite	LC		
Haliastur indus	Brahminy Kite	LC		
BURHINIDAE				
Burhinus grallarius	Bush Stone-curlew	LC		X
Esacus magnirostris	Beach Stone-curlew	V		
HAEMATOPODIDAE				
Haematopus longirostris	Pied Oystercatcher	LC		
Haematopus fuliginosus	Sooty Oystercatcher	R		
CHARADRIIDAE				
Vanellus miles	Masked Lapwing	LC		
Charadrius ruficapillus	Red-capped Plover	LC		
SCOLOPACIDAE				
Numenius phaeopus	Whimbrel	S	M	
Numenius madagascariensis	Eastern Curlew	R	M	
Tringa nebularia	Common Greenshank	S	M	
Heteroscelus brevipes	Grey-tailed Tattler	S	M	
Calidris ruficollis	Red-necked Stint	S	M	
LARIDAE				
Larus novaehollandiae	Silver Gull	LC		
Sterna bergii	Crested Tern	S	M	
Sterna hirundo	Common Tern	S	M	
COLUMBIDAE				
Phaps chalcoptera	Common Bronzewing	LC		
Geopelia placida	Peaceful Dove	LC		
Geopelia humeralis	Bar-shouldered Dove	LC		
CACATUIDAE				
Calyptorhynchus banksii	Red-tailed Black-Cockatoo	LC		
PSITTACIDAE				
Trichoglossus haematodus	Rainbow Lorikeet	LC		
Platycercus adscitus	Pale-headed Rosella	LC		
CUCULIDAE				
Eudynamys orientalis	Pacific Koel	LC		
Scythrops novaehollandiae	Channel-billed Cuckoo	LC		
CENTROPODIDAE				
Centropus phasianinus	Pheasant Coucal	LC		
STRIGIDAE				
Ninox boobook	Southern Boobook	LC		
PODARGIDAE				
Podargus strigoides	Tawny Frogmouth	LC		
CAPRIMULGIDAE				
Eurostopodus mystacalis	White-throated Nightjar	LC		
APODIDAE				
Hirundapus caudacutus	White-throated Needletail	S	M	
CORACIIDAE				
Eurystomus orientalis	Dollarbird	LC		
ALCEDINIDAE				
Dacelo novaeguineae	Laughing Kookaburra	LC		
Todiramphus macleayii	Forest Kingfisher	LC		
Todiramphus chloris	Collared Kingfisher	LC		
MEROPIDAE				
Merops ornatus	Rainbow Bee-eater	S	M	
MALURIDAE				
Malurus melanocephalus	Red-backed Fairy-wren	LC		
PARDALOTIDAE				
Pardalotus striatus	Striated Pardalote	LC		
ACANTHIZIDAE				
Gerygone levigaster	Mangrove Gerygone	LC		
MELIPHAGIDAE				
Lichenostomus fasciogularis	Mangrove Honeyeater	LC		

Melthreptus albogularis	White-throated Honeyeater	LC		
Philemon corniculatus	Noisy Friarbird	LC		
PACHYCEPHALIDAE				
Colluricincla harmonica	Grey Shrike-thrush	LC		
DICRURIDAE				
Dicrurus bracteata	Spangled Drongo	LC		
Myiagra rubecula	Leaden Flycatcher	LC		
ARTAMIDAE				
Cracticus nigrogularis	Pied Butcherbird	LC		
Gymnorhina tibicen	Australian Magpie	LC		
Artamus leucorhynchus	White-breasted Woodswallow	LC		
CAMPEPHAGIDAE				
Coracina novaehollandiae	Black-faced Cuckoo-shrike	LC		
Lalage leucomela	Varied Triller	LC		
ORIOLIDAE				
Sphecotheres vieilloti	Australasian Figbird	LC		
CORVIDAE				
Corvus orru	Torresian Crow	LC		
HIRUNDINIDAE				
Hirundo neoxena	Welcome Swallow	LC		
Petrochelidon nigricans	Tree Martin	LC		
DICAEIDAE				
Dicaeum hirundinaceum	Mistletoebird	LC		
NECTARINIIDAE				
Cinnyris jugularis	Olive-backed Sunbird	LC		X
MAMMALS				
MACROPODIDAE				
Macropus giganteus	Eastern Grey Kangaroo	LC		
EQUIDAE				
Equus caballus	Horse	I		
SUIDAE				
Sus scrofa	Pig	I		

Appendix 2:
Essential Habitat Mapping



VEGETATION MANAGEMENT ACT
ESSENTIAL HABITAT MAP

Requested By: BRETT@BIODIVERSITY.TV
Date: 18 Dec 08 Time: 08.09.41

Centered on point position:
Latitude: -23.7889 Longitude: 151.2402 (decimal degrees)

2003 Remnant endangered regional ecosystem
- Dominant
- Sub-dominant

2003 Remnant of concern regional ecosystem
- Dominant
- Sub-dominant

2003 Remnant not of concern regional ecosystem

Non-remnant

Plantation Forest

Dam or Reservoir

2003 Remnant Vegetation Cover (RVC)

Vegetation Management Act Essential Habitat
Area identified as essential habitat by the EPA for a species of wildlife listed as endangered, vulnerable, near threatened or rare under the *Nature Conservation Act 1992.*

Vegetation Management Act Essential Habitat Species Records

Roads
© MapInfo Australia Pty Ltd 2006

Bioregion boundary

National Park, Conservation Area State Forest and other reserves

Cadastre line
The maximum spatial error of parcels extracted for this map from the Digital Cadastral Data Base(DCDB) range from: 14m to 251m at a 95% confidence level. Property boundaries shown are provided as a locational aid only.

Towns

Coordinate entered

Queensland Government

LOCALITY DIAGRAM

2000 0 2000 m

Horizontal Datum: Geocentric Datum of Australia 1994 (GDA94)

Labels for Vegetation Management Act Essential Habitat are centred on the area of interest (1.1km surrounding and including a Lot on Plan or 2.2km around the selected coordinates). Labels relate to the attached species list.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/-100 metres. The extent of remnant regional ecosystems as of 2003, depicted on this map is based on rectified 2003 Landsat TM imagery (supplied by SLATS, Department of Natural Reources and Water).

Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Natural Resources and Water, the Environmental Protection Agency and MapInfo Australia Pty Ltd, makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.

All datasets are updated as they become available to provide the most current information as of the date shown on this map.

Additional information is required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.nrw.qld.gov.au/vegetation or contact the Department of Natural Resources and Water.

Digital regional ecosystem data is available in shapefile format, for Lot on Plans from www.epa.qld.gov.au/REDATA or from the Queensland Herbarium for larger areas.
Email: regional.ecosystem@epa.qld.gov.au

Species Name	Family	Common Name	Secondary Sites - Relative Abundances[1]					Quaternary Sites - Relative Abundances[1]		
			S1	S2	S3	S4	S5	Q1	Q2	Q3
Acacia leiocalyx	Mimosaceae	Black Hickory Wattle	C			R	C	U	U	C
Allocasuarina torulosa	Casuarinaceae	Forest She-oak								R
Alloteropsis semialata	Poaceae	Cockatoo Grass					I			U
Alphitonia excelsa	Rhamnaceae	Red Ash	C					U	U	
Altsonia constricta	Apocynaceae	Bitter Bark		I						
Aristida queenslandica var. dissimilis	Poaceae	Queensland Wiregrass								U
Avicennia marina	Verbenaceae	Grey Mangrove		I						
Breynia oblongifolia	Euphorbiaceae	Coffee Bush	U				U		U	
Bruguiera gymnorhiza	Rhizophraceae	Orange Mangrove		I						
Bruononiella australis	Acanthaceae	Blue Trumpet	R							
Cassytha filiformis	Lauraceae	Dodder Laurel								U
Ceriops tagal	Rhizophraceae	Yellow Mangrove		U	I					
Chloris divaricata	Poaceae	Slender Chloris				I				
Chloris inflata *	Poaceae	purpletop chloris	I							
Chrysopogon fallax	Poaceae	Golden Beard Grass					I			
Corymbia citriodora subsp. citriodora	Myrtaceae	Lemon-scented Gum	U							U
Corymbia tessellaris	Myrtaceae	Moreton Bay Ash						I		
Crotalaria montana var. angustifolia	Fabaceae	Rattlepod	R			R		U		
Cryptostegia grandiflora *	Asclepiadaceae	Rubber Vine	I							
Cupaniopsis anacardioides	Sapindaceae	Tuckeroo		I						
Cyanthillium cinereum	Asteraceae		O						U	
Cymbopogon refractus	Poaceae	Barbwire Grass	C					C		U
Cyperus gracilis	Cyperaceae	Graceful Sedge	U							
Desmodium heterocarpon var. strigosum	Fabaceae					R				
Dianella brevipeductulata	Phomeriaceae		R							
Dodonaea lanceolata var. subsessilifolia	Sapindaceae	Native Hop Bush	O							
Emilia sonchifolia var. sonchifolia *	Asteraceae	Emilia	I			C	C			
Enchylaena tomentosa	Chenopodiaceae	Ruby Saltbush			I		I			
Enneapogon robustissimus	Poaceae		I							
Epaltes australis	Asteraceae						R			
Eragrostis brownii	Poaceae	Brown's Lovegrass	O			U		U		U
Eremophila debilis	Myoporaceae	Winter Apple	I							

			S1	S2	S3	S4	S5	Q1	Q2	Q3
Eucalyptus crebra	Myrtaceae	Narrow-leaved Ironbark	U			I	U	U	U	
Eucalyptus exserta	Myrtaceae	Queensland Peppermint	I				I	I	I	
Eucalyptus tereticornis	Myrtaceae	Forest Red Gum				U	U	U	U	
Eustrephus latifolius	Smilacaceae	Wombat Berry	U						U	
Evolvulus alsinoides	Convolvulaceae	Blue periwinkle	I							
Fimbristylis polytrichoides	Cyperaceae				I					
Gahnia aspera	Cyperaceae	Sawsedge	R							
Glycine tabacina	Fabaceae	Glycine Pea	U							U
Gomphocarpus physocarpus *	Asclepiadaceae	Balloon Cotton Bush				I				
Gomphrena celosioides	Amaranthaceae	Gomphrena Weed					I			
Heteropogon contortus	Poaceae	Giant Speargrass	U				A	C	A	
Hibiscus divaricatus	Malvaceae		R							
Imperata cylindrica	Poaceae	Blady Grass				C				
Indigofera hirsuta	Fabaceae	Hairy Indigo				I	R			
Jasminum simplicifolium subsp. australiense	Oleaceae	Native Jasmine	I							
Lantana camara *	Verbenaceae	Lantana						I		
Leptochloa decipiens subsp. decipiens	Poaceae	slender cane grass	C							
Leptochloa digitata	Poaceae	umbrella cane grass				C	C			
Lomandra multiflora	Xanthorrhoeaceae	Many-flowered Mat Rush	R							
Lophostemon suaveolens	Myrtaceae	Swamp Box	I			U		U	I	I
Ludwigia octovalvis	Onagraceae	Willow Primrose				U				
Melaleuca quinquenervia	Myrtaceae	Paper Tea-tree				I	I			
Murdannia graminea	Commelinaceae	Slug Herb				R	R			
Myoporum acuminatum	Myoporaceae	Coastal Boobialla		I						
Opuntia stricta *	Cactaceae	Common Prickly Pear	R							
Oxalis corniculata var. corniculata *	Oxalidaceae	Creeping Oxalis					R			
Paspalidium distans	Poaceae					I				
Passiflora suberosa *	Passifloraceae	Corky Passion Flower	R							
Phyllanthus virgatus	Euphorbiaceae		U							
Planchonia careya	Lecythidaceae	Cocky Apple	I			U		U		
Pogonolobus reticulatus	Rubiaceae	Medicine Bush	U				U		U	
Pseuderanthemum variabile	Acanthaceae					R				
Pterocaulon sphacelatum	Asteraceae					I				
Rhizophora stylosa	Rhizophraceae	Spotted Mangrove		A						
Rhynchosia minima	Fabaceae	Rhynchosia	R							

			S1	S2	S3	S4	S5	Q1	Q2	Q3
Sarcocornia quinqueflora	Chenopodiaceae	Bead Weed			I					
Scleria brownii	Cyperaceae		I							U
Sida hackettiana	Malvaceae		C			U				
Sida rhombifolia *	Malvaceae	Common Flannel Weed	U			O				
Sporobolus virginicus	Poaceae	Saltwater Couch			I					
Themeda triandra	Poaceae	Kangaroo Grass					R			
Vitex trifolia var. trifolia	Lamiaceae	Coastal Vitex		I						
Xanthorrhoea johnsonii	Xanthorrhoeaceae	Grass Tree								R

Key:

[1] Relative abundances: A – Abundant (>100 plants per transect); C – Common (50-100 plants); O – Occasional (20-49 plants);

U – Uncommon 5 – 20 plants; R – Rare (<5 plants); I – Incidental (recorded outside transect but within same RE).

* - denotes exotic species

***Sporobolus virginicus* grassland on marine clay plains (RE 12.1.2)**

Description: This Regional Ecosystem was identified at the east of the DMPF within the intertidal zone. This RE is generally found in close proximity to high water mark and was often devoid of vegetation. Where vegetation was present species included *Sporobolus virginicus* (saltwater couch), *Enchylaena tomentosa* (ruby saltbush) and *Sarcocornia quinqueflora* (bead weed).

Secondary Transect 3 **Curtis Island 15/04/09**	
Vegetation Community	Saltpan
R.E.	12.1.2
Transect Start	151.186625; -23.755802
Transect End (50m)	n/a
Bearing	0
Aspect	-
Slope	0°
Soil	Grey/brown. Fine grained marine sediments with small metamorphic rocks.
Weeds	-
Notes	-
Strata	**Dominant Species**
Ground (G): <1 m	*Enchylaena tomentosa*
FPC: 0%	*Sarcocornia quinqueflora*
Litter: 1%	*Fimbristylis polytrichoides*
Bare: 99%	*Sporobolus virginicus*

Mangrove shrubland to low closed forest on Quaternary estuarine deposits (RE 12.1.3)

Description: The mangrove communities lie adjacent to RE 12.1.2 in the far western section of the DMPF in the intertidal zone associated with Gladstone Harbour. This RE is characterised by a dense low canopy cover dominated by *Rhizophora stylosa* (spotted mangrove), *Avicennia marina* (grey mangrove) and *Ceriops tagal* (yellow mangrove) with the absence of any ground layer.

Secondary Transect 2 **Curtis Island 15/04/08**	
Vegetation Community	Mangroves
R.E	12.1.3
Transect Start	151.18431; -23.756437
Transect End (50m)	n/a
Bearing	-
Aspect	-

Secondary Transect 2 Curtis Island 15/04/08	
Slope	0°
Soil	Grey/brown marine sediments and sub-angular rocks
Weeds	-
Notes	-
Strata	Dominant Species
Shrub (S1): 2-3 m	*Avicennia marina*
FPC: 80%	*Ceriops tagal*
	Rhizophora stylosa
Ground (G):	No groundcover species present
FPC: 0%	
Litter: 10%	
Bare: 90%	

Eucalyptus tereticornis open forest to woodland on Cainozoic alluvial plains (R.E. 12.3.3)

Description: This vegetation community occurs on the alluvial plains present at the south and east of the DMPF site. The RE is characterised by *Eucalyptus tereticornis* (forest red gum) as the dominant canopy species with a mid-storey primarily comprised of *Lophostemon suaveolens* (swamp box). The shrub layer is relatively dense and supports *Acacia leiocalyx* (black wattle), *Planchonia careya* (cocky apple), *Pogonolobus reticulatus* (medicine bush) and *Sida hackettiana.* The ground cover is dominated by native grass and herb species including *Eragrostis brownii* (Brown's lovegrass), and *Heteropogon contortus* (giant speargrass).

Secondary Transect 4 Curtis Island 15/04/09	
Vegetation Community	*E. tereticornis* grassy woodland on alluvium
R.E	12.3.3
Transect Start	151.189041; -23.755146
Transect End (50m)	151.188814; -23.755505
Bearing	SW
Aspect	-
Slope	Flat
Soil	Grey/ brown fine-grained alluvium with small pebbles.
Weeds	-
Notes	Melaleuca quinquenervia fringes this community on the mud-flat side.
Strata	Dominant Species

Secondary Transect 4 **Curtis Island 15/04/09**	
Canopy (T1): 14-18 m	*Eucalyptus tereticornis*
FPC: 16%	
Mid-Storey (T2): 6-8 m	*Lophostemon suaveolens*
	Eucalyptus tereticornis
Shrub (S1): 1-2 m	*Planchonia careya*
FPC: 5%	*Sida hackettiana*
Ground (G): <1 m	*Eragrostis brownii*
FPC: 44%	*Heteropogon contortus*
Litter: 45%	*Imperata cylindrica*
Bare: 11%	*Leptochloa digitata*

Corymbia citriodora, Eucalyptus crebra open forest on metamorphics ± interbedded volcanics (RE 12.11.6)

Description: This RE was recorded at the far south and east of the DMPF site where it occurs on the rocky slopes of the surrounding hills. This RE is characterised by the dominance of *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum) and *E. crebra* (narrow-leaved ironbark) in the canopy. Shrub layer species include *Alphitonia excelsa* (red ash), *Acacia leiocalyx* (black wattle) and *Sida hackettiana*. Ground cover species include *Cymbopogon refractus* (barbwire grass) and *Leptochloa decipiens* (slender cane grass).

Structural and floristic descriptions of the dominant species in each strata surveyed within this RE are described in the table below.

Secondary Transect 1 **Curtis Island 15/04/09**	
Vegetation Community	*C. citriodora* and *E. crebra* woodland on metamorphics
R.E.	12.11.6
Transect Start	151.185507; -23.757019
Transect End (50m)	151.185393; -23.757308
Bearing	SW
Aspect	NW
Slope	12°
Soil	Dark brown; fine clay with small metamorphic rocks.
Weeds	
Notes	On slope of hill- Entire hill is RE 12.11.6
Strata	**Dominant Species**

Secondary Transect 1 **Curtis Island 15/04/09**	
Canopy (T1): 12-16 m	*Corymbia citriodora subsp. citriodora*
FPC: 25%	*Eucalyptus crebra*
	Eucalyptus exserta
Mid-Storey (T2): 6-10 m	*Eucalyptus crebra*
	Corymbia citriodora subsp. citriodora
Shrub (S1): 1-4 m	*Acacia leiocalyx*
FPC: 40%	*Alphitonia excelsa*
	Pogonolobus reticulatus
	Sida hackettiana
Ground (G): <1 m	*Cyanthillium cinereum*
FPC: 46%	*Cymbopogon refractus*
Litter: 54%	*Heteropogon contortus*
Bare: 0%	*Leptochloa decipiens*

***Eucalyptus crebra, E. tereticornis* grassy woodland on metamorphosed sediments and interbedded volcanics (RE 12.11.14)**

Description: This RE is present across the lower slopes at the north of the DMPF site and is characterised by a canopy of *Eucalyptus tereticornis* (forest red gum) and *E. crebra* (narrow-leaved ironbark). The shrub layer is dominated by *Pogonolobus reticulatus* (medicine bush), *Planchonia careya* (cocky apple) and *Acacia leiocalyx* (black wattle). Ground cover species include *Cymbopogon refractus* (barbwire grass) and *Leptochloa decipiens* (slender cane grass).

Structural and floristic descriptions of the dominant species in each strata surveyed within this RE are described in the table below.

Secondary Transect 5 **Curtis Island 15/04/09**	
Vegetation Community	*E. tereticornis* & *E. crebra* open woodland on metamorphics
R.E.	12.11.14
Transect Start	151.188355; -23.750094
Transect End (50m)	151.188654; -23.749966
Bearing	S
Aspect	-
Slope	flat
Soil	Dark brown; fine clay with small metamorphic rocks.
Weeds	
Notes	

Secondary Transect 5 Curtis Island 15/04/09	
Strata	**Dominant Species**
Canopy (T1): 8-14 m	*Eucalyptus crebra*
FPC: 17%	*Eucalyptus tereticornis*
Mid-Storey (T2): 6-8 m	*Eucalyptus crebra*
	Eucalyptus tereticornis
	Eucalyptus exserta
Shrub (S1):1-3 m	*Acacia leiocalyx*
FPC: 25%	*Breynia oblongifolia*
	Pogonolobus reticulatus
Ground (G):<1 m	*Cymbopogon refractus*
FPC: 67%	*Emilia sonchifolia var. sonchifolia* *
Litter: 32%	*Heteropogon contortus*
Bare: 1%	*Leptochloa decipiens*

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

DEPARTMENTAL ADVICE

Development of a LNG Plant and Ancillary Onshore and Marine Facilities on Curtis Island

EPBC 2009/4977

February 2011

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Definitions and abbreviations used in this advice

CG	Queensland Co-ordinator General
CSG	Coal seam gas
Department	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EHMS	Environmental Health Management Systems
EIS	Environmental Impact Statement (including supplementary information, unless indicated otherwise)
EMP	Environmental Management Plan
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
APLNG Project	Australia Pacific LNG Project
LNG	Liquefied Natural Gas (Natural gas that has been cooled to minus 161°C, the point at which methane gas condenses into a liquid. When natural gas is cooled into liquid form, its volume is reduced to 1/600 of its original size. This is equivalent to a 43cm beach ball being reduced to the size of a ping pong ball. This liquefaction process allows gas to be shipped to markets throughout the world.)
MNES	Matters of national environmental significance, protected under Part 3 of the EPBC Act.
Proponent	Australia Pacific LNG Pty Limited
Referral	The referral from Australia Pacific LNG Pty Limited (APLNG) for the Development of a LNG Plant and Ancillary Onshore and Marine Facilities on Curtis Island (unless otherwise indicated).
SI	Supplementary Information (published electronically by APLNG in mid August 2010)

DEPARTMENTAL ADVICE

Development of a LNG Plant and Ancillary Onshore and Marine Facilities on Curtis Island

EPBC 2009/4977

Overview

The proposal concerns the development, construction, operation of and decommissioning of a multi-train liquefied natural gas (LNG) processing facility (the LNG Facility) and associated onshore facilities within the Curtis Island Industry Precinct of the Gladstone State Development Area, as described in the referral received from the proponent under the *Environment Protection and Biodiversity Conservation Act 1999* ('the EPBC Act') on 6 July 2009 ('the referral').

The location of the proposed facility is shown in Figure 1 below. In the referral Australia Pacific LNG Pty Limited (APLNG) stated that the LNG plant would be developed in stages up to an ultimate production capacity of around 16 million tonnes per annum (mtpa), and nominally comprising three to four LNG 'trains'. (An LNG train is a packaged assemblage of liquefaction and purification equipment available in a range of reasonably standard sizes. Most LNG plants consist of several such trains.) During the assessment process the planned capacity was revised and is now expected to be up to 18Mtpa.

If approved the Project would have an expected life of at least 30 years.

The proponent for the referred action is Australia Pacific LNG Pty Limited (ABN 68 001 646 331). Origin and ConocoPhillips are joint owners of Australia Pacific LNG. The APLNG project is a 50:50 joint venture to produce export quality LNG from coal seam gas (CSG).

The proposal is one of three components of the overall APLNG project. The other components of the Project are the expansion of APLNG's coal seam gas (CSG) fields in the Surat Basin, to provide gas for the LNG Plant (2009/4974); and the construction and operation of a high pressure gas transmission pipeline(s) of approximately 447 km in length to link the APLNG gas fields to the LNG Plant (2009/4976). Referrals for these three actions were received on 6 July 2009 and each determined to be controlled actions that required formal assessment on 3 August 2009.

The proposal concerning the development, construction, operation of and decommissioning of the LNG Facility and associated onshore facilities (2009/4977) was determined to be a controlled action because of its likely significant impacts on listed threatened species and communities; listed migratory species; National Heritage places; and World Heritage properties (the 'controlling provisions') which are each protected under the EPBC Act. As such, the proposal has been assessed for its impacts on those controlling provisions. Under the EPBC Act, the Minister must decide whether or not to approve the action for each controlling provision.

A correction notice was published on 17 May 2010 clarifying that the designated proponent was not Australia Pacific LNG limited as stated in earlier EPBC Act notices but rather Australia Pacific LNG Pty Limited.

The proposal has been assessed under the bilateral agreement with Queensland, with a single Queensland assessment process at EIS level covering all components of the Project. The Project has been the subject of a report by the Queensland Coordinator-General (CG), provided to the Commonwealth on 9 November 2010. The report of the CG is the assessment report in terms of Section 47(4) of the EPBC Act.

The Coordinator-General declared the Australia Pacific LNG Project to be a 'significant project for which an Environmental Impact Statement (EIS) is required' under the *State Development Public Works Organisation Act 1971* (SDPWO Act) on 9 April 2009.

On 29 March 2010 the Project's EIS was released for public comment for a period of five weeks, closing 4 May 2010.

A total of 36 submissions were received, 18 submissions from advisory agencies, 5 from members of the public and 13 from non-government organisations.

The issues raised were essentially the same as those raised in comments on the similar Santos and QGC CSG/LNG proposals. Principal amongst these were concerns about associated water and groundwater management (risk to security and quality of existing Great Artesian Basin (GAB) supplies), social impacts (mainly housing and workforce related), hazard and risk associated with LNG production, storage and shipping, and cumulative impacts of the proposed LNG industry expansion in the CSG fields and Gladstone areas.

Following a review of submissions received on the EIS, the CG decided that no formal supplementary EIS with public review was necessary but that supplementary information on some matters should be provided by APLNG and made publicly available. On 19 July 2010 the CG requested that APLNG undertake supplementary work in accordance with section 35(2) of the SDPWO Act to assist in his evaluation of the EIS. This work was completed in mid August 2010 and the results of studies undertaken made available on the APLNG website. http://www.aplng.com.au/ Meetings with a range of stakeholders, including Queensland government agencies and DSEWPAC, were also held.

This additional material included:

- Advice on project changes since the EIS was lodged
- Additional assessment work and studies completed since the EIS was lodged
- Response to issues raised in the EIS submissions
- Briefings of key advisory agencies on the above matters

Since the publication of the EIS further refinements have been made to the proposed LNG plant and associated facilities in terms of layout and operation. These have reduced the likely area of disturbance and potential environmental impacts, and improved the risk profile of the proposed facilities.

A summary of changes relevant to potential impacts on matters protected by the EPBC Act are discussed below (paragraph 21). This Departmental Advice is based on the APLNG LNG Facility and associated onshore facilities as currently envisaged (December 2010).

The report of the CG on the APLNG project is the assessment report in terms of Section 47(4) of the EPBC Act, and its provision to the Minister on 9 November 2010 iniated the approval consideration process under Part 9 of the EPBC Act. On 16 December 2010 the Minister extended the time in which to make a decision to approve a controlled action under Section 130 (1A) of the EPBC Act for each of the referred actions that constitute the APLNG project until 22 February 2011.

A summary of the report of the Coordinator General is at http://www.dip.qld.gov.au/resources/project/aplng/coordinator-generals-report-executive-summary.pdf

In brief the Coordinator General made the following findings (report of the Coordinator General, Section 10.3.5, Page 187).

> **LNG Facility** (listed threatened communities)
> The EIS assessed that EPBC-listed threatened communities are not present on the Curtis Island project site and that development of the proposed LNG facility will not impact upon any threatened communities. The Coordinator-General concurs with this assessment.
>
> **Migratory Marine**
> Relatively minor impacts on migratory marine species may occur on a temporary basis during the construction period caused by dredging and underwater noise sources; however, long-term impacts are predicted to be minimal. A condition is imposed (Appendix 1, Part 1, Condition 7) that requires a Significant Species Management Plan to be prepared for all listed migratory species potentially impacted by the project. Where impacts on species cannot be avoided, a condition is imposed (Appendix 1, Part 1, Condition 5) to ensure appropriate offsets are implemented.
>
> **World and National Heritage**
> It is noted that all the LNG proponents, including APLNG, are contractually obliged to contribute to rehabilitation and management of the (approximately) 4500-hectare Environmental Management Precinct of the Gladstone State Development Area on Curtis Island, which has a similar status to a protected area. It is considered that this requirement could form the basis for any offset required under the EPBC Act.
>
> **Conclusions**
> Conditions have been set to further manage impacts to threatened species, ecological communities, natural and heritage features, transport impacts, safety and risk and social impacts through management strategies, regulatory conditions and monitoring and reporting requirements. It is considered that, on balance, there are strong positive net advantages to be derived from the project that will benefit the state of Queensland.

Shipping
The Coordinator-General is satisfied that harbour management by the Gladstone Ports Corporation and the LNG shipping provisions of Maritime Services Queensland, through the Regional Harbour Master, will be sufficient to manage the transit of LNG ships through Gladstone harbour in a safe manner.

Offsets
APLNG has not provided sufficient detail in its draft offsets program for it to be approved within this report. Environmental offsets must be secured by the proponent in a manner that achieves a 'no net loss' of biodiversity outcomes. An environmental offsets program, consistent with QGEOP must be provided to the Coordinator-General for approval. Relevant conditions to this effect are included in Appendix 1, Part 1, Condition 5 of the report of the Coordinator-General.

Recommendations

This advice recommends that the impacts of the proposal are not unacceptable, having regard to the proposed conditions, mitigation measures and offsets, and therefore should be approved, for the following controlling provisions under the EPBC Act:

Controlling Provisions for the action	Recommendation	
	Approve	Refuse to Approve
World Heritage properties (ss 12, 15A)	Approve	
National Heritage places (ss 15B, 15C)	Approve	
Listed threatened species and communities (ss 18, 18A)	Approve	
Listed migratory species (ss 20, 20A)	Approve	

The Department considers that the proposal will not have unacceptable impacts, subject to compliance with the proposed conditions. A table summarising potential impacts on matters protected by the EPBC Act and conclusions on the acceptability of likely impacts is provided at Attachment E1.

Background

The proposed action

1. APLNG ('the proponent') is proposing to locate the LNG Facility in the south-west section of Curtis Island. The facility would liquefy coal seam gas (CSG) to enable it to be transferred to ships for export. The proposed facility would have four liquefaction trains, each rated at approximately 4.5million tonnes per annum (Mtpa). The liquefaction plant would include equipment that removes impurities from the incoming natural gas, refrigerates the clean gas, and ultimately turns it into LNG so that it can be more readily stored and transported. Four LNG storage tanks are proposed to be built, each with a 160,000 m^3 capacity. The storage tanks would be fitted with internal pumps, and with all LNG and vapour connections going through the roof (dome) of the tank. LNG tanks are specially engineered and constructed double-walled storage tanks. They have exterior concrete walls that are over 1 metre thick. An inner tank is made of a special steel/nickel alloy to accommodate the very cold LNG. The space between the walls is filled with insulation to maintain a cold environment for the LNG. The tanks are not pressurised.

2. Development of the LNG Facility is proposed to occur in stages, initially comprising two LNG trains (increasing to four), with each train requiring approximately 250-270 petajoules of gas from the CSG fields per annum to produce approximately 4.5 Mtpa of LNG. The planned completed overall facility would have a total capacity of approximately 18 Mtpa of LNG. Initial production of LNG is planned for late 2014 with completion of train 1, with production from train 2 expected by mid 2015 and production from trains 3 and 4 dependant on the LNG market and gas field development but likely around 2017/2018. The EIS addresses in general terms the impacts expected from the 18 Mtpa proposal. The LNG facility is planned to operate 24 hours per day, seven days a week.

3. In the EIS APLNG stated that because of the low heating value of CSG, 'spiking' of the LNG product may be required for some potential markets. Liquefied Petroleum Gas (LPG) (liquefied propane and/or butane) would be unloaded from ships and stored in one full containment tank to supply LPG for this purpose. Since the EIS was published APLNG has indicated that 'spiking' with LPG is no longer likely.

4. APLNG intend that the LNG facility will use Conoco-Phillips' proprietary Optimized Cascade technology to convert the incoming natural gas to LNG. This technology has been utilised at the Darwin LNG facility since 2006 and is the process proposed to be used by most other LNG proposals in Queensland.

5. The proposed LNG facility would include two jetties for loading LNG ships (and unloading LPG ships if required). Submersible pumps located within the LNG storage tanks would pump LNG from the tanks to the jetty head loading platform, where pipelines and high pressure hosing in articulated metal loading arms would transfer the LNG to specialised LNG transport vessels. The jetty platform at each berth is proposed to be a two-level structure consisting of a lower main deck and an elevated mezzanine deck. Loading arms would be supported by the lower deck, curbed to contain potential LNG spills and sloped

to drain for LNG containment. A trestle structure is proposed to connect to the shoreline and on-shore tanks.

6. A materials offloading facility (MOF) is proposed for the following functions:

- Offload of modules for LNG trains;
- Offload of general construction materials from barges; and
- Embarkation point for personnel travelling to and from the Project site by ferry.

7. A ramp would be the first element to be constructed, to allow initial access to the island and simultaneous operations of the ramp with the construction of the wharf. This would be followed by the construction of a temporary “rock dock” constructed near the MOF to allow the offloading of equipment and materials (bulk aggregate and waste) for the construction of the main facility. When completed the MOF would be capable of handling approximately 2,500 tonne loads and crane access. Roll-on/roll-off ramps to unload heavy equipment, modules and materials would be provided for construction of all LNG trains.

8. The LNG tankers proposed to be used will likely be between 260 and 290 m in length with a carrying capacity of 145,000 to 170,000 m^3 with a draught of 11.5 m. They would be double hulled. In the future LNG tankers with a capacity of up to 215,000 m3 (“Q-Flex” vessels) may also be utilised. These vessels have a draught of 12 m with a length of 315 m, and are the largest LNG tankers currently trading in the Asia Pacific market. Even larger LNG tankers (“Q-Max”) are currently under consideration by shipping companies. At a 16 Mtpa nominal average production rate LNG vessels would arrive every two to three days for loading and export, 120 to 180 large vessel visits per year. Turnaround time for vessels is expected to be approximately 24 hours, with a product loading taking approximately 14 hours.

9. The Project would require the following ferry or barge journeys within the Port of Gladstone:

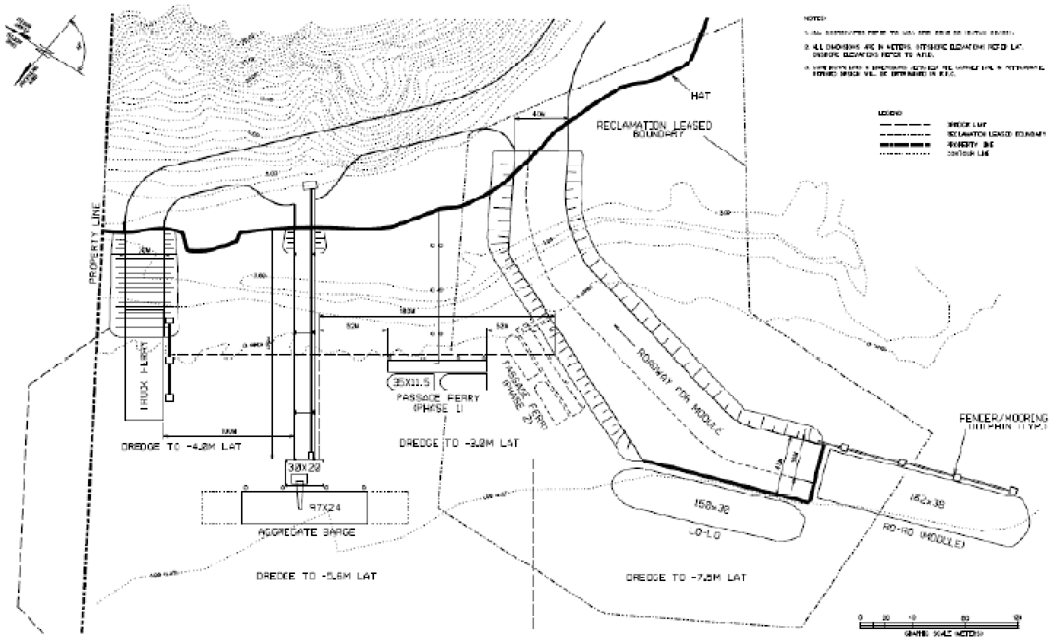
- Approximately 140 one-way ferry journeys per month during the peak construction period (Fishermans Landing to Curtis Island);
- Approximately 70 barge journeys (direct to the materials offloading facility) per month at the peak construction period;
- Additional ferry journeys from Fishermans Landing to Curtis Island, for transport of consumables and equipment and for waste removal from site.

10. Dredging will be required to enable vessels to access the APLNG terminal facilities and MOF. This dredging work will be undertaken by Gladstone Port Corporation (GPC) as part of the recently approved Western Basin Dredging and Disposal Project (WBDDP). This project accommodates the long-term dredging and dredged material disposal required to provide safe and efficient access to the existing and proposed Gladstone Western Basin (Port Curtis, from Auckland Point to The Narrows) development areas. The WBDDP comprises dredging associated with the deepening and widening of existing channels and swing basins and the creation of new channels, swing basins, berth pockets and approaches for MOFs. It is proposed that dredged material will in part be placed into reclamation areas north of Fisherman's Landing to create a land reserve to be used to service new port facilities. The WBDDP has been examined and approved with conditions under the EPBC Act, and under Queensland legislation.

11. In addition to the significant capital dredging program required to provide shipping access to the several proposed LNG facilities planned to be located on Curtis Island, which is to be undertaken by GPC, APLNG also proposes to improve shipping access to shoreline facilities, including the MOF, by undertaking a relatively small amount of dredging. The initial estimated volume of spoil for this inshore dredging activity was expected to be approximately 900,000 m^3, planned to be used in part, to reclaim some tidal and low-lying areas on the APLNG site. Changes to the planned LNG facility layout have resulted in a reduction in the expected dredging volume to approximately 500,000 m^3. Since the publication of the EIS the area planned for reclamation on Curtis Island has been reduced and it is planned that most of the spoil would now be used at the already existing Fisherman's Landing reclamation area on the mainland, if the proposed LNG plant project is approved and timing of the proposed dredging allows this.

12. As noted above, to facilitate the early transfer of materials, equipment and personnel to/from the site for construction and operational purposes, a temporary rock dock, a roll-on roll-off dock and a construction ferry dock would be required. These marine facilities would be located to the north of the planned MOF with access from Fisherman's Landing to the Laird Pt site along a route around the north of North Passage Island. As a result, additional dredging to that described and assessed in the Gladstone Ports Corporation's (GPC) Western Basin Dredging and Disposal Project's EIS would be required. The Figure below shows the proposed marine facilities on Curtis Island.

Marine facilities



13. Australia Pacific LNG has undertaken coastal sediment modelling to identify the potential impacts from dredging plumes likely to result from these dredging activities. Results indicate that Total Suspended Solids (TSS) concentrations associated with the dredging for the rock dock, roll-on roll-off dock, construction ferry dock and MOF are not significant. Predicted TSS concentrations are characterised by elevated levels on the eastern side of The Narrows' main channel for short durations at low tide. Statistical analysis of the modelled results was undertaken for selected locations at dredging locations and within sensitive seagrass areas. This analysis indicated that the 90th percentile TSS concentrations associated with this dredging would not exceed levels of normal background concentrations. This suggests that seagrasses would not be adversely affected. Australia Pacific LNG has undertaken to develop mitigation measures in consultation with GPC to minimise potential impacts during dredging operations. To ensure that dredging is undertaken in a way that minimises potential impacts on the environmental values of the GBRWHA the Department recommends that the proponent be required to develop and implement a Dredging and Construction Management Plan.

14. The Department is of the view that as far as possible all significant dredging activities should be undertaken by GPC either as part of the Western Basin Dredging and Disposal Project, or in a manner that is in accord with this proposal, particularly as regards timing. The objective is to minimise impacts as far as possible on sea grass beds and other natural assets that might otherwise occur with multiple dredging activities underway at the same time in the same area. Therefore additional dredging by APLNG should be restricted to that which is necessary to enable building and operating of a construction dock and/ or rock dock.

15. Facilities on the mainland are proposed to be established to provide for barge and ferry transport of materials and personnel as well as mainland material staging and stockpiling, labour sourcing, training, and would likely include buildings including offices and warehousing. The mainland ferry terminal would accommodate personnel and roll-on/off barges as well as facilities for loading barges with construction materials such as sand, gravel, and rock. Mainland facilities would also provide space for car parking and overnight bus and truck parking. Different facilities may be used during the initial construction stage from those that might be used during operations. The mainland servicing facilities are planned to be in an already established area such as on Fisherman's Landing, not a greenfield site.

16. APLNG is proposing to house the bulk of its construction workforce in a temporary worker accommodation facility (TWAF) at the north east corner of the site. The LNG plant and TWAF would require standard infrastructure services including power, water, telecommunications and sewage disposal. Power is proposed to be provided by gas turbine generators, water by a reverse osmosis (desalination) plant (RO plant), and waste disposal through a sewage treatment plant, all located on the APLNG site. The sewage and RO plants would incorporate outfalls to Port Curtis.

17. A peak construction workforce of between 3,000 and 4,000 could be required on-site during the proposed concurrent construction of the first two LNG trains, depending on the construction methodology employed. Increased modularisation to manage the anticipated over-demand of available domestic construction labour might result in reduced peak numbers. The workforce would be accommodated in the TWAF and local housing on the mainland. A workforce of approximately 100 is estimated to be required to operate the first train of the LNG plant, with approximately 75 additional people required for each additional train. The 18Mtpa LNG plant would require an operational workforce of approximately 325.

18. It is likely that in the longer term water supply and sewage disposal requirements will be met by infrastructure links to the mainland. Arising from approval conditions placed on the Gladstone Liquefied Natural Gas (GLNG) and Queensland Curtis LNG (QCLNG) proposals by the Queensland government, there is a requirement to investigate the opportunity for synergies and improved environmental outcomes in the provision of utilities, in particular, the provision of shared water and sewerage infrastructure as an alternative to each facility having its own RO and sewage treatment plants.

19. The Gladstone and Area Water Board (GAWB) and Gladstone Regional Council (GRC) have submitted a proposal to the Queensland Government, and parallel referral under the EPBC Act, for a project that would provide a potable water pipeline from the RG Tanna Coal Terminal on the mainland to the south west of Curtis Island, and a sewer pressure main to convey flows from the island to the mainland for treatment. These pipelines would facilitate the provision of water and sewage services to the proposed LNG plants on Curtis Island. This proposal may have environmental benefit if the Gladstone Sewage Treatment Plant (STP) and any associated outfall discharge can achieve high water quality objectives through scale advantages, or if the treated waste is recycled or disposed of on land, and RO brine discharge is avoided. At the time of writing (January 2011) the proposed project that would facilitate mainland sewage disposal and clean water supply was under examination under the EPBC Act.

20. APLNG has advised that they will utilise the proposed mainland linked water and sewage services if they area available, and the proposed LNG plant is approved. However, the timing of the proposed mainland water supply and sewage disposal project, even if it were to go ahead, is such that the early construction stages of the APLNG plant, if approved, would be likely to require an RO plant and packaged sewage treatment plant and associated outfalls, as described in the EIS, and as also proposed by Santos and QGC for their LNG facilities. The period the APLNG RO and sewage treatment plants would likely be in operation is therefore uncertain at this stage.

21. The APLNG EIS states that the site for the LNG facility will cover approximately 270 ha, which includes a reclamation area of approximately 39ha needed for LNG facility infrastructure. (About 24ha for the LNG plant, 15ha for marine loading facilities). Vegetation clearance would be limited to areas required for the placement of facility infrastructure. It is expected that approximately 60% of the existing natural vegetation on the project site would be cleared with the remainder being retained. APLNG has designed the facility layout to reduce disturbance of the coastal fringing vegetation (particularly mangroves). Vegetated areas that are not cleared during construction would be retained and managed. Cleared areas required around the facility and equipment will be stabilised and maintained. Where practical, areas cleared during construction not needed for operation would be landscaped. Figure 1 shows the footprint of the proposed facility. Figure 2 provides an aerial view of the completed LNG plant and associated facilities as it would appear from the west.

22. As noted in the CG report, the current layout is a refinement of that presented in the EPBC referral, published EIS and the supplementary information. The main planned changes are:

- Material Offloading Facility (MOF) – this has been realigned to improve safety and navigation for marine access. It has also been reduced in size, resulting in a smaller reclaimed seabed area and now includes an operational ferry terminal;
- Ground flares - the design of the flare system has been modified from two wet/dry ground flares with a stack marine flare, to a five ground flare system that includes wet/dry and marine flaring. Three of the five ground flares would be constructed during the development of trains 1 and 2, with one of three being a spare. At ultimate development, two additional flares would be incorporated into the flare system. The spare unit would allow maintenance

to occur on the flares without impacting on the operation of the plant, increasing plant availability. The revised configuration performs the same role as described in the APLNG Project EIS, but allows splitting of the flare to multiple smaller units to increase efficiency. The optimised configuration (five ground flare system and the inclusion of the marine flare) has reduced visual impacts to sensitive receptors. It has also reduced heat turbulence at altitude, which reduces potential impacts to aviation safety;

- LNG storage tanks - the revised location of the LNG storage tanks to the south west area within the LNG facility site is intended to decrease the generation of boil-off gas during loading operations and reduce construction effort. The latter objective would be achieved due to improved foundation suitability and the shorter loading line to the loading berths from the storage tanks;
- Stormwater and discharges - stormwater management improvements and revised discharge point locations have been incorporated into the planned LNG facility layout;
- Acid gas incinerators - acid gas incinerators have been included on the acid gas removal units to allow for any changes in sulphur content of CSG through the life of the project. APLNG has undertaken additional air dispersion modelling associated with emissions from the acid gas incinerators. This modelling indicates that air quality objectives for sulphur dioxide would be met for normal and non-normal operation of the LNG facility (inclusive of background levels) at sensitive receptors; and
- Utility infrastructure has been revised as LNG facility design progresses.

ATTACHMENT E

Figure 1 - Proposed location of APLNG LNG Plant components on Curtis Island

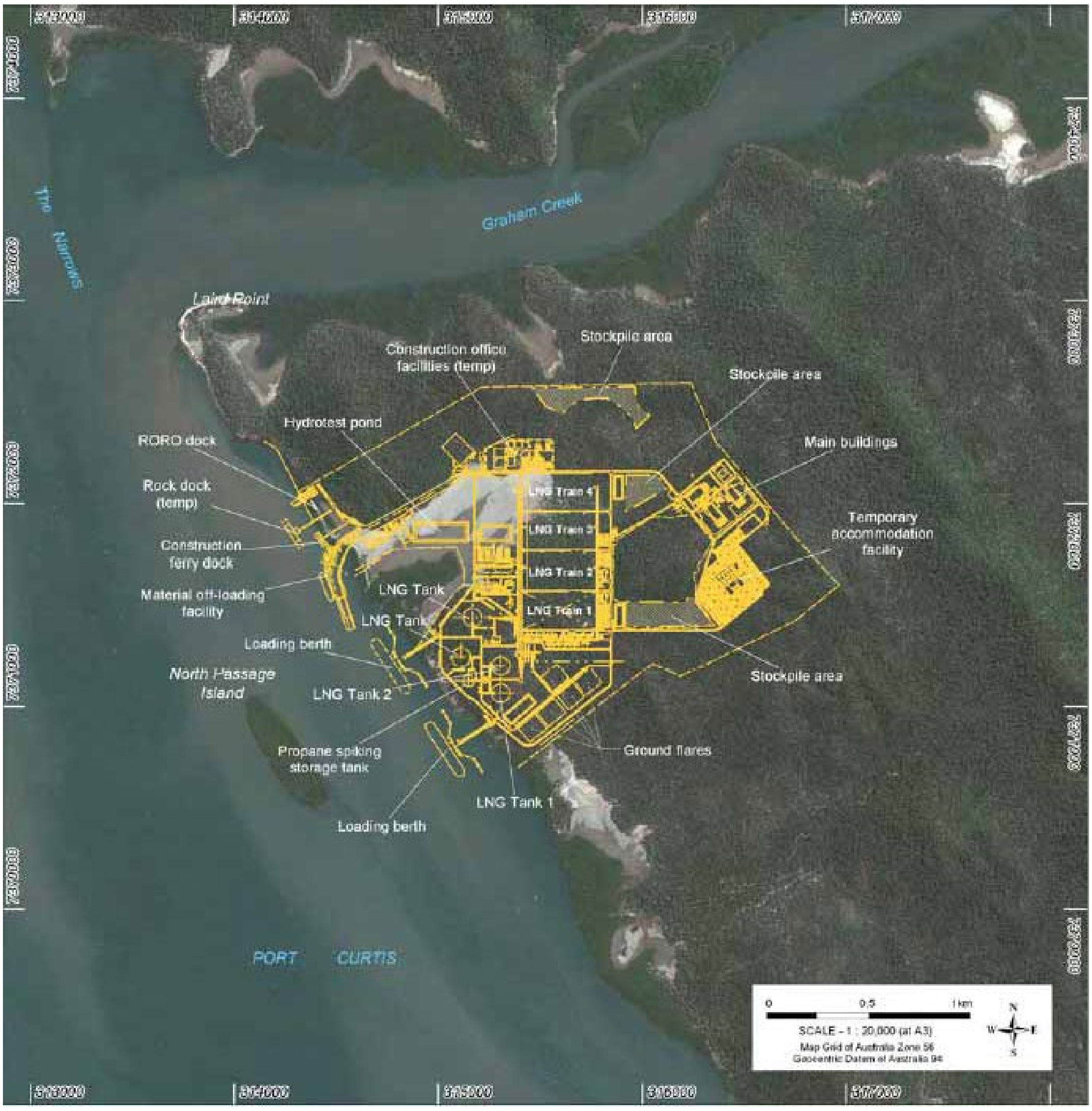
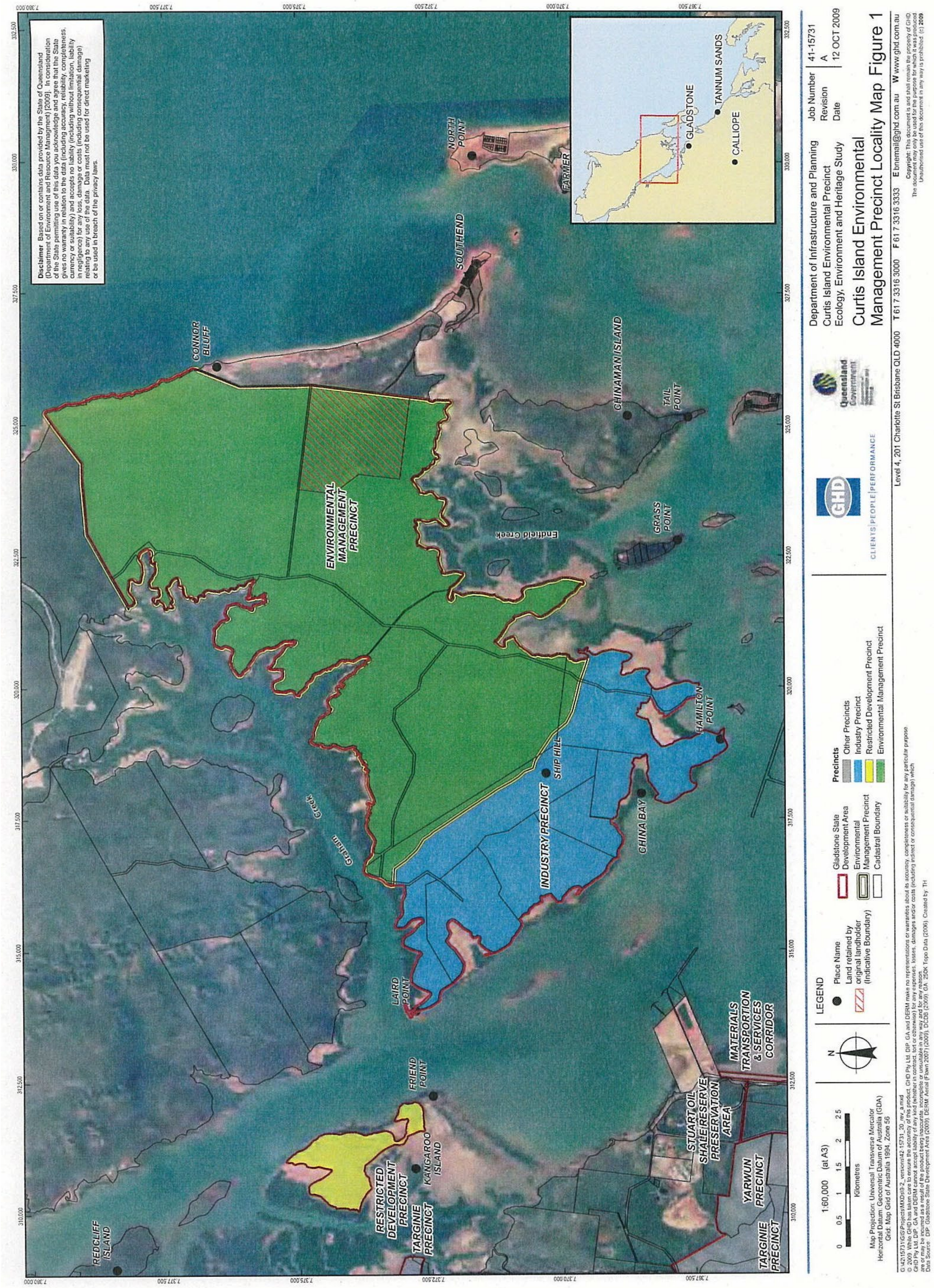


Figure 2 Artist impression of LNG Plant and facilities from the west

ATTACHMENT E

Figure 3 - Map of Curtis Island Environmental Management Precinct



Site selection/alternatives

23. Alternative locations for the LNG facility were examined in a multi-stage siting study in the region between Townsville and Brisbane. Early investigations also included sites in New South Wales. This study relied upon input from several sources including the Connell Wagner study completed for the Queensland Department of Infrastructure and Planning. The initial review examined a variety of key maritime, land access, environment, land use planning, and site suitability issues such as:

- the availability of land within an area set aside for industrial development (in Bundaberg, one of the main contending options, the available land is marginal in terms of size, taking into account the need to accommodate potential future growth of the project. Gladstone had a large State Development Area with an extension on Curtis Island, including the Curtis Island Industrial Precinct within it specifically established for LNG export facilities);
- ease and safety of access and navigation. (A key element is the technical limitations and costs involved in building cryogenic product lines linking the liquid gas produced in the LNG plant to the LNG ships. Typical cryogenic pipeline to facilitate a terminal exporting 3Mtpa costs in the range of US $20 million to $30 million per kilometre. Increased length also raises operational issues because, as the LNG travels along the pipeline away from its refrigerated source, it increases in temperature resulting in some conversion from liquid to gas. This is known as 'boil off' and requires the gas to be returned for re-liquefaction or to be flared off. Both options result in a loss of energy, increased operational expense and increased hazard. International practice indicates that it is acceptable, under normal circumstances to operate loadout pipelines of between 1 and 2 kilometres in length. Some LNG export sites, due to significant site constraints, operate cryogenic pipelines up to 3 kilometres in length. Relatively few LNG export facilities have cryogenic pipelines longer than this.);
- the existence of a protected natural deepwater harbour. Bundaberg has significant maintenance dredging issues at the mouth of the Burnett river;
- the existence of port/shipping infrastructure, which was relatively under-developed in the case of Bundaberg;
- relative proximity to the coal seam gas fields; and
- the existence of no fundamentally prohibitive social or environmental issues. (Both the Bundaberg and Gladstone options were close to or within some type of environmentally protected zone).

24. A site selection screening study was then performed on a short list of sites to assess the location suitability for an LNG facility and the associated constructability. Prior consultant reports were initially reviewed to identify potential site selection criteria. Site specific conceptual layouts were developed to establish site cost criteria to be used in a comparison ranking matrix of the key cost drivers, together with site related subjective advantages and disadvantages for an LNG facility.

25. Based on screening level evaluations of these and other criteria, two locations on Curtis Island were selected for a more rigorous detailed site development selection: Hamilton Point and Laird Point (two berth options). Both sites are located within the Curtis Island Industry Precinct of the Gladstone State Development Area (GSDA). The Curtis Island Industry Precinct designates the land in the precinct for the development and operation of LNG facilities (including liquefaction and storage) for export. The Curtis Island Industry Precinct also designates land for the establishment of infrastructure associated with the LNG facilities including transport linkages to wharf facilities. The two sites investigated further were both consistent with this development intent.

26. In all, 62 factors were considered in the site comparison. These factors were weighted in importance and assigned a criteria weight. From the analysis, the Laird Point site was selected as the preferred option The Laird Point site has the following attributes:

- available land within a state development area assigned for LNG facility development;
- navigable access, given extension of dredged shipping channels;
- ability to design marine facilities with short trestle lengths;
- soils and geology suitable for LNG facility development;
- adequate land for viable LNG facility layout for full development and safety risk considerations;
- located in an industrial precinct with opportunities for industrial synergies to minimise overall industry potential environmental impacts; and
- proximity to the feed gas supply.

27. It is intended that the waste water streams, including stormwater, at the proposed LNG facility will be managed to minimise environmental risks and impacts on receiving waters.

28. Decommissioning and rehabilitation of the LNG facility would be in accordance with relevant statutory approvals, APLNG Environmental policies, and best practice techniques available at the time of decommissioning.

29. A preliminary facility hazard assessment for the proposed LNG plant has been undertaken based on the planned Optimized Cascade process (OCP) intended to be used to produce LNG and using conservative assumptions. For each of the potential worst case scenarios involving the hazards identified, consequence modelling has been performed. Contours showing the hazard end points (defined as the distance from the source of a hazard to the point at which the impact from the potential consequences is at a level that is considered not to be a threat to human safety) have been overlaid on a plan of the site. The results indicate that most of the hazards do not result in any off-site impact. There are, however, scenarios where the hazard end-point extends over the site boundary bordered by the coastline in an area which is not occupied and not planned to be built upon.

30. APLNG has developed a preliminary Environmental Management Plan (EMP) for the construction and operation of the proposed LNG facility on Curtis Island. APLNG intends that the final LNG facility EMP will be used to support an application for an environmental authority (petroleum activities) for a petroleum facilities licence (PFL) issued under the *Petroleum and Gas (Production & Safety) Act 2004* (Queensland).

Description of the environment

31. The proposal concerns the construction and operation of an LNG processing plant on Curtis Island, the largest of approximately 552 continental islands in the Great Barrier Reef World Heritage Area (GBRWHA), with an area of 46,600 ha.

32. Curtis Island has a predominantly natural vegetated landscape of eucalyptus forests and woodlands with fringing foreshore mangroves and saltpan vegetation. In the south-western section of Curtis Island the vegetation consists mainly of *Corymbia citriodora, Eucalyptus crebra* open forest on metamorphic and volcanic soils on the hills, with patches of *Eucalyptus tereticornis* woodland to open forest on alluvial plains in low lying areas. The same communities occur on the mainland but large areas of remnant vegetation, as found on Curtis Island, are generally uncommon at a regional scale as a result of clearing for agriculture, and in the immediate vicinity of Gladstone, for urban and industrial development. The undulating to hilly terrain predominant on Curtis Island has a number of linear ridges running along the length of the island. Ship Hill, to the east of the CIIP is the southern tip of one of these ridges. The coastal fringe in the south western section of the island comprises of a strip of low swampy coastal plains and mangrove flats extending north into Graham Creek and The Narrows channel.

33. The foreshore areas of Curtis Island supports mangrove shrubland to low closed forest on marine clay plains and estuaries, with isolated patches of saltpan vegetation, including grassland and herbland on marine clay plains. These communities also occur along the mainland coast and are not as directly impacted by agricultural clearing as more inland communities. However, there are several reclamation areas and industrial facilities that have removed large patches of these communities along the coast to the south and north of Gladstone.

34. Curtis Island has a tropical savanna climate with the wetter months of December to February receiving around three times the rainfall of the dry winter months of June to August (average January rainfall 143mm, August 32.4mm). Average maximum daytime temperatures range from 31 degrees Celsius in January to 23 degrees in July. At the moment Curtis Island is largely undeveloped, has a very low residential population and no industrial development.

35. The Port of Gladstone is located 525km north of Brisbane on the Central Queensland coast, and adjacent to the City of Gladstone. The port is situated within a semi-enclosed estuarine system to the north of Gladstone. An outer series of barrier islands (Curtis and Facing) provide protection for enclosed waters allowing estuarine environments to establish. Most of these estuaries receive a limited supply of freshwater from a narrow coastal hinterland. The port is wholly contained within the GBRWHA and National Heritage place.

Assessment and public consultation

36. Matters relating to the assessment process for the APLNG project are also described in the brief to which this advice is attached. The assessment process included the initial assessment of the APLNG project for the purpose of a controlled action decision; the assessment under the bilateral agreement with Queensland and subsequent report by the Queensland Coordinator-General.

37. Public comments were taken into account by the Coordinator-General when preparing his report and have been taken into account by the Department in preparing this advice and associated briefing. Further details of the public comments have been described above.

Existing regulatory arrangements for LNG plant construction, operation and decommissioning

38. The management framework for constructing, operating and decommissioning an LNG Facility is primarily established under Queensland legislation, and to a lesser extent, Australian legislation. Relevant legislation includes:

- *Great Barrier Reef Marine Park Act 1975*;
- *State Development and Public Works Organisation Act 1971*;
- *Goods Safety Management Act 2001*;
- *Environmental Protection Act 1994*;
- *Queensland Development Code Part MP 3.3 Temporary Accommodation Buildings and Structures; and*
- *Petroleum and Gas (Production & Safety) Act 2004*.

39. Enforcement of this legislation is variously the responsibility of State agencies and the Great Barrier Reef Marine Park Authority (GBRMPA).

40. In relation to shipping, the International Maritime Organization develops conventions surrounding maritime safety and marine environment protection to which Australia is a signatory. These conventions are implemented through domestic legislation, relevantly including

- *Great Barrier Reef Marine Park Act 1975*;
- *Maritime Transport Security Act 2003*;
- *Navigation Act 1912*;
- *Protection of the Sea (Prevention of Pollution) from Ships Act 1983*;
- *Protection of the Sea (Civil Liability) Act 1981*;
- *Transport Safety Investigation Act*;
- *Transport Operations (Marine Pollution) Act 1995* (Queensland); and
- *Transport Operations (Marine Safety) Act 1994* (Queensland).

41. Enforcement of this legislation within Australia and the Great Barrier Reef (GBR) region is variously the responsibility of the Australian Maritime Safety Authority (AMSA), the Department of Infrastructure and Transport, Maritime Safety Queensland (MSQ), and the Great Barrier Reef Marine Park Authority (GBRMPA).

42. AMSA implements a rigorous Port State Control program to ensure the seaworthiness and safety of foreign flag vessels arriving in Australian ports. Ships found to have major faults are detained in port under the *Navigation Act 1912* until the faults are addressed.

43. The Gladstone Ports Corporation (GPC) manages and operates the Port of Gladstone. GPC is a port authority under the *Transport Infrastructure Act 1994* (Queensland) and is responsible for managing the Port of Gladstone.

44. Great Barrier Reef waters are subject to stringent regulatory regimes. The Reef is designated as a 'Particularly Sensitive Sea Area', which requires measures such as compulsory or recommended pilotage in particular areas, and a mandatory vessel reporting system in difficult navigation areas, which AMSA is seeking to extend to waters adjacent to the Port of Gladstone through the International Maritime Organization. Legislation and related management arrangements provide a high degree of regulatory control over ship movements and, together with the proposed conditions, a robust level of risk management for the shipping activities proposal. In particular:

   - the GPC operates a vessel traffic service which regulates shipping movements within the Port of Gladstone. This service is supported by automatic shipping identification systems, radar and closed-circuit TV monitoring systems;
   - pilotage *within* the Port of Gladstone is provided by MSQ. LNG tankers will be escorted through the port by tugs;
   - MSQ has a Marine Emergency Response Plan and an Oil Spill Response Plan in place within the Port of Gladstone;
   - the discharge from vessels of pollutants, including sewage and waste, is regulated under the *Great Barrier Reef Marine Park Act 1975* and other *legislation*, with limits applying on the distance from land and the outer edge of the GBR in which waste can be disposed; and
   - ships arriving in the Port of Gladstone from international ports are subject to AQIS inspection.

45. In April 2010, the Government announced a package of measures to further strengthen marine environment protection in the GBR following the March 2010 grounding of the bulk carrier *Shen Neng 1*. The package included:

   - extending the ReefREP system and associated coastal vessel traffic service to the southern boundary of the 'Particularly Sensitive Sea Area' which would cover waters adjacent to Gladstone; and
   - reviewing the offences under the *Protection of the Sea (Prevention of Pollution* from *Ships) Act I983* and the *Navigation Act I9I2*, with a view to strengthening penalties for breaches.

Assessment of impacts

Overview

46. This assessment is limited to impacts on the controlling provisions for the proposed action: listed threatened species, listed migratory species, World Heritage properties; and National Heritage places, protected under Part 3 of the EPBC Act.

47. On the basis of the information available, the Department has made the following conclusions in relation to the matters protected by the controlling provisions for the action:

Controlling provision	**Acceptability of impacts**
World Heritage properties	Not uncceptable if the proponent is required to: • undertake pre-clearance surveys; • minimise the visual impact of the construction and operation of the LNG facility; • implement a Curtis Island environment protection code of conduct for the construction and operational workforce; • implement an Environmental Offsets Plan to offset the loss of habitat and associated World Heritage and National Heritage values caused by the construction and operation of the LNG facility; • implement a Construction Environmental Management Plan, and an Operational Environmental Management Plan; • ensure that discharge of treated sewage effluent into the waters surrounding Curtis Island meets the definition of tertiary treatment as specified in section 135(3) of the Great Barrier Reef Marine Park Regulations 1983; • implement a Quarantine Management Plan to prevent the introduction of non-endemic species on to Curtis Island; • implement a Water Mouse Environmental Management Plan; • implement a Marine Turtle Management Plan; • implement a Dredging and Construction Management Plan; • implement a Migratory Shorebirds Environmental Management Plan; • implement a Shipping Activity Management Plan, and • implement a Decommissioning Plan.

Controlling provision	Acceptability of impacts
National Heritage places	Not unacceptable if the proponent is required to abide by the requirements listed above in relation to World Heritage properties.
Listed threatened species	Not unacceptable if the proponent is required to: • undertake pre-clearance surveys; • implement a Construction Environmental Management Plan, and an Operational Environmental Management Plan; • ensure that discharge of treated sewage effluent into the waters surrounding Curtis Island meets the definition of tertiary treatment as specified in section 135(3) of the Great Barrier Reef Marine Park Regulations 1983; • implement a Quarantine Management Plan to prevent the introduction of non-endemic species on to Curtis Island; • implement a Water Mouse Environmental Management Plan; and • implement a Marine Turtle Management Plan.
Listed migratory species	Not unacceptable. if the proponent is required to: • undertake pre-clearance surveys; • implement a Construction Environmental Management Plan, and an Operational Environmental Management Plan; • ensure that discharge of treated sewage effluent into the waters surrounding Curtis Island meets the definition of tertiary treatment as specified in section 135(3) of the Great Barrier Reef Marine Park Regulations 1983; • implement a Quarantine Management Plan to prevent the introduction of non-endemic species on to Curtis Island; • implement a Water Mouse Environmental Management Plan; and • implement a Marine Turtle Management Plan.

Potential sources of impacts

Clearing

48. The primary potential source of impacts from the proposed LNG Facility on terrestrial species and communities is the clearing of the construction site. The LNG facility holding is approximately 270 ha in total area, which includes a reclamation area of approximately 39ha needed for LNG facility infrastructure. (About 24ha for the LNG plant, 15ha for marine loading facilities). Vegetation clearance would be limited to areas required for the placement of facility infrastructure. It is expected that approximately 60% of the existing natural vegetation on the project site would be cleared with the remainder being retained.

Construction and operation

49. Some impacts associated with the operation of the construction camp and the LNG Facility, particularly lighting, flares, dredging, operation of a brine outfall from a reverse osmosis (RO) plant and sewage effluent disposal, the movement of vessels and the presence of personnel could impact on flora and fauna on the island, as well as turtles and marine mammals in the waters adjacent to the proposed LNG Facility. Several of these species are listed threatened or listed migratory species, and the presence of a range of native flora and fauna is an attribute that contributes to the values of the Great Barrier Reef World Heritage Area and National Heritage Place.

50. Constructing, operating and decommissioning the proposed LNG Facility involves activities common to a range of industrial projects such as site clearing, construction, water and sewage treatment, waste management, release of emissions to air and water, concrete batching, and chemical storage. This being the case, the management of these activities is well understood and would be regulated through a number of standard conditions under Queensland legislation and in particular through an environmental authority attached to a petroleum facilities licence for the site.

51. APLNG has developed a preliminary Environmental Management Plan (EMP) for the construction and operation of the proposed LNG Facility on Curtis Island. It has been structured to meet the requirements of the relevant Queensland EPA guidelines and related operational policies. The EMP proposes environmental management strategies to prevent or minimise environmental harm. Monitoring, corrective actions and reporting requirements are incorporated to ensure that the proposed management strategies are properly implemented. The final LNG Facility EMP will be used to support an application for an environmental authority (petroleum activities) for a petroleum facilities licence (PFL) under the Queensland *Petroleum and Gas (Production & Safety) Act 2004.*

52. The objectives of the EMP are to provide:

- evidence of practical and achievable plans to ensure that the project's environmental requirements are complied with;

- an integrated plan for monitoring, assessing and controlling potential impacts;
- local, state and Commonwealth authorities with a common focus for approval conditions and compliance with policies and conditions; and
- the community with evidence that the LNG Facility development will be managed in an environmentally acceptable manner.

53. To ensure that the performance of the proposed LNG Facility is in accord with the predictions outlined above, and ensure that specific matters protected by the EPBC Act are not adversely affected by the construction, operation and decommissioning of the proposed LNG facility, the Department recommends that a condition of approval be that environmental management plans be developed and submitted for the approval of the Minister prior to construction, commissioning and decommissioning of the LNG facilities respectively, and once approved implemented.

Flaring and lighting

54. LNG Facilities operate continuously. For health and safety reasons and to minimise accident risk, all hydrocarbon processing facilities require good lighting in the night to ensure that all valves, inspection ports and safety equipment can be monitored continuously or very frequently. While the lighting can be minimised by using shrouds, proximity sensors to activate lighting on as a needs basis and utilising lights with wavelengths that suit human vision but to which other animals are less sensitive, there will of necessity be some form of lighting at the LNG Facility throughout the night. There is no such artificial light source in this part of Curtis Island at present, although there are several well-lit industrial facilities on the opposite shoreline and two similar LNG facilities have recently been approved for construction immediately to the south of the proposed APLNG plant.

55. Flares provide a means of safe disposal of vapour streams from hydrocarbon processing facilities, including LNG facilities, by burning them under controlled conditions in a way that ensures adjacent equipment or personnel are not exposed to hazards, while meeting environmental regulations. The chemical process used for flaring is a high temperature oxidation reaction to burn combustible components, mostly hydrocarbons, or waste gases from industrial operations. During combustion the gaseous hydrocarbon reacts with atmospheric oxygen to form carbon dioxide and water. Other byproducts include carbon monoxide, hydrogen and others. Efficiency of hydrocarbon conversion is generally over 98 per cent. In industrial situations the most common flare systems are elevated flares and ground flares.

56. Selection of the type of flare is influenced by availability of space; the characteristics of the flare gas (composition, quantity and pressure); investment and operating costs; public amenity, health and safety requirements and environmental regulation. The elevated flare is most commonly used in refineries and chemical plants. They generally have larger capacities than ground flares. The waste gas stream is fed through a stack from at least 10m to over 100m in height, depending on the volumes of gases involved and safety considerations, and burned at the tip of the stack. APLNG intends to use ground flares with protective barriers. This considerable reduces the visual impact of flaring activities.

57. The main operational process affecting the visual impact of the LNG Facility would be the flaring of the processing flares. Flaring, except for a small pilot flame for ignition purposes, would only occur under certain circumstances. The processing flares would be required to operate at start up; planned maintenance periods and under emergency situations. During start-up of a LNG Facility it is necessary to flare gas at certain points in the process to ensure the gas specifications are met at all points in the facility. The amount of gas flared would be likely to be around forty percent of the normal flow rate, and last for up to twenty four hours.

58. The emergency flare will only occur as a matter last resort, when other pressure containing safety devices have failed and flaring is required to ensure the facility is brought to a safe condition as soon as possible. Gases would be released to the flare system the maximum flow rate. Should there be a serious fire at the LNG Facility it might be necessary to evacuate all pressurised hydrocarbon inventories within the area of the fire. The pressure blowdown would likely last approximately forty minutes, and the rate at which the gas is released would be similar to the emergency flaring case. The need for such emergency pressure relief is expected to be very infrequent.

59. Flaring would also be required during periods of planned maintenance during which a whole LNG train would be de-pressured. This is likely to be every three years for each train. The amount of gas flared would be minimized by reducing LNG to the storage tanks to as low a pressure as possible, before the gas is flared to atmosphere. De-pressuring of a train generally takes less than eight hours.

60. Even with the use of ground flares that are shielded so that they are not visible laterally, routine flaring and lighting on the plant required for safe operation, the loom of light at night in the sky above southern Curtis Island would increase above the current background level caused by the presence of the city of Gladstone and the industrial plants on the mainland because of the planned LNG Facility, and may affect marine turtles in particular.

61. Artificial light during construction and operation of the LNG Facility could potentially deter fauna from using the general area. During operation, birds and microbats may benefit from increased levels of food resources such as insects become attracted to lights. Artificial lighting also has the potential to affect turtles and seabirds. The proponent has proposed that the following measures would be adopted to minimise impacts to fauna from noise, vibration and lights:

- all equipment and machinery used during construction would be maintained in good working order, and where practicable shielded to minimise noise emissions;
- operating times will be minimised so that impacts are reduced overall, especially at night;
- lights used at the operating LNG Facility to be used sparingly, of a minimum power to fulfil safety requirements and not be directed towards surrounding bushland; and
- hoods or covers would be used to reduce the amount of light spilling onto these areas.

62. Nonetheless the Department believes the management of lighting, including flaring, is an area that requires closer examination, and this is discussed further below.

Effluent and Brine

63. Treated effluent would either be disposed of to the ocean via an outfall or potentially via a proposed pipeline to the mainland and the Gladstone STP, as discussed above. The majority of the output from the Gladstone STP is understood to be recycled or placed into sewage effluent absorption beds and/or irrigation fields. However, the proposed means of dealing with sewage is only a proposal at this stage. In the early stages of site preparation it is likely that effluent will need to be loaded into tankers and barged to the mainland for disposal at an existing wastewater treatment plant. If agreed by Queensland authorities treated sewage effluent and stormwater may also be reused for on-site irrigation.

64. Nutrient input loads to the inshore area of the Great Barrier Reef World Heritage Area have risen by more than 30 per cent following urban development in coastal catchments over recent decades. Sewage disposal via ocean outfall is one source of these nutrients. The two principal nutrients, nitrogen and phosphorus, exist in several forms in marine waters. When there is a large concentration of nutrients (phosphorus and nitrogen) in the water, Reef environments are affected in a number of ways:

- nutrients encourage phytoplankton growth, which leads to decreased water clarity and reduced light for coral and seagrass communities;
- phytoplankton growth encourages filter-feeding organisms such as sponges, tubeworms and barnacles to grow, which compete for space with the existing coral community;
- nutrients encourage algal growth, which grow over coral communities; and
- excessive phosphorus weakens the coral skeleton, making it vulnerable to storm damage.

65. In the EIS APLNG modeled discharge of effluent and concluded that impacts on marine biota from the discharge would not be significant in the near or far-field. Effluent is proposed to be discharged with the brine waste stream from a desalination facility (see below), and possibly with treated storm water run-off, using a diffuser during both construction and operational phases. The site layout may however change, as further detailed planning is completed, possible requiring a new point of discharge to be utilized.

66. Modeling of sewage discharge combined with the desalination plant brine was undertaken and using worst-case scenarios showed that it is possible to achieve a dilution of 1 in 50 (exceeding the required dilution for salinity) within 12.8 m and 7.20 m of the diffuser, for construction and operations phase of the project, respectively, in all cases. Modelling also indicated that dilution of brine in the near field is aided by the addition of treated wastewater by lowering initial concentrations. Given the rapid dilution the risk of impact to local water quality conditions is considered low, with model results indicating that there would be no detectable changes in local water quality due to this discharge.

67. Freshwater is required to operate the LNG Facility and for ablution purposes. It is proposed that sea water would be desalinated by an RO plant to provide water for the LNG facility, supplemented by storm water harvested on site. The desalinated water would be further treated to meet specific needs such as processed water and potable water. The seawater intake would be greater that the volume of useable water produced. The balance would be discharged back to Port Curtis. Typical predicted volumes and uses are provided in the table below:

Predicted water demand during construction period

Requirement	**Volume or rate**
Hydrotest water	160,000m^3
LNG facility concrete work	31,500m^3
Site preparation/dust control	6,000m^3
Potable water	433,000m^3
Potable water demand rate	Varies from 1 to 35 m^3/hr over construction period

Predicted water demand during operations

Requirement	**4 LNG trains m^3/hr**
Treated water demand	1.6
Potable water demand	13.3
Laboratory usage	2.4
Clinical usage	2.0
Demineralised water	26.7
Safety showers	6.0
Fire water flush demand	1.6
Total water demand	53.6
Add 20% margin	10.7
Recommended freshwater demand	**64.5**
Total seawater intake to the plant	**160.8**

68. Seawater would be extracted using pumps located at the marine facilities such as a product loading wharf. A sodium hypochlorite dosing system would be provided to suppress biological growth in the seawater pipe-work. Circular clarifiers would be used to remove any silt present and the settled seawater would be pumped to the desalination units.

69. The seawater intake would be greater that the volume of useable water produced. The balance would be discharged back to Port Curtis. The desalination units would use the Reverse Osmosis process, the technology most commonly used in modern desalination plants. The process involves using pressure to drive seawater through a semi-permeable membrane. The membrane allows fresh water to pass through while it retains salts and other impurities, which are discharged back to the ocean.

70. Marine fauna and flora are adapted to average salinity levels within a relatively narrow range. Disposal of brine with significantly higher concentrations of salts can cause severe damage or death to individuals of many species, although many marine species are able to tolerate short-term fluctuations in the order of 20 to 30 per cent around the mean salinity level. The salts involved in brine discharge are those naturally occurring in seawater. The main issue is the time and distance over which the brine mixes and drops to background salinity levels. It is generally easier to assure dilution to background levels occurs quickly when brine is discharged into high energy oceanic environments with currents parallel to the coast, and more difficult in low energy areas such as those where salt marsh and mangrove are present as is the case here.

71. Brine is discharged to the sea via a diffusing system, designed to ensure thorough mixing with seawater. Hydrodynamic modelling is normally carried out to assist in the design of the diffusing system to ensure that any impact on the marine environment is low. Typically the discharge brine flow rate is 30–70 per cent of the feed water flow, resulting in the brine discharge being some 1.3–1.7 times the inflowing seawater concentration.

72. In addition to the high concentration of salts, brine discharges may contain, depending on the design of the RO plant, at low levels (less than 10ppm), various chemicals used in the pretreatment stage of the desalination plant, including anti fouling materials. The chemicals used in pretreatment of seawater are typically:

- sodium hypochlorite (NaOCl) or free chlorine, used for chlorination, preventing biological growth;
- ferric chloride ($FeCl_3$) used for the flocculation and removal of suspended matter from the water;
- sulphuric or hydrochloric acid used for pH adjustment;
- sodium hexametaphosphate and similar chemicals, to prevent scale formation on the pipes and on the membranes; and
- sodium bisulphite ($NaHSO_3$), used in order to neutralize any remains of chlorine in the feed water.

73. Cleaning membranes typically takes place 3 or 4 times a year, and the chemicals products used are mainly weak acids and detergents (citric acids, sodium polyphosphate and ethylenediaminetetraacetic acid (EDTA)) and caustic alkali. Water cleaning chemical solution in membranes must be neutralized before being discharged to the sea.

74. In the case of the APLNG plant the modelled proposed outfall and diffuser design comprises a 20m long diffuser with 50mm diameter orifices located every 2m along the diffuser oriented horizontally with the ambient current flow during the construction phase, and a diffuser 20m long with six port openings (diameter of 0.10m) during plant operation phase. It is anticipated that during steady state LNG production (four-trains), brine disposal will be at an average rate of 96m3/hr and up to a maximum rate of 116 m3/hr.

75. Based on modelling utilising recognised models and techniques and known attributes of the surrounding waters, discharges from the proposed LNG facility desalinisation plant indicate that salinity impact will be within the natural ambient salinity variations and are not likely to be detrimental to the marine environment.

76. The major issue of potential concern is residual oxidant concentrations (chlorine and disinfection by-products). Chlorine in discharge can potentially impact marine organisms. Residual chlorine in the brine will be treated through a dechlorination process prior to discharge to reduce chlorine concentration. This process of dechlorination will also reduce the likelihood that chlorination by-products are formed. As a result, there are unlikely to be any significant impacts on the receiving environment from discharge of residual oxidants or any other residual contaminants present in the brine waste stream.

77. To minimise potential impacts from high suspended solids loads on the marine environment, screens and filters will be utilised and waste materials collected from them will likely be transferred to land fill, rather than into the brine stream discharged into the marine environment. This is proposed to be further investigated during detailed design.

78. If the modelled performance is achieved it is likely that the brine discharge would have no significant water quality effects anywhere in Port Curtis. Scale inhibitors normally used in these water treatment systems are suitable for human consumption and will not adversely impact on any marine organisms.

79. The high pressure pumps and energy recovery systems associated with the operation of RO plants, such as turbines, may produce a significant level of noise, sometimes over 90 dB(A). This could have an impact on the behaviour of marine species, particularly cetaceans, in the vicinity of the RO intake and discharge points. While the proponent states that marine mammals and turtles would not be significantly impacted by underwater noise, lighting or vessel movements associated with the project, this potential noise source was not included in the noise impact modeling undertaken for the proposed LNG Facility and associated infrastructure. Good design and sound reduction technologies can ensure noise levels are minimized to a level where no impact is likely, and the RO plant intended to be utilized is unlikely to produce unacceptable noise levels. The condition requiring the development of environmental management plans for the construction and operational phases of the LNG facilities requires that technical specifications for key pieces of equipment, including acoustic performance, be provided as part of that plan.

80. Runoff from a disturbed construction site or poorly designed operating facility has the potential to contaminate surrounding waterways and impact on important habitats. It is proposed that the waste water streams in the LNG Facility be managed to minimise impacts on receiving waters using the following management strategies:

- treating potentially contaminated water;
- minimising the potential for contaminants to be mobilised in off-site runoff; and
- directing naturally occurring runoff around the site and away from process or utility areas.

81. The site would be divided into multiple surface water management catchments with each catchment containing uses with varying potential for stormwater contamination. The key features of the drainage arrangements are:

- process areas would be built on bunded concrete slabs;
- the bunded areas would each have a sump to collect stormwater;
- stormwater collected in the bund sumps would pass through a skimmer with the skimmed water/oil being routed to a corrugated plate interceptor (CPI) oil/water separator unit for removal of oil and grease and suspended solids;
- the skimmer underflow would flow to a first flush retention pond with excess runoff above the first flush volume by-passing the initial stormwater storage and discharging directly to the stormwater outlet system;
- water in the first flush pond would be tested and if suitable discharged to the stormwater outlet system. Otherwise (off-spec) it would be sent to the contaminated water tank for transport to an approved off-site treatment and disposal facility; and
- stormwater runoff would be directed around the site and away from process areas. Clean stormwater from non-process areas and undisturbed catchments will be discharged via drains to the surrounding natural (ephemeral) drainage system.

82. During construction of the LNG facility, a temporary stormwater drainage system would direct site runoff to sedimentation ponds. Outfall structures would enable high flows encountered during major storm events to be managed by discharging to Port Curtis after an initial 10 minute diversion.

83. Implementation of this stormwater management system should ensure that contaminated stormwater is not discharged from the site and the water quality of Port Curtis protected, if the LNG Facility were to be approved. The condition requiring the development of environmental management plans for the construction and operational phases of the LNG facilities to the satisfaction of the Minister, and the implementation of the approved plans, will address this matter.

Noise and Vibration

84. Noise and vibration during facility construction and operation may disturb fauna in the vicinity of the activity. Individuals of most fauna species will generally move away from the source to avoid these impacts. However, acclimatisation by some species may occur over the long term. Noise assessment and acceptability standards are primarily based on human protection. There are no widely-accepted guidelines on noise levels which affect wildlife. The levels or characteristics of noise that may startle or otherwise impact the feeding or breeding pattern of birds or other native fauna are also not firmly established in the technical literature. However some studies show that birds tend to accept and/or adapt to constant steady noise levels, even of a relatively high level (in the order of 70 dBA). Higher noise levels may cause some degree of behavioural changes in birds.

85. Sudden loud or impulsive or impact noises are capable of causing birds and other animals to become startled, which if occurring over the longer term, may affect feeding and breeding behaviour in some species. Conversely, there are instances where noise has been used in an attempt to deter flocks of birds (and bats) from various sites including crops, airports and waste disposal sites eg tailings ponds at the Olympic Dam copper/gold/uranium mine in South Australia. The success of such trials has been limited, suggesting that acclimatisation to even this form of noise occurs in some groups of animals.

86. Noise generated by the LNG Facility construction could reach approximately 100 dBA for piling and 80-85 dBA for heavy earthmoving activities measured at a distance of 100m. On this basis, it would be expected that construction and piling at the LNG Facility site could cause disturbance to wetland and terrestrial birds. This would most likely result in avoidance of the area for the duration of these activities. As alternative habitats are available elsewhere, an overall loss of avian diversity as a result of construction will probably not occur. Once peak noise levels and construction activity stops, many, if not all species will resume utilising wetlands and woodlands around the LNG Facility site. Few long-term impacts are therefore expected.

87. Impacts to mammals, such as dispersal and avoidance, are expected from elevated noise levels. However, the attenuation provided by terrain and woodlands on the site will tend to reduce the distance at which impacts are felt. These impacts are considered to be minor. Overall construction and operations noise and vibration are not predicted to impact on sensitive receptors under most conditions.

88. Underwater noise arising from construction activities and from vessel movements has the potential to displace dugong and cetaceans from critical habitat and interrupt critical behaviours. Cetaceans have been found to avoid some human sound sources for ranges of several kilometres, abandoning valuable habitat in the process. There are a number of underwater noise sources that may impact on cetaceans and dugong. These include pile driving and marine vessel traffic. It should be noted, however, that natural noise levels in the marine environment can be quite high. Monitoring of existing ambient underwater noise at the proposed site of the marine facilities was found to be dominated by the 'crackling' sound of Snapping Shrimp with levels consistently in the range of 155-165dB (peak). Some relatively lower level peak noise contributions from distant wharf ship loader activity at Fisherman's Landing were also identified. Fish chorus sound was identified as a transient sound that occurred as fish moved through the monitoring area.

89. Percussive piling for the construction of the material offloading facility (MOF) jetty is most likely to be of a frequency and volume that will cause disturbance to dolphins. While information is limited, some research indicates that Indo-Pacific dolphins avoid areas during pile driving but return once construction ceases. Overall, it is considered that disturbance to dolphins will occur during the construction phase as a result of pile driving, however, dolphins will again utilise the area once construction activities cease. The overlap of dolphin populations with areas of high vessel activity suggests at least, in part, they habituate to boating activities.

90. Noise generated by vessel activity can also change the behaviour of dugong and result in alienation from important habitat. Potential energetic costs of boat disturbance to dugongs include: a reduction in energy intake, the energy expended while moving, and the possible cost of moving to a different patch on the seagrass beds. Disturbed dugongs may be forced to spend time searching for alternative feed patches and may be forced to feed on less desirable patches with lower nutritional value. However, if animals are able to move to suitable nearby habitat then this may largely mitigate impacts from disturbance. In the case of Port Curtis, existing high value dugong (seagrass) habitat occurs in areas unaffected by the proposed APLNG plant location.

91. APLNG proposes to utilise a number of mitigation strategies to reduce potential impacts of noise, including the use of bubble curtains, pile cap cushions and applying "soft starts" to pile driving. (A bubble curtain is created by forcing air from compressors into an enclosure around the noise source. The bubble curtains function by as sound absorbers. Soft starts refer to the increasing of pile energy gradually over a period of time, allowing animals to move away before the noise reaches full volume.) It is also planned to monitor the usage of the area adjacent to the LNG facility by dolphins and dugong prior, during and after construction.

Workforce

92. A population of 3,000 – 4,000 workers living on Curtis Island (and almost 10,000 if each of the other three LNG plants were to proceed), with many daily movements to and from the mainland, poses a number of risks to the environment from the introduction of weeds and pests such as cats, dogs, rats mice etc. While Curtis Island already has all of these - as well as feral cattle, horses, pigs and cane toads – uncontrolled movement of people and equipment would increase the risk of additional introductions, with resulting pressure on native flora and fauna (whether EPBC Act listed or otherwise) that contribute to the biodiversity and conservation values of Curtis Island in a regional, World Heritage and National Heritage site context. It is therefore recommended that a condition of approval be that a quarantine management plan be developed to your satisfaction, and once approved implemented.

93. For similar reasons it is important that personnel accommodated on Curtis Island are restricted to the immediate site, do not enter the Curtis Island Environmental Management Precinct (see figure 3) and do not unnecessarily impact on the environment through thoughtless behaviour. To ensure this occurs it is recommended that a condition of approval be that a suite of prohibitions and the provision of a mandatory induction program, including guidance as to the importance of Curtis Island environments, be developed to the satisfaction of the minister, and once approved implemented.

94. Barge/ferry services would continue to transport personnel to Curtis Island during the operation of the LNG facility as well as during construction, requiring the following ferry or barge movements:

- Approximately 140 one-way ferry journeys per month during the peak construction period (Fishermans Landing to Curtis Island);
- Approximately 70 barge journeys (direct to the materials offloading facility) per month at the peak construction period;
- Additional ferry journeys from Fishermans Landing to Curtis Island, for transport of consumables and equipment and for waste removal from site.

95. Barges would be relatively slow moving, but dedicated ferries to move personnel are planned to be 'fast cat' style vessels. While generally designed to minimise wake, a benefit in terms of impacts on coastal vegetation such as mangroves and salt flat flora, such vessels pose a risk to turtles and dugong that are generally too slow moving to evade such vessels. A condition requiring the proponent produce a Turtle and Dugong Management Plan for your approval is proposed.

96. Scheduled ferry services are only a minor element in the overall movement of vessels in Gladstone Harbour/Port Curtis area. It has been estimated that vessel movements within the Port of Gladstone fall in the range of 70,000 to 80,000 movements per year. On this basis LNG Facility associated vessel movements are expected to produce an increase in movements of approximately 12 per cent at the peak construction period, and by less than 5 percent during LNG Facility operations.

Hazard and Risk

97. LNG facilities are hazardous facilities and unplanned events (fire, explosion) could have an impact on matters protected by the EPBC Act. The LNG Facility is to use the Optimized Cascade process (OCP) to produce export quality LNG from coal seam gas. Plot plans have been provided by the engineering contractor for the OCP design and have been used to analyse the hazards.

98. As detailed design information is not yet available, a number of conservative assumptions regarding the likely process conditions have been made. These assumptions will almost certainly overestimate the hazards associated with the final design of the facility. The proponent has proposed that further detailed risk analyses, required in order to obtain Queensland Government approvals to operate the facility, will be conducted during the detailed design stage.

99. For the LNG facility, for each of the potential worst case scenarios involving the hazards identified, consequence modelling has been performed. Contours showing the hazard end points have been overlaid on plans of the LNG facility. The hazards and potential scenarios modelled to determine the 'hazard end point' (defined as the distance from the source of a hazard to the point at which the impact from the potential consequences is at a level that is considered not to be a threat to human safety. The criteria for hazard end points are set by relevant design standards.

100. Typical scenarios are:

- loss of containment of natural gas or liquid natural gas in the process from various points of release, including the product loading facility;
- loss of containment of refrigerant gas or liquid from various points of release;
- fire within the facility involving process or refrigerant liquids in storage; and
- explosion of an unpurged vessel during decommissioning.

101. The results indicate that most of the hazards did not result in an off-site impact. Only over the water immediately in front of the LNG facility does the hazard end-point extended over the site boundary. It is therefore concluded that a significant hazard is not present, and it is extremely unlikely that even a major accident involving gas leakage and explosion at one LNG plant site would impact on a neighbouring site within the CIIP.

102. The quantitative risk assessment for the LNG Facility includes assessment of consequences of catastrophic failure. However, risks (likelihood) of deliberate harm which includes an act of terrorism has been excluded from the risk assessments, as Federal and state agencies in Australia are responsible for assessing threats including threats of deliberate harm on critical infrastructure such as the APLNG Facility and shipping operations. An assessment conducted at Gladstone by these agencies found that the introduction of the LNG Industry would not change the existing threat levels. Because of security considerations these assessments are not public documents.

Decommissioning

103. At the end of its useful life the proposed LNG Facility and associated infrastructure will be required to be fully or partially decommissioned, and the site rehabilitated, depending on the proposed future use of the site. If not done carefully decommissioning activities can lead to environmental contamination and other damage. Decommissioning of the LNG Facility would involve flushing all process equipment and associated pipe work with water. This water would be disposed of in accord with a decommissioning plan developed in conjunction with regulatory authorities.

104. Decommissioning procedures would largely involve the removal of equipment and structures that are of no further economic value including, where necessary, testing to establish whether any decontamination work is required and the performance of such work. If applicable, any ponds would be decontaminated, filled and re-contoured to match the surrounding topography. The site would be re-contoured as necessary and revegetated to stabilise against erosion. If sediment ponds are not to remain, these would be drained, filled, re-contoured, topsoiled and revegetated. Any stormwater management ponds present at the time of decommissioning will be used to assist with the provision of water for rehabilitation, where necessary. Buildings and plant not agreed to remain on site would be demolished and disposed of to ensure the safety of the area. Building materials would be recycled where practicable. It is intended that equipment will either be removed and used at other projects or auctioned. Hardstand (including concrete footings and foundations) not to be used in future projects would be removed and the area ripped, topsoiled and revegetated. The rehabilitated industrial/infrastructure areas would be regraded where necessary.

105. Sites that might have been contaminated by operational activities would be identified in the site management plan (including register and survey plan) which will be maintained for the life of the project. Identified contaminated areas will be included on the Queensland EPA Environmental Management Register and Contaminated Land Register as appropriate. On decommissioning, Phase 1 and 2 contaminated land assessments would be conducted in potentially contaminated areas to standards prescribed by the Queensland *Environmental Protection Act 1994*. Contaminated areas would be assessed and areas that have elevated levels of contaminants would be remediated as they become available during the life of the project. Depending on the future land use, the top 0.5 m of soil at all fuel storage areas would be remediated. In addition, any hazardous materials and wastes would be removed from site or remediated. Remediation measures would be discussed with the Queensland EPA prior to commencement of remediation works. Rehabilitation and decommissioning plans will be developed in conjunction with regulatory agencies at least five years prior to decommissioning.

106. The above discussion of potential sources of environmental impact arising from the building, operation and decommissioning of the proposed LNG facilities serve as a background to the discussion below of specific EPBC Act listed threatened species, listed migratory species, World Heritage properties; and National Heritage places.

Assessment of impacts on matters of national environmental significance

107. The matters protected were found to be listed threatened communities, listed migratory species, listed threatened plant and animal species identified as present or where potential habitat was identified within the infrastructure footprint of the LNG facility. World Heritage Area and National Heritage Place attributes potentially affected by the proposed LNG Facility include the diversity of flora and fauna of the WHA, feeding and/or breeding grounds for international migratory seabirds, cetaceans, and sea turtles, coastal and adjacent islands with mangrove systems of exceptional beauty, mangrove, saltmarsh, and seagrass systems, habitats for species of conservation significance, and species of plants and animals of conservation significance, including dugong and other marine mammals, marine turtles and migratory birds.

108. Attachment E1 provides, in table form, the conclusions of the Department in relation to the expected impacts taking into account the proposed management/mitigation measures to avoid or deal with these impacts. The table also provides references to specific parts of the Report of the Coordinator-General on the APLNG project proposal, the EIS produced by the proponent, and supplemental information published on the APLNG website after the publication of the EIS where these species are discussed.

Migratory Species (ss. 20 and 20A) and Threatened Species (s18 & s18A)

109. The Department's Environment Reporting Tool (ERT) identified the following Matters of National Environmental Significance (MNES - or controlling provisions) as potentially occurring within the project area:

- one listed threatened ecological community;
- 43 listed animal species;
- six listed plant species; and
- 33 listed migratory species as potentially occurring within the project area.

110. In undertaking work for the EIS APLNG identified two other listed communities as being potentially present - Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions, and Weeping Myall Woodlands. They also considered several additional listed threatened and migratory species as being potentially present. All of these species have been considered in this Advice.

111. For most listed species the impacts from the proposal will be negligible. The Department has considered the potential impacts, including those listed above for each species and ecological community potentially occurring within the marine facilities project area. Those species and ecological communities most likely to be impacted are discussed below. The Department is confident that the strict requirements and conditions set out in this Advice will ensure any impact on MNES is acceptable.

112. The following species and communities - Water Mouse, *Xeromys myoides* (vulnerable), a number of migratory shorebirds, small terrestrial migratory bird species, including White-throated Needletail (*Hirundapus caudacutus*), Black-faced Monarch (*Monarcha melanopsis*), Spectacled Monarch (*Monarcha trivirgatus*) and Rufous Fantail (*Rhipidura rufifrons*), marine turtles and Dugong - are discussed in more detail below, because impacts on them have been identified (in the APLNG EIS documentation and for the and adjacent QGC and Santos sites) as more likely to occur as a result of the proposed action than impacts on other species that occur on or near the site of the proposed LNG plant and associated marine facilities. Impacts on the ecological attributes of the site and surroundings that contribute to the World Heritage and National Heritage values of the Great Barrier Reef are also discussed.

113. The primary potential source of impacts from the proposed LNG plant on terrestrial species and communities is the clearing of the construction site, involving proposed clearing of approximately 180 ha of forest (including mangroves), and reclamation (that is destruction of the existing vegetation cover by deposition of materials to increase the height of the reclaimed area so that it is above tidal influence) of approximately 2.4 hectares of mangroves and 24 hectares of saltpan/saltmarsh on the south western side of Curtis Island. According to APLNG this area of mangroves represents 0.03% of the estimated mangrove cover (6,736ha), and 0.5% of the saltpan/salt marsh habitat (4,573ha) in the Port Curtis region. The plant footprint site boundaries for the LNG facility have been chosen to minimise the removal of mangrove habitat in particular. A large stand of mangroves and a small mangrove lined creek in the centre of the Project is proposed to be left undisturbed.

114. The vegetation communities at the proposed LNG Facility site are typical of coastal Queensland environments in the Curtis region and range from open woodland, with individual eucalypts and iron bark trees as large, tall canopy trees, to closed medium density undergrowth of eucalypt saplings. The sapling understorey includes larger trees distributed relatively evenly throughout. A Shrubby understorey with a dense covering of native grasses and herbaceous species and small infestations of environmental weeds including balloon cotton (*Gomphocarpus physocarpus*) and flannel weed (*Sidacordifolia*) were also present.

115. The dominant vegetation types consist of *Corymbia citriodora* (Lemon-scented Gum, also known as Spotted Gum in Queensland) woodland, *Eucalyptus tereticornis* (Forest Red Gum, also known as Blue Gum in Queensland) woodland with *Eucalyptus crebra* (Narrow-leaved Ironbark). Saltpan and saltmarsh is also present.

116. There is some evidence of past and ongoing disturbance (for example the presence of feral species) and the site contains relatively few native species of conservation significance in terms of the Queensland regional ecosystems (RE) classification scheme. (Recognition of defined regional ecosystems are a fundamental element of the Queensland biodiversity planning framework. They are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. Regional ecosystems have been examined throughout Queensland and assigned the status of 'Endangered', 'Of concern', or 'Least concern' based on the area of the community present in the landscape in total and in relation to its presence prior to European clearing, among other characteristics (Attachment E4 provides details of the framework). There is some overlap with EPBC Act listed threatened ecological communities, however because of the different scale of focus - national or continental versus state - many Queensland 'endangered' or 'of concern' regional ecosystems are not listed under the EPBC Act. They may of course nonetheless provide habitat for individuals of species that are EPBC listed, and to the attributes of the site that contribute to World Heritage values.)

117. The LNG Facility provides habitat for the following categories of fauna species that could be affected by vegetation clearing:

- arboreal mammals that utilise hollows for shelter – including Brush-tailed Possum (*Trichosurus vulpecula*) and Sugar Glider (*Petaurus breviceps*);
- reptiles that utilise ground debris and trees for shelter. Species previously recorded in the area were predominantly skinks and geckoes;
- amphibians that utilise ground debris, drainage lines and trees for shelter (such as native Green Tree Frogs as well as the Cane Toad (*Bufo marinus*);
- ground-dwelling mammals that utilise ground debris for shelter. None were recorded during previous fauna surveys in the area;
- microchiropteran bats that utilise hollows, dense vegetation and bark for shelter; and
- birds that utilise trees for nesting, including Barn Owl (*Tyto alba*) and Powerful Owl (*Ninox strenua*).

118. The Powerful Owl is known to inhabit the LNG Facility site, although no hollows of sufficient size for nesting were observed on site, and the cumulative impact of this and other adjoining proposals will remove a substantial area of potential foraging habitat and potential nest and roost sites for the species. Two individuals may be adversely impacted, or at worst lost, as a result of the proposed LNG site (APLNG, QGC plus Santos) clearing activities. The Powerful Owl is not an EPBC Act listed species. An offset for this impact has been proposed and would be required under Queensland legislation.

119. Several pairs of Beach Stone-curlews use habitat within and immediately adjacent to the LNG Facility site. The Squatter Pigeon was not recorded in surveys on site, but is known to be present on Curtis Island. The Squatter Pigeon is a nomadic, highly mobile species with a wide distribution. Within the Curtis Island and Gladstone area there is a large extent of similar habitat available.

120. The proponent has proposed a number of measures to stage and reduce the impacts of clearing as far as possible. The areas of vegetation to be cleared would be restricted to the minimum required. Tape, pegs or other markers would be employed to clearly delineate areas to be cleared prior to commencement with particular attention being paid when delineating clearing areas in proximity to (Queensland) listed vegetation communities that are not be disturbed.

121. Where clearing of vegetation is within or in close proximity to riparian communities, erosion and sedimentation mitigation measures would be utilised to ensure waterways are not impacted and riparian vegetation is not significantly affected. (The drainage lines on site are ephemeral).

122. Any clearing involving the removal of stands of woodland vegetation would be undertaken in stages to reduce disruption and allowing for fauna dispersal, thus retaining habitat connectivity. In other words clearing would be undertaken towards the direction of any adjacent contiguous vegetation that is not to be cleared to ensure isolated stands of vegetation are not created.

123. The proponent has suggested a program to offset the loss of cleared vegetation communities in accordance with current Commonwealth and state criteria for the offsetting of significant vegetation communities. A biodiversity offset strategy and management plan would be developed. Because the loss of the habitats described above will also affect attributes which contribute to the value of the GBRWHA and National Heritage place, a requirement for an overall offset package is recommended as a condition of approval.

Water Mouse (*Xeromys myoides*)

124. Impacts on the Water Mouse are discussed in this section, as potential impacts on this species were identified in the EIS as a result of the proposed action. This species is listed as vulnerable under the EPBC Act.

125. Surveys undertaken by proponents for LNG facilities on Curtis Island have indicated the presence of Water Mouse habitat on Curtis Island ranging from low to excellent habitat values. (Each of the proposed LNG sites support the same vegetation communities in slightly varying proportions.)

126. Subsequent to the release of the APLNG EIS, additional work undertaken for the company, reported in June-July 2010, identified a mound that has the potential to be a 'nesting' mound of the Water Mouse on the APLNG site near to the site of proposed marine facilities, although it is recognised that identification of such structures as definitely Water Mouse mounds is very difficult. Another proponent of a similar LNG project, QGC, produced a Water Mouse Management Plan (available at http://www.qgc.com.au/_dbase_upl/WaterMouse20101122.pdf) in October 2010, in which mounds identified as possible water mouse mounds on the APLNG and Santos sites are considered more likely to be structures built by crabs. The targeted survey work by QGC did not capture an individual of the species. Nonetheless in the survey report prepared for APLNG it is recommended that further targeted survey work be undertaken, given the brief nature of the survey and the size of the study area.

127. The Department's Species Profile and Threats (SPRAT) database indicates that the Water Mouse is known only from coastal areas of the Northern Territory and Queensland. It occurs only in three discrete populations on the eastern and northern Australian coastline and is indicated as being likely to occur in the project area. The database indicates that the species requires mangrove communities and associated saltmarsh, sedgelands, clay pans and freshwater melaleuca. The species' diet is dependant on a variety of crustaceans, all of which are common on intertidal saltmarsh habitat in south-east Queensland and the project area.

128. APLNG identified the Water Mouse as potentially occurring in the LNG facility site based on habitat preference. The mangroves and associated habitat at the front of the saltpan have been identified as the most suitable habitat within the site for this species. The development footprint directly impacts on sections of this habitat, related to the construction of the marine facilities. The remaining habitat is potentially impacted by indirect effects of development. Such effects relevant to this species, or their prey (principally crabs), include an altered hydrological regime, sediment or pollutant influx, increases in feral predators and the potential for competition from introduced rodents.

129. It is unknown whether or not a population of the Water Mouse exactly how much Water Mouse habitat might be directly or indirectly impacted by the APLNG LNG facility and marine facilities. It is therefore difficult to determined what, if any, offset measures would be required. It is recommended that the proponent be required to undertake further targeted survey work for the species in the footprint of the LNG facility.

130. The proponent should quantify total habitat loss of the species and if required, propose adequate mitigation or offset measures. A condition requiring this further work has been included as stated above. The Department considers that this condition will satisfactorily mitigate the impact of this proposal on the Water Mouse.

Marine Turtle species

131. Three listed marine turtle species inhabit areas potentially affected by the construction and operation of the proposed LNG Facility - the Green Turtle (Chelonia *mydas*) – EPBC listed as migratory and vulnerable; the Loggerhead Turtle (*Caretta caretta*) – EPBC listed as endangered and migratory; and the Flatback Turtle (*Natator depressus*) – EPBC listed as migratory and vulnerable. The proposal creates similar potential impacts for all three of these species, and they are therefore discussed collectively in this section.

132. Curtis Island and Facing Island are identified in the Department's Species Profile and Threats data-base (SPRAT) as a major nesting area for the Green Turtle. The east coast of Curtis Island is identified in SPRAT as a major nesting area for the Flatback Turtle. The proponent has also identified Facing Island and a beach adjacent to Tannum Sands (on the mainland, south of Gladstone) and the Port of Gladstone as nesting sites for this species. The nearest nesting site for the Loggerhead Turtle to the Port of Gladstone is among the 13 islands of the Capricorn-Bunker Group, approximately 80km east of Gladstone.

133. The recent EIS for the Western Basin Strategic Dredging and Disposal Project (EPBC 2008/4904) also identifies that Port Curtis is recognised as providing important foraging habitat for the Flatback Turtle, the Loggerhead Turtle and the Green Turtle. Port Curtis was identified as of particular importance for Green Turtles as it supports large amounts of seagrasses, an important food source. The area impacted by the proposed APLNG development does not contain significant seagrass cover. The major seagrass beds in Port Curtis occur elsewhere.

134. In Australia, the main threats to marine turtles are disturbance (e.g. from artificial light) and habitat damage due to coastal development; by-catch from fisheries and shark control measures; predation on nests; boat strikes; entanglement and ingestion of marine debris; and in some areas, Indigenous harvesting. Potential threats include changes to the sea surface temperature, particularly changes to the Southern Oscillation Index, which determines breeding intervals; chance disasters (e.g. oil spills).

135. Hatchling sea turtles often emerge from their nests at night and are attracted to the brighter, lower elevation sea horizon. Hatchlings that move towards artificial lights instead of the sea are likely to be killed by predators or exposure, or burned if they are attracted to fire. The threat to hatchlings from artificial lights depends on the wavelength and strength of lights, and the strength of ambient moonlight.

136. A 2005 study found that the hatchlings of the Hawksbill Turtle (related to the Green Turtle) are more attracted to short-wavelength lights (ultra-violet, blue and green lights) at lower light intensities than to high pressure sodium vapour lights (e.g. streetlights, which emit yellow-orange light) and gas flares (open flames that burn excess gas), emitting mainly long wavelengths) (K L Pendoley, 'Sea Turtles and the Environmental Management of Industrial Activities in North West Western Australia', PhD thesis, Murdoch University, 2005). 500W fluorescent lights attracted hatchlings at a distance of 800m. Some distant offshore lights from pearling vessels and drilling rigs (for example an offshore drilling rig 3.3km away) were bright enough to affect hatchling movements. Flares may attract hatchlings on moonless nights. There is also accumulating evidence that when the skyline of turtle nesting beaches become brightly illuminated, the associated adult nesting population will decline (Salmon *et al.* 2000), not because of mortality of the turtles but because the adult turtles choose not to use that beach.

137. The proponent has identified beaches on the ocean side of southern Curtis Island and Facing Island as supporting an important intermediate breeding population of Flatback turtles, and that the beaches also support occasional nesting behaviour of the Loggerhead turtle and Green turtle.

138. APLNG considered that the Green Turtle, Loggerhead Turtle and the Flatback Turtle are likely to be present within the Port of Gladstone. The proponent considers that potential impacts to nesting behaviour for these species are negligible due to the location of the marine facilities on the south-western side of Curtis Island.

139. The Pacific Ridley (Olive Ridley) turtle (*Lepidochelys olivacea)* and the Leatherback (*Dermochelys coriacea*) might be possible visitors to Gladstone Harbour, though neither has been recorded as being sighted.

140. The proponent proposes mitigation measures to minimise light pollution and potential impacts to nesting turtles and hatchlings including ensuring that all lighting with the LNG Facility is minimised during design phase by:

- reducing the intensity of light glow using low pressure sodium (LPS) lights;
- using timers to reduce the amount of time the lights are used;
- installing movement sensor lights; and
- restricting the height of available light or applying shrouds to control direction.

141. Nonetheless, with routine flaring (even though this is proposed to be from ground flares only, so that flares are not in a direct line of sight from turtle beaches) and lighting on the plant required for safe operation, the loom of light at night in the sky above southern Curtis Island would increase above the current background level, caused by the presence of the city of Gladstone and the industrial plants on the mainland, if the planned APLNG LNG Facility is constructed. Additional LNG facilities would add to this loom, even if, as is the case with the APLNG proposal, they have ground level flares. Because of the existing light levels it is difficult to estimate the degree of impact new LNG facilities on Curtis Island might have to the night light regime.

142. The Department therefore believes that a robust monitoring regime is needed to be able to identify if any impact on turtle populations does occur that can be attributed to the operation of the LNG Facility, if it were to be approved, and that responses measures can be implemented to make good or offset any impact that is detected. A recommended condition of approval is that a long-term marine turtle management plan be developed by the proponent, potentially in cooperation with other LNG Facility operators, and that the plan be implemented following examination and approval by the Minister.

143. In recent decades there has been an increase in the number of turtles killed by collision with vessels and cuts from propellers, and injuries to turtles are expected to rise as vessel traffic increases in coastal waters. Recreational power boats and other rapid moving craft in inshore waters, as well as large ships travelling at cruising speed in more open waters, all contribute to the problem. The landward section of the proposed shipping channel for the APLNG project will extend from the proposed marine facilities on south-west Curtis Island through the Port of Gladstone and south-east between Facing Island and Tannum Sands on the mainland. Although this channel is already utilized, the increased shipping volume related to this project (12.5 per cent above the shipping volume in 2008) increases the risk of turtle strikes, especially as part of the breeding areas for Flatback Turtles are adjacent to this channel. This creates a high risk of an impact on the Flatback Turtle, and a risk of impacts on the Green Turtle and the Loggerhead Turtle.

144. The proposed conditions developed for this proposal are designed to cover a number of potential impacts associated with shipping activity on the three turtle species discussed (such as oil and chemical spills, and impacts on sea grasses), to provide for their protection. The proposed conditions, which includes the requirement for a Shipping Activity Management Plan, are relevant to their protection. The Department considers that, to satisfactorily mitigate the impact of this proposal on the three marine turtle species, it will be important to ensure that the proponent develops measures that take into account the particular vulnerability to vessel strikes of this slow-moving species.

145. The Department considers that, if these conditions are implemented, they will satisfactorily mitigate the impact of this proposal on these species.

Migratory Species (ss. 20 and 20A)

146. The following marine turtle species which were referred to above in the discussion of impacts on threatened species are also listed as migratory species under the EPBC Act:

- Flatback Turtle (*Natator depressus*);
- Loggerhead Turtle *(Caretta caretta*); and
- Green Turtle (*Chelonia mydas*).

147. The Dugong is a marine mammal listed as a migratory species under the EPBC Act and is found in the waters adjacent to the proposed LNG facility.

148. A significant proportion of the global Dugong population is found in northern Australian waters from Western Australia to Moreton Bay, Queensland. The large populations in the Great Barrier Reef were one of the natural features associated with its World Heritage listing.

149. The Rodds Bay Dugong Protection Area established under Queensland legislation includes the Port of Gladstone and the majority of Curtis Island waters (including those between Fisherman's Landing and the site of the proposed marine facilities on Curtis Island) east to Facing Island.

150. The large-scale movements of Dugongs have made interpretation of long-term trends in their abundance in Queensland difficult. However, there is evidence of a long-term decline along the Queensland urban coast region with shorter-term local fluctuations. A 2000 study estimated changes in Dugong populations since the 1960s along a 10° latitudinal stretch of the urban coast of Queensland, south of Cairns (this area includes the Port of Gladstone). This study suggests that, since the early 1960s, populations have declined to about 3 per cent of their size in this region (K Dobbs et al 'Incorporating dugong habitats into the marine protected area design for the Great Barrier Reef Marine Park, Queensland, Australia.' *Ocean & Coastal Management*. 51:368-375.)

151. The operation of the proposed LNG Facility could potentially impact on individuals of this species (and other marine mammals and marine turtles) through the proposed discharges to sea described in the **Potential Sources of Impacts** section of this report above. However with the proposed mitigation measures also discussed and the proposed conditions of approval regarding the implementation of environmental management plans for construction operation and decommissioning of the plant, no unacceptable impact is likely on the dugong or other marine creatures as a result of the proposed LNG Facility.

152. The seagrass species *Halodule uninervis*, *Halophila ovalis, Halophila decipens, Halophila minor,* Halophila *spinulosa,* and *Zostera capricorni* are not listed under the EPBC Act. However these seagrass species are a food source for the Dugong, which is a listed migratory species. As such, impacts on these seagrasses are likely to have consequential impacts on the Dugong. These seagrass species are also a value of the Great Barrier Reef World Heritage Area. The area impacted by the proposed APLNG development does not contain significant seagrass cover. The major seagrass beds in Port Curtis occur elsewhere. Modelling of proposed dredging activity for the proposed marine facilities indicates that sea grasses would be unlikely to be affected. The proposed conditions would require the proponent to minimize disturbance to seagrass species.

153. The Department considers that the shipping activities described in the referral create the potential for impacts on the Dugong, especially in relation to vessel strikes and their impact on the seagrass food source for this species. This may arise from risks of disturbance to seagrass meadows caused by prop-wash, and anchor scouring. The increase in vessel movements may also increase risks of interference to the migratory pathways for this species, and for other migratory species in the project area.

154. The proposed conditions are designed to cover a number of potential impacts associated with shipping activity on the Dugong (such as oil and chemical spills), and to provide for the protection of this species. The requirement for a Shipping Activity Management Plan, is relevant to the protection of the Dugong. The Department considers that, if this condition is implemented, it will satisfactorily mitigate the impact of this proposal on the Dugong.

Migratory Shorebirds

155. Seven migratory bird species listed under the EPBC Act were identified during the field survey of the LNG facility study area. Based on habitat preference, the LNG facility site may support suitable habitat for a further 34 migratory bird species which may be expected to occur, at least occasionally, in the vicinity of the site.

156. Shorebird feeding grounds and roosting sites have been identified within the greater Port Curtis area but the LNG facility is not located within any of these identified areas. The LNG facility site does, however, contain intertidal flats suitable for foraging habitat for a range of migratory shorebird species.

157. .The construction period potentially involves a high level of disturbance with increased activity and potentially loud intermittent noise. The majority of migrating shorebirds will utilise the area from November through to March each year. Disturbance as a result of construction activity outside of this period will not significantly impact these shorebirds.

158. The construction of marine facilities associated with the proposed development is likely to temporarily disrupt this migratory shorebird habitat. Once operational the shorebird habitat is not likely to alter significantly over the long term. The increased human activity however, is expected to deter some species. It is likely that there will be a reduction in the use of the area of mudflat around the facility. However the area does not act as core habitat for any of the migratory shorebirds as similar vegetation communities and topography is found elsewhere in the region.

159. Although it is likely that only a small number of shorebirds presently roost and forage in the LNG Facility project area, there is uncertainty as to the number likely to be permanently displaced in the longer term. Furthermore the habitat that would be lost contributes to the ecological and conservation World Heritage values of this part of Curtis Island.

160. The Department therefore recommends that the proponent be required to undertake further targeted survey work for the migratory birds in the footprint of the proposed Marine Facilities. The proponent should better quantify total habitat loss and if required, propose adequate mitigation or offset measures. A condition requiring this further work has been included to achieve this objective.

Other Migratory Species

161. A number of small migratory bird species, such as *Hirundapus caudacutus* (White-throated Needletail), *Monarcha melanopsis* (Black-faced Monarch), *Monarcha trivirgatus* (Spectacled Monarch) and *Rhipidura rufifrons* (Rufous Fantail), although not all sighted in surveys at the APLNG, (or Santos or QGC LNG) sites, are likely to utilise, at times, some of the vegetation communities presently located on the proposed LNG Facility sites. The impact on these species is not likely to be significant, although individuals may be lost or displaced and the local population reduced. Nonetheless the woodland habitats that would be lost contribute to the ecological and conservation World Heritage and National Heritage values of this part of Curtis Island. For these reasons suitable habitat for these species must be included in the package of offsets to be imposed as a condition of approval.

162. Once clearing has been completed the operation of the plant will have the potential for only minor additional impact, as long as conventional well understood environmental management regimes are in place, as discussed in the **Potential sources of impacts** section of this recommendation report (above).

World Heritage properties (ss.12 and 15A) and National Heritage places (ss. 15B and 15C)

163. Curtis Island and the Narrows, the channel between Curtis Island and the mainland, are part of the Great Barrier Reef World Heritage Area and National Heritage Place. World Heritage and National Heritage values are interrelated in that on 15 May 2007, under the *Environment and Heritage Legislation Amendment Act (No. 1) 2003,* the then Minister for the Environment and Water Resources, determined that the Australian World Heritage properties included in the World Heritage List, including the GBRWHA, would be included in the National Heritage List for those World Heritage values that the World Heritage Committee had identified each property as having. For the GBRWHA the World Heritage Values as currently categorised are (vii), (viii), (ix), and (x), corresponding with National Heritage Criteria (a), (b), (c), (d), and (e). These corresponding National Heritage criteria for each place are identified in a Schedule to the determination.

164. The Great Barrier Reef was inscribed on the World Heritage List in October 1981. The World Heritage criteria against which the Great Barrier Reef was listed remain the formal criteria for this property. The World Heritage criteria are periodically revised and the criteria against which the property was listed in 1981 are not necessarily identical with the current criteria. For instance the values which the GBRWHA was inscribed are those described for natural criteria (i), (ii), (iii) and (iv) in the nomination document of 1981. Today the numbering of those four criteria in the World Heritage Operational Guidelines are (vii), (viii), (ix) and (x). For the GBRWHA the following criteria apply:

World Heritage

(i) to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

(ii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;
(iii) to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;
(iv) to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

National Heritage

(i) the place has outstanding heritage value to the nation because of the place's importance in the course, or pattern, of Australia's natural or cultural history;
(ii) the place has outstanding heritage value to the nation because of the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;
(iii) the place has outstanding heritage value to the nation because of the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history;
(iv) the place has outstanding heritage value to the nation because of the place's importance in demonstrating the principal characteristics of:
   a. a class of Australia's natural or cultural places; or
   b. a class of Australia's natural or cultural environments;
(v) the place has outstanding heritage value to the nation because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.

ATTACHMENT E

Figure 2 - Great Barrier Reef World Heritage Area

165. World Heritage Area and National Heritage Place attributes potentially affected by the proposed LNG facility, through direct clearing and the activities discussed in the **Potential sources of impacts** section of this recommendation report (above), include the diversity of flora and fauna of the GBRWHA, feeding and/or breeding grounds for international migratory seabirds, cetaceans, and sea turtles, coastal and adjacent islands with mangrove systems of exceptional beauty, mangrove, saltmarsh, and seagrass systems, habitats for species of conservation significance, and species of plants and animals of conservation significance, including dugong and other marine mammals, marine turtles and migratory birds. The proponent considers that the potential for impact on the World Heritage and National Heritage values of the Great Barrier Reef is low.

166. The GBRWHA covers 348 000 km^2, making it, until recently, the largest World Heritage Area. At the 34th session of the World Heritage Committee in Brasilia, in July-August 2010 two slightly larger sites were inscribed on the World Heritage List: Papahānaumokuākea (USA), 360 000 km^2 of ocean and reefs North of Hawaii) and the Phoenix Islands Protected Area (Kiribati, 408,250 km^2 of marine and island habitats in the Southern Pacific Ocean).

167. The GBRWHA stretches more than 2,300km along the northeast coast of Queensland (low water mark), from the tip of Cape York in Queensland in the north, south of the Tropic of Capricorn to just north of Bundaberg (see <u>Figure 3</u>). Its outer boundaries are defined by coordinates of latitude and longitude. Its width varies from around 90km to around 300km. Its boundaries are the same as those of the Great Barrier Reef Region (GBRR) defined in the *Great Barrier Reef Marine Park Act 1975* (the GBRMP Act).

168. Approximately 99 per cent of the World Heritage Area is comprised of the Great Barrier Reef Marine Park, which extends up to mean low water mark. However, the following areas within the Great Barrier Reef World Heritage Area are not part of the Commonwealth Marine Park:

- most of the approximately 900 islands in the Great Barrier Reef are within the World Heritage Area but not part of the Commonwealth Marine Park. Some 50 per cent of all Great Barrier Reef islands are Queensland National Parks, and only around 70 islands, or parts of islands, are under Commonwealth control (for example lighthouse stations), and 21 of these islands are managed as part of the Great Barrier Reef Marine Park;
- internal waters of Queensland, for example many deep bays or narrow inlets; and
- a number of small coastal exclusion areas around ports or major centres, for example Cairns, Gladstone and Townsville Ports.

169. The rights of the state of Queensland over its coastal waters are subject to the operation of the GBRMP Act. The Commonwealth has jurisdiction to regulate, through the GBRMP Act, in relation to all waters within the Great Barrier Reef Region (GBRR), which extends to the low water mark.

170. The GBRMP boundary recognises that the waters in identified port areas do not necessarily have conservation as their primary objective but are industrial/commercial areas with the potential for industrial activity to expand through time, and therefore excludes them. The GBRWHA boundary, however, does not have these port exclusion areas.

171. The current Operational Guidelines for the Implementation of the World Heritage Convention published by UNESCO require that all properties nominated for inscription on the World Heritage List satisfy conditions of integrity, where integrity is defined as ‘a measure of the wholeness and intactness of the natural and/or cultural heritage and its attributes’. Examining the conditions of integrity therefore requires assessing the extent to which a property:

- includes all elements necessary to express its outstanding universal value;
- is of adequate size to ensure the complete representation of the features and processes which convey the property’s significance; and
- suffers from adverse effects of development and/or neglect.

172. The Operational Guidelines include further directions for describing and assessing the condition of integrity for each possible World Heritage criterion, for example criteria (vii) to (x) in the case of the GBRWHA. These comprehensive directions include examples of what integrity means in particular circumstances, including the statement that: ‘ a coral reef should include, for example, seagrass, mangrove or other adjacent ecosystems that regulate nutrient and sediment inputs into the reef’.

173. The World Heritage ‘integrity’ criteria at the time of inscription were less comprehensive than those currently applied. The only reference to integrity in the Great Barrier Reef World Heritage nomination is:

‘The area nominated also meets the condition of integrity in that it includes the areas of the sea adjacent to the Reef’.

WHA Planning and Management Regime

174. In Australia, there is a range of regimes for the protection and management of World Heritage sites:

- Some are managed as protected areas as state-owned ‘national’ parks, for example most of the Tasmanian Wilderness;
- Some are Aboriginal-owned national parks, for example Uluru Kata Tjuta and Kakadu;
- Some overlay a large number of jurisdictions and tenures, and have a multiple use philosophy, for example the Great Barrier Reef and Wet Tropics of Queensland.

175. The EPBC Act provides protection for World Heritage values. There is legislation in place to prohibit mining within the GBRR. Ninety nine percent of the GBRWHA is Marine Park and within the Marine Park 33 per cent of the area is highly protected by ‘no-take’ zones

176. The GBRWHA supports large commercial fisheries and major shipping routes pass through it. There are 10 large trading ports along the Barrier Reef coast. There are large industrial plants along the coast, not in the GBR WHA, that discharge into the GBR WHA – including Korea Zinc near Townsville, and Gladstone Pacific Nickel.

Curtis Island and its World Heritage Attributes

177. There are approximately 552 continental islands in the GBRWHA (The figure is approximate as estimates depend on the judgments made as to whether or not very small islets or outcrops should be counted as 'islands'). The total area of these continental islands is about 1627 km^2 or 0.1 per cent of Queensland's terrestrial land area. Curtis Island is the largest of these with an area of 46,600 ha. This is approximately 0.1339 per cent of the total area of the GBR WHA, and 28.641 per cent of the total area of all continental Islands within the GBR. The next largest continental island is Hinchinbrook Island, situated further north in the wet tropics, which has greater relief (the highest point is Mount Bowen reaching 1142m in height) and greater biodiversity.

178. The present day continental islands represent mountainous regions of the now submerged continental shelf. According to Thom and Chappell (1975) between 12,000 and 10,000 years before present (BP) the sea level rose to 30m below its present level. At this time some of the present day offshore islands were separated from the mainland. Some 6,000 years BP the sea had risen to about its present level. During this period large amounts of sand moved inshore and along the shore to form most of the present day coastal dune systems. Some of these dunes occur on Curtis Island, Great Keppel Island, Percy Islands, Whitsunday Island, Hinchinbrook Island, Lizard Island, Turtle Head Island and Albany Island (near Cape York).

179. It has been postulated that at the time of island formation most of the island flora consisted of dry open forest elements. The present 46 per cent rainforest flora of the total flora of all the continental islands is due to the process of re-colonisation by flora species from the mainland, a process which is likely continuing. Only three endemic island plant species are found within the GBRWHA, none on Curtis Island. Seventy nine or 6 per cent of Queensland's known rare and endangered flora species occurs on continental islands (that is 94 per cent occur on the mainland).

180. Curtis Island is at the northern extremity of the South Eastern Queensland bioregion, opposite the area on the mainland where, further to the west, the Brigalow Belt South and Brigalow Belt North bioregions meet (although the Brigalow (*Acacia harpophylla* dominant and co-dominant) EPBC Act listed threatened community does not occur on Curtis Island).

181. The island has biogeographical significance as it supports species and communities which are at their distribution limits. These include: five plant species (northern limit, *Dianella brevipedunculata*; southern limit, *Alyxia obtusifolia, Lindernia anagallis, Marsilea crenata and Solanum viridifolium*; the tropical marine plain community; and the southernmost rookery site of the flatback turtle (*Natator depressus*). The seagrass species *Halophila tricostata* is at the limit of its distribution. Several species of mangrove, *Acanthus ilicifolius*, *Avicennia eucalyptifolia*, *Xylocarpus australasicus* and *Bruguiera exaristata*, are also at or near the limit of their distribution. The estuarine crocodile, *Crocodylus porosus,* is also at the southern extent of its distribution in this area.

182. The Narrows between Curtis Island and the mainland represents an uncommon passage landscape and is one of only five narrow tidal passages separating large continental islands from the mainland in Australia. It is also an important indicator of past geomorphological (sedimentation) processes.

183. Curtis Island is largely undeveloped and has a small residential population.

184. Prior to the declaration of the environmental management precinct (EM Precinct see Fig 2) as part of the Curtis Island extension to the Gladstone State Development Area (GSDA), further discussed below, more than 50 per cent of Curtis Island was protected as conservation estate in the following parks and reserves:

- Cape Capricorn Conservation Park;
- Curtis Island Conservation Park;
- Curtis Island National Park;
- Curtis Island State Forest;
- North Curtis Island State Forest; and
- Curtis Island Nature Refuge.

185. The majority of these reserves are to the north of Graham Creek. The addition of the EM Precinct, south of Graham Creek, increased the area of Curtis Island under conservation management to around 68 per cent. The remainder is a combination of privately held freehold and leasehold areas, apart from the Queensland Government owned Curtis Island Industrial Precinct (CIIP) part of the Gladstone State Development Area (GSDA). The main land use on the freehold and leasehold areas, apart from the recently proclaimed CIIP, is cattle grazing.

186. To the south of Graham Creek lies the most recent extension of the GSDA, the majority of which is in several parcels on the adjacent mainland. Some 70 per cent of this area has been designated as an environmental management precinct (EM Precinct), approximately 4,590 ha in area (See Figure 3). Previously used as a cattle grazing property, the EM Precinct is intended to protect and maintain areas of high ecological significance, and provide areas for public open space. The Department understands that the area is not currently retained under an arrangement that assures its status as a conservation area in perpetuity. Each proponent intending to establish LNG production and export facilities on Curtis Island will be required to provide financial support to the ongoing planning, development and management of the EM Precinct. The rest of the Curtis Island portion of the GSDA is the 1500 ha Curtis Island Industry Precinct (CIIP), which was created specifically for the establishment of liquefied natural gas facilities on the west coast of southern Curtis Island.

187. Notwithstanding the extent of conservation areas on Curtis Island, there is much evidence of disturbance, particularly at the southern end of the island. For example vegetation of the proposed LNG Facility has evidence of a long history of disturbance including grazing, thinning and exotic weed invasion. The majority of vegetation is currently grazed and exhibits some degradation of ground-cover and mid-strata species. The fauna diversity recorded on the site was very low and some species expected to be present were not detected. These include native and exotic rats and mice and small ground dasyurids such as dunnarts (*Sminthopsis spp.*) and *Antechinus spp*. These groups are especially vulnerable to feral predators and habitat disturbance. They also naturally experience population booms and crashes. Their absence may primarily be attributed to the historical disturbance and presence of feral cats and wild dogs at the LNG Facility study area.

188. Domesticated cattle and horses are present throughout the LNG Facility study area and surrounds. Signs of impacts from grazing include erosion and weed infestations typical of pasture situations. Feral cats (*Felis catus*) have been observed either at the APLNG site or the adjoining Santos and QCG sites, as have pigs, (*Sus scrofa*) and tracks from wild dogs or dingos (*Canis familiaris*). Cane toads are abundant throughout the study area.

189. A recent study of the EM Precinct identified a number of land contamination issues including an old collapsed cattle dip, and an unofficial tip in a dry drainage line containing a number of old car bodies, a significant number of rusting 44 gallon drums and other rubbish. About 23 tonnes of waste was recovered from the site and removed from Curtis Island to mainland disposal sites.

190. The southern end of Curtis Island is close to Gladstone and several major industrial plants on the mainland lie within less than 10 km of the CIIP:

- One of the world's largest alumina refineries – Queensland Alumina Ltd (QAL);
- The worlds first greenfield alumina refinery to be constructed since 1985 – Rio Tinto Aluminium Yarwun Alumina Refinery;
- Australia's largest aluminium smelter – Boyne Smelters Ltd (BSL);
- Australia's largest cement kiln – Cement Australia;
- The largest power station in Queensland – Gladstone Power Station (NRG);

- The largest industrial grade ammonium nitrate plant in the world, a very large scale sodium cyanide plant and a chloralkali plant – Orica; and
- Queensland Energy Resources, formerly Southern Pacific Petroleum Oil Shale, trial shale oil plant.

LNG Facility Impacts

191. There would be some impact on World Heritage and National Heritage values, as represented on Curtis Island, caused by the proposed clearing of the site and construction of an LNG Facility with supporting infrastructure on the south-western side of Curtis Island (on the northern side of the Port of Gladstone) north east of Gladstone city. As discussed above vegetation clearing would occur across the majority of the site.

192. This planned clearance would have a long term, potentially permanent impact on a vegetated area that cannot be avoided if the proposed facilities are constructed. The building of an LNG Facility would have an impact on the natural beauty and aesthetic importance of Curtis Island and thus to the GBRWHA (i.e. World Heritage value criterion VII) because of the change from a natural to a built environment with large structures and lighting visible from some distance away. The LNG Facility would be visible from Port Curtis; and the LNG train and storage tanks would be visible from Port Curtis parts of the Mount Larcom-Gladstone Road and the structures would be visible from Tide, Witt and Turtle Islands. Views from the mainland coastline at Targinie towards Curtis Island would be most significantly affected. Overall there would be minor impacts because the site directly faces a large industrial port precinct, dominated by man-modified elements, and visually linking with the industrial landscapes of the existing Gladstone waterfront port areas.

193. Clearing of natural vegetation at the LNG Facility site would have a minor local impact on some ecological and biological processes, as described under the Potential sources of impacts sections of this report (above), but these are not considered to reach the level that could be considered unacceptable in terms of World Heritage criterion (ix) (significant ongoing ecological and biological processes) or criterion (x) (significant natural habitat for in-situ conservation of biological diversity).

194. There would be very little impact on attributes that contribute to criterion (vii) (significant geomorphic or physiographic features) of the GBRWHA.

195. No sites of indigenous cultural heritage were identified on Curtis Island in the vicinity of the LNG Facility through desktop searches undertaken by the proponent. Field surveys have not been completed, however, the *Aboriginal Cultural Heritage Act 2003* (Queensland) sets out provisions for determining cultural significance. The legislation ensures that impacts to any areas that are located in surveys would be mitigated and managed in accordance with the *Aboriginal Cultural Heritage Act 2003* and with a Cultural Heritage Management Plan (CHMP) agreed with the Port Curtis Coral Coast Traditional Owner group.

196. There were no sites of non-indigenous heritage identified in any of the world, state or local registers searched for the LNG Facility study area. Heritage sites identified during field surveys were not considered to be of state significance. If sites of State Significance were to be located in the future, any work needing to be conducted by the proponent would be undertaken in accordance with the *Queensland Heritage Act 1992*.

Secondary Impacts

197. Some impacts associated with the construction and operation of the LNG Facility, particularly lighting, flares, dredging, operation of a brine outfall from a reverse osmosis (RO) plant and the movement of vessels could impact on turtles and marine mammals in the waters adjacent to the proposed LNG Facility. Several of these species are listed threatened or listed migratory species, and their presence is an attribute that contributes to the values of the Great Barrier Reef World Heritage Area and National Heritage Place.

198. The most significant of these activities are the lighting regime and on the LNG Facility and passenger ferry movements. The level and significance of these impacts has been discussed above in relation to specific EPBC Act listed species and in the Potential **sources of impact** section of this report.

Conclusion

199. Constructing, operating and decommissioning the proposed LNG Facility involves activities common to a range of industrial projects such as site clearing, construction, water and sewage treatment, waste management, release of emissions to air and water, concrete batching, chemical storage. This being the case, the management of these activities is well understood and would be regulated through a number of standard conditions under Queensland legislation and in particular through an environmental authority attached to a petroleum facilities licence for the site.

200. The majority of impacts on Listed threatened species and communities, Listed migratory species, World Heritage properties and National Heritage places from the construction and operation of the proposed LNG Facility can be avoided or reduced to a large extent through good design. The residual potential impacts can be largely managed through the implementation of suitable environmental management strategies outlined in the draft environmental management plans, as refined by the recommended conditions of approval. There will nonetheless be some unavoidable loss of natural vegetation and habitat for a range of fauna species.

201. This in turn means that there would be minor direct impacts on one attribute that contributes to the World Heritage values for which the GBRWHA is listed, at one locality on Curtis Island, one of more than 500 continental islands in the GBRWHA (albeit the largest).

202. Impacts on ecosystem values via changes to the existing lighting regime and through emissions to water (particularly RO brine and sewage effluent disposal), and to air, with the measures proposed and conditions of approval recommended, are likely to be minor. Clearing of natural vegetation at the LNG Facility site would have a minor local impact on some ecological and biological processes. None of these impacts but are considered to reach the level that could be considered unacceptable in terms of World Heritage criterion ix (significant ongoing ecological and biological processes) or criterion x (significant natural habitat for in-situ conservation of biological diversity).

203. While Curtis Island and surrounding waters have biogeographical significance supporting species and communities which are at their distribution limits – ranging from the southernmost rookery site of the flatback turtle (*Natator depressus*) to several species of mangrove, *Acanthus ilicifolius*, *Avicennia eucalyptifolia*, *Xylocarpus australasicus* and *Bruguiera exaristata*, also at or near the limit of their distribution – none of the species involved would be significantly affected by the proposed LNG Facility development.

204. The uncommon passage landscape of The Narrows between Curtis Island and the mainland, one of only five narrow tidal passages separating large continental islands from the mainland in Australian, would also be largely unaffected, apart from the visual impact discussed below.

205. The Department does not believe that the minor changes to landform proposed (site levelling and profiling, foundation building, cut and fill operations and minor dredging) are of a scale that could be considered to impact on attributes that contribute to criterion VIII (significant geomorphic or physiographic features) of the GBR WHA. Larger scale channel dredging is required for the ease of passage of LNG tankers and will have some impact on the sub sea geomorphological features of the wider part of the Narrows. This proposal has been referred as a separate action (Gladstone Ports Corporation Port of Gladstone Western Basin Strategic Dredging and Disposal Project, EPBC Reference Number: 2009/4904).

206. If the proposed LNG Facility is built, however, there will be impacts on the natural beauty and aesthetic importance of Curtis Island and thus some diminution of the overall aesthetic landscape values of the GBRWHA (i.e. World Heritage value criterion VII) because of the change from a natural to a built environment with large structures and lighting visible from some distance away, as has been discussed above. A table summarising key GBRWHA attributes, values and potential impacts is provided at Attachment E3.

207. At the controlled action decision stage it is not necessary for an action to impact on the whole of a World Heritage property, all of the values of a World Heritage property, or a whole value of a World Heritage property, to be considered to have a significant impact on World Heritage values. It is sufficient if an action is likely to have a significant impact on a part, element or feature of a World Heritage property, which embodies manifests, shows or contributes to the values of that property. The consideration now, taking into account the assessment of the proposal, proposed mitigation measures and offsets proposed, is whether or not the impact involved is acceptable.

208. The assessment process shows that the proposed LNG Facility is likely to have a minor impact on one listing value at one locality within the large GBRWHA. At the controlled action decision point the reasoning that significant impact on any area, however small, is an impact on the whole World Heritage Area is a sensible means of ensuring proposals are properly examined and is one way of minimising the chance of incremental degradation that might otherwise occur if significant actions limited to small areas were exempt from examination on an area of impact or number of attributes affected formulaic basis. However, in considering the acceptability or otherwise of a controlled action that impacts on one small area within the GBRWHA an ‘all or nothing’ approach does not recognise the reality of the vast range of landscapes, range of land uses, tenure arrangements, development settings or the spatial distribution of attributes that contribute to the values of the place that make up the GBRWHA.

209. Further discussion of the policy and planning context of Curtis Island within the World Heritage Area and National Heritage Place is provided at Attachment E4.

Offsets

210. Under the Queensland *Vegetation Management Act 1999* the loss of regional ecosystems and essential habitat are likely to be required to be offset for the LNG facility. The regional ecosystems are either ‘endangered’, ‘of concern’ or associated with wetlands/watercourses, and include habitat for the Queensland listed Powerful owl, Glossy-black Cockatoo Koala and Beach stone curlew. An average ratio of around 3:1 will be applied in calculating the areas required to offset this level of clearing, and the CG has determined that the securing of around 250 ha of priority coastal land within the southeast Queensland bioregion is a suitable initial offset (the habitats for some of the species overlap, that is, for example, both the Powerful owl and Glossy black cockatoo utilise the same open forest and woodlands that will form part of the offset land package). However, while in the same bioregion, the area of land to be protected may not necessarily be on Curtis Island.

211. To some extent the local scale impacts on the existing natural ecosystems at the proposed LNG site are already intended, under measures put in place by the Queensland Government, to be offset through increased protection of 70% of the Gladstone State Development Area (GSDA) on the southern end of Curtis Island as an environmental management precinct (EM Precinct). (See Figure 3.)

212. The EM Precinct is approximately 4,590 ha in area. It was previously used as a cattle grazing property but retains tracts of eucalypt woodlands and other vegetation communities and associated fauna in reasonably good condition. The EM Precinct is intended to protect and maintain areas of high ecological significance, and provide areas for public open space. Each of the LNG proponents intending to establish production and export facilities in the industrial precinct on Curtis Island will be required to provide financial support to the ongoing planning, development and management of the EM Precinct.

213. A recommended condition of approval is that an Environment Offsets Program to compensate for the direct loss of habitat and associated World Heritage and National Heritage values, caused by LNG Facility construction and operation, including funding to support programs that must have the objective of identifying, protecting, conserving, presenting, and transmitting to future generations and, if appropriate, rehabilitating, the World Heritage values of the GBRWHA property, must be provided to the Minister for consideration and if approved implemented by the proponent. In addition an area of land containing equivalent attributes or characteristics to those of the area of Curtis Island impacted by the LNG facility, and which contribute to the World Heritage and National Heritage values of the GBR, must be secured and permanently protected in a secure land tenure arrangement. As the number of LNG tankers required to export the LNG would increase with each additional LNG train (by approximately 60 LNG tanker movements), with attendant increases in risk to attributes which contribute to the values of the GBR WHA and National Heritage place (for example the chance of grounding and damage to corals, or collisions with marine mammals and turtles), the proposed condition incorporates a monetary contribution to offsetting measures that increases with each additional LNG train that comes into operation.

214. In summary the impacts of the proposal are considered to be acceptable having regard to the following:

- the relatively degraded character of southern Curtis Island. The SEIS reports that vegetation within the project site has a long history of disturbance from grazing, thinning and exotic weed and feral animal invasion. The Great Barrier Reef Marine Park Authority has confirmed this view in discussions with the Department;
- the area does not act as core habitat for any terrestrial species listed under the EPBC Act, or the IUCN Red List. The EPBC Act species considered most likely to be present within the LNG Facility is the Water Mouse (*Xeromys myoides*, vulnerable);
- the proposed facility is adjacent to the heavily industrialized Port of Gladstone;
- the proposed conditions would require a substantial package of direct and indirect offsets in relation to the World and National Heritage values of the area. That package should contribute to improving the heritage values of Curtis Island (e.g. through weed and feral animal control); and
- the proposed conditions for the avoidance and mitigation of impacts.

215. The recommended conditions reflect the need to preserve the natural values of the GBRWHA that this proposal may impact. The Department considers that, if these conditions are implemented, they will satisfactorily mitigate the impact of this proposal on the GBRWHA and National Heritage Place.

Indirect and cumulative impacts

Site Clearing

216. The cumulative effect of several adjoining LNG facilities: (the QGC Queensland Curtis LNG project, Santos Gladstone LNG (GLNG) project, the Australia-Pacific LNG (APLNG) project owned by ConocoPhillips (50 per cent) and Origin Energy (50 per cent) and the Curtis Island LNG (CILNG) project proposed by Shell) would result in the loss of a total of approximately 800 ha of open eucalypt woodland/forest, including medium density undergrowth. This represents approximately 1.7 per cent of Curtis Island. Open woodlands occupy approximately 65 per cent of the sites, with medium density saplings occupying the remaining 35 per cent.

217. Below mean high water mark a total of around 30 ha of mangrove forest would likely be cleared. A very small area of claypan and salt flat community would also be affected.

218. These habitats provide low value (compared with other areas in the region) roosting and/or foraging habitat for approximately 0.003 per cent of the total proportion of the migratory shorebird population in the Curtis Coast Region. A small number of individuals of several small terrestrial listed migratory bird species and possibly listed threatened reptile species would be directly affected by the proposed removal of woodland. The 30 ha of mangrove forest and the immediate inland strip of saline grassland (where present) represent an area of potential habitat, including foraging resources, for the listed threatened Water Mouse. Likely evidence of the presence of the Water Mouse has been found on one of the proposed LNG Facility sites, but no individual has been seen. No EPBC Act listed threatened species has been located on any of the sites in surveys to date.

219. The clearing of several adjacent LNG facility sites will create a strip of unnatural and/or depauperate habitat along the south west coast of Curtis Island between Graham Creek (Laird Point) in the north and Hamilton Point in the south, a distance of approximately 8km. This will have a limited affect on connectivity as the similar (apart from the intertidal mangrove and associated communities) forest and woodland communities immediately inland from the proposed LNG facility sites will be left intact, and further east similar communities exist in the Environmental Management Precinct which has been set aside as a conservation area. (Approximately 68 per cent of Curtis Island is under some form conservation management.) Graham Creek already provides a natural partial barrier to north/south movement to many flightless fauna species. The mangrove fringing coastal forest will be left largely intact between the proposed marine offloading facilities, construction docks and LNG loading docks.

220. The south west corner of Curtis Island, including the sites of the proposed LNG facilities, has been historically altered by clearing for pastoral, agricultural and forestry activities. Specific impacts have included grazing, weed invasion and selective thinning. Field studies have determined that areas of remnant vegetation impacted by the proposed projects have a relatively low habitat value and have been degraded to some degree by exotic weed invasion. In this context the construction of several LNG facilities is not expected to significantly reduce the overall conservation value of Curtis Island. Nonetheless, the habitat that would be lost, though a very small area in the context of the GBRWHA as a whole or of the terrestrial land area (islands) within the GBRWHA, contributes to the ecological and conservation values of the World Heritage and National Heritage place.

221. Similarly the clearing of each proposed LNG site will progressively increase the area of woodland lost and alter the aesthetics of each site when viewed from the city of Gladstone, from viewpoints in Gladstone harbour and from other mainland view points looking towards Curtis Island in the GBR WHA. Fringing mangroves of generally lower growth height will be retained for most of the 8km coastline of south-west Curtis Island. When constructed each LNG Facility will have several major storage tanks, large industrial buildings, flare stacks of various heights, and jetties and other marine facilities, occupied for long periods by vessels of various sizes up to large LNG tankers. At night the presence of a series of well lit industrial facilities along a coastline previously devoid of artificial sources of light (apart from shipping traffic) will also reduce the visual attributes of this corner of Curtis Island and the associated World Heritage values.

222. Each additional LNG facility will increase the industrial nature of a landscape previously a totally natural one, progressively reducing the visual attributes of this corner of Curtis Island and the associated World Heritage values.

223. For these reasons suitable habitat for the species of local and regional conservation value and habitat lost must be included in the package of offsets to be imposed as a condition of approval.

Operational impacts

Flares and lighting

224. As they operate continuously, for health and safety reasons, the flares and lighting required on LNG facilities would create a loom of light at night in the sky above southern Curtis Island. This would add to the current background level caused by the presence of the city of Gladstone and the industrial plants on the mainland. Each additional LNG facility is likely increase this loom, even if ground level flares are employed. Even if flares are not in a direct line of sight from turtle nesting beaches, there is potential for some disruption to turtle nesting which is likely to increase with each additional LNG facility.

225. For this reason a condition proposed to be imposed on each proponent is the development and implementation of a long-term marine turtle management plan, expected to be put in place jointly by LNG Facility operators, and in cooperation with Gladstone Port Corporation.

Emissions to water

226. Each of the proposed LNG facilities and their associated works involves the disposal of brine from reverse osmosis desalination plants and sewage treatment facilities. The potential discharge flows have been modelled taking into account the prevailing natural conditions as well as the expected discharges from adjacent facilities. In each case results indicate limited impact only in the immediate vicinity of the discharge points with a typical decrease by a factor of 50 to 80 in discharge concentrations within a 200m radius of the discharge point, with no expected overlap with adjacent facility discharges.

227. Nonetheless more stringent performance standards for emissions to water should be applied to industrial facilities proposing to locate in the CIIP than may be the case elsewhere, in recognition of the close proximity of other plants and the risk of unexpected cumulative impact, and the importance of the area as part of a World Heritage area. A condition of approval requires additional modelling, performance monitoring and the adoption of additional mitigation measures if unexpected environmental impacts not acceptable to the Minister are detected.

Emissions to air

228. In relation to emissions to air, the key pollutants emanating from each proposed LNG Facility during operation would be the result of combustion of CSG (methane) as a fuel to power gas turbines. The combustion of natural gas releases very small amounts of sulfur dioxide and nitrogen oxides, virtually no ash or particulate matter, and relatively low levels of carbon monoxide, and other reactive hydrocarbons, compared with oil or coal. Very small amounts of fugitive (unburned) methane may also be emitted.

229. LNG production involves chilling natural gas down to minus 160°C where the gas becomes a liquid. This reduces the volume by a factor of roughly 600. This volume reduction is what makes LNG the method of choice for transporting the fuel over long distances. However reducing the temperature of the gas to minus 160°C requires energy and expensive processing equipment. Typically about 10 per cent of the natural gas entering an LNG Facility must be burned to provide the energy needed for refrigeration. Cooling of the feed CSG to minus 160°C is planned to be achieved by using gas turbine compressors powered by CSG.

230. All electricity requirements for on-site operations at the proposed LNG facilities on Curtis Island will be generated onsite by gas turbine powered generators using CSG as the fuel.

231. Flaring of process gases during operation is another form of combustion that releases air pollutants, including greenhouse gases.

232. Overall combustion of CSG would be the primary source of conventional air pollutants and greenhouse gas emissions from the proposed LNG facilities, and each proponent has focussed on maximising the efficiency of activities that require CSG combustion. While increased efficiency reduces greenhouse gas emissions, latest generation turbines are also designed to reduce emissions of other pollutants, such as nitrogen oxides.

233. There is a well developed airshed model for the Gladstone area which can be run to simulate the expected inputs from existing and new point sources of air pollutants.

234. Modelling for each proposed LNG Facility has been undertaken taking into account other proposed LNG facilities as well as existing industrial sources. This shows that during normal operation there will be no exceedance of the Queensland Environmental Protection (Air) Policy objectives at any sensitive location (populated area).

235. The Gladstone airshed model, augmented by sampling of stack emissions and ambient air quality, can be used by regulating authorities to predict levels of air pollutants taking into account all LNG facilities and other actual and potential point sources of emissions in the airshed, thus allowing emission levels on individual facilities to be made as stringent as necessary to ensure ambient air quality objectives/standards are met.

236. While primarily based on protecting human health it is generally accepted that air quality that meets acceptable health standards also protects fauna and flora (with the exception of some agricultural crop plants). As the proposed LNG facilities would be required to meet Queensland Environmental Protection (Air) Policy objectives it is not expected that there will be any impact on the flora and fauna in the vicinity of the proposed LNG facilities (and hence WHA and NH values associated with ecological systems and biodiversity conservation) or elsewhere from emissions to air from the proposed LNG facilities.

Greenhouse Gas Emissions and contribution to global warming

237. In addition to conventional air pollutants, LNG facilities also emit significant volumes of carbon dioxide and small quantities of other gases that contribute to the global load of these gases, and thus to global warming and climate change.

238. There is consensus that emissions from human activities are largely responsible for a measured global increase in the levels of greenhouse gases in the atmosphere. There is evidence of climate change resulting from elevated greenhouse gas concentrations. Since the beginning of last century, air temperature has increased by 0.6°C on average worldwide.

239. In Australia the expected changes include an increase the severity and frequency of many natural disasters, such as bushfires, cyclones, hailstorms and floods. An increase in the frequency and severity of drought conditions resulting from climate change will reduce the availability of water. Water flows into the Murray-Darling Basin, already stressed, are likely to decline by 15 per cent if the temperature warms by 1°C. Reductions in flows of around 50 per cent are possible by the end of the century. Many other regions are also likely to experience reductions in water flows.

240. Native plants and animals are also likely to suffer as a result of climate change with a large reduction in the extent and quality of their habitats. A temperature rise of 2.1°C to 2.9°C could see the geographical ranges of 83 per cent of species reduced by at least 50 per cent. A 5°C increase could result in a loss of 90 to 100 per cent of the core habitat for most native vertebrates. Ninety Australian animal species have so far been identified at risk from climate change, including mammals, insects, birds, reptiles, fish and amphibians from all parts of Australia. This includes around 1/3rd of the EPBC Act listed threatened species in the 'endangered' category, and 1/6th of those listed as 'vulnerable'.

241. It is also predicted that changes in the climate will directly impact the Great Barrier Reef World Heritage Area through:

- increased water temperature;
- increased sea level;
- increased severity of storms and cyclones;
- ocean acidification;
- changed rainfall and runoff; and
- changes to the El Niño Southern Oscillation.

242. The ecological consequences of climate change will be serious. Mass coral bleaching, which is caused by sustained high water temperatures, have already begun to increase in frequency and severity. The range of other potential impacts on the Great Barrier Reef are numerous with many only just coming to light.

LNG Facility greenhouse gas sources

243. At an LNG Facility carbon dioxide (CO_2) contained in the feed gas stream must be removed prior to the liquefaction process and therefore higher CO_2 content feed gas results in greater CO_2 removal prior to liquefaction. This CO_2 is often vented to the atmosphere and so directly adds to the greenhouse gas footprint of an LNG Facility.

244. In the case of the Curtis Island CSG based proposals, in contrast to some LNG facilities utilising offshore petroleum natural gas, where carbon dioxide content may be up to 12 per cent, the CO_2 content of the feedstock CSG is less than 1 per cent, possibly as low as 0.2 per cent depending on the specific CSG field from which the feed gas will be supplied. Proponents have assumed the feed gas has a CO_2 content of 1 per cent for the purposes of greenhouse gas emission estimates.

245. Because methane (natural gas) is itself a potent greenhouse gas with a warming potential some 21 times that of CO_2, it is very important to avoid as far as possible the loss of methane from the LNG processing plants (as well as from the pressurised CSG field facilities and pipelines). This is also important for safety reasons. Nonetheless there are always very small amounts of fugitive emissions from LNG processing facilities.

246. All of these sources of greenhouse gases have been taken into account in the greenhouse gas modelling undertaken by each proponent.

247. The proposed APLNG project plans for two 4.5 Mtpa production trains with possible expansion to four trains and total output of 18 Mtpa. The Santos Gladstone LNG (GLNG) project involves two production trains of up to 4 Mtpa capacity and possible expansion to three trains. The QCG LNG processing plant would have a production capacity of up to 12 Mtpa comprising three LNG trains, and the Curtis Island LNG (CILNG) project proposed by Shell has plans for up to 16 Mtpa of LNG from four production trains.

248. Taking the upper estimates of the LNG production rate, and assuming all proposals proceed, the total LNG production capacity of all four plants would be approximately 54 Mtpa LNG. Assuming the emissions intensity (tonnes of greenhouse gas per tonnes of LNG produced) from all sources at each LNG Facility (excluding emissions from the CSG fields and pipelines but taking into account construction phases of the LNG facilities is 0.253, this would produce 13.6Mtpa carbon dioxide equivalent (CO_2-e). This is a little more than the proposed coal-fired Bayswater power station in NSW which is expected to emit approximately 12.4 Mtpa CO_2-e. Brown coal electricity generation in the Latrobe valley of Victoria, from several power stations, produces approximately 60 Mtpa CO_2-e.

249. In 2007, annual greenhouse gas emissions in Australia were estimated at 597Mtpa CO_2-e. In 2009 Australia generated a lower volume, an estimated 537 Mtpa, reflecting the state of the global economy.

250. Using these figures, four LNG facilities on Curtis Island, assuming all planned LNG trains are built and are in operation at each facility (not necessarily the case as each proponent intends to build LNG trains sequentially, and all trains may not be built if demand for LNG does not trend as expected) would result in the 'Curtis Island LNG hub' producing in the order of 2.278 per cent (or 2.53 per cent using 2009 figures) of Australia's total greenhouse gas emissions. As Australia's contribution to global greenhouse gas emissions is approximately 1.5 per cent, the 'Curtis Island LNG hub' would be responsible for approximately 0.034 per cent to 0.038 per cent of global GHG emissions, and in a simplistic pro rata sense, responsible for 0.034 per cent to 0.038 per cent of any associated global warming and other climatic changes, such as warming of the world's oceans.

251. However, this does not take into account the potential for LNG to displace other fossil fuels with a much larger greenhouse gas emissions profile when burned (primarily to produce electricity) in countries importing the LNG. Natural gas has a lower carbon intensity than oil or coal. Natural gas produces 51.3 kg CO_2-e per GJ compared with diesel, fuel oil and black coal which emit between 69.9 - 93.1 kg CO_2-e per gigajoule (GJ - one billion joules. Six gigajoules is about the amount of chemical energy in a barrel of oil). The combined emissions from combusting LNG, including emissions from extracting, processing and transporting LNG, are around 35 per cent less than the emissions from combusting coal alone. This comparison assumes that state-of–the-art coal-fired power generation technology is used and does not include emissions from extracting, processing and transporting coal. The main markets for LNG from Queensland are developed and developing Asian economies. These countries face the challenge of satisfying increased energy demand while, at the same time, limiting growth in greenhouse gas emissions. When exported to markets such as Korea, Taiwan and China, LNG has the potential to reduce the need for more carbon-intensive fuels such as coal.

252. In practice the Australian contribution to current annual global greenhouse gas emissions, though relatively large on a per capita basis, is only one amongst many contributions that are made by all other nations. Whether one LNG Facility or several were to be built and operated would make little difference to global emissions. The global demand for LNG is large and growing and if the proposed CSG LNG facilities do not proceed the demand for LNG would remain and would likely be met by other LNG projects elsewhere in Australia or elsewhere, with no reduction in global greenhouse gas emissions (and potentially an increase if oil or coal-fired electricity generating plants were substituted for planned LNG based power generation).

253. Nonetheless each of the proponents of the proposed LNG facilities has adopted the most recent and energy efficient technologies for producing LNG and intends to implement a range of energy conserving strategies and techniques to minimise greenhouse gas emissions. Benchmarking against other Australian and international LNG facilities demonstrated that the proposed LNG facilities would be amongst the world's least greenhouse gas-intensive LNG facilities.

254. In regard to the overall APLNG project the extraction of coal seam gas and conversion to LNG, will generate GHGs. The EIS states that the proponent intends to mitigate the project's impact (as a whole) on climate change by applying the energy efficient design and technology coupled with appropriate management strategies, monitoring and reporting.

255. The Department agrees that LNG technology has an important role to play in addressing climate change, and that natural gas is a cleaner energy source with the lowest carbon emissions of all fossil fuels. The Intergovernmental Panel on Climate Change has identified fuel switching from more greenhouse gas-intensive fuels to natural gas in power generation as a key mitigation technique available to reduce greenhouse gas emissions. (See *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, at 7.3.3.)

256. The department notes that conditions relating to GHG emissions have been imposed by the Queensland Coordinator-General. Offsets recommended for impacts on listed migratory and threatened species will incidentally also provide some benefits in terms of GHG emissions. The Department does not therefore recommend additional conditions be imposed for GHG emissions that might impact on MNES.

LNG Facility Hazard Assessment

257. LNG Facilities are hazardous and unplanned events could have an impact on the surrounding environment, and potentially on neighbouring LNG facilities.

258. The planned layout of the Curtis Island Industrial Precinct took into account the planned use of the sites for LNG production, and this was a factor in the allocated areas set aside which are large enough to incorporate buffer zones between each expected LNG processing facility footprint. As detailed design information is not yet available for each LNG facility, proponents have all made conservative assumptions regarding the likely process conditions based on the proposed design and technical specifications of the equipment proposed to be utilized.

259. As such these assumptions may have overestimated the hazards associated with the final design of the facilities. Further detailed risk analyses, required in order to obtain Queensland Government approvals to operate the facilities, will be conducted during the detailed design stage for each plant.

260. Nonetheless, for each LNG facility, for each of the potential worst case scenarios involving the hazards identified, consequence modelling has been performed. Contours showing the hazard end points have been overlaid on plans of the LNG facilities and criteria for hazard end points set by relevant design standards.

261. The typical worst case scenarios are:

- loss of containment of natural gas or liquid natural gas in the process from various points of release, including the product loading facility;
- loss of containment of refrigerant gas or liquid from various points of release;
- fire within the facility involving process or refrigerant liquids in storage; and
- explosion of an unpurged vessel during decommissioning.

262. In each case the results of modelling indicates that there is no potential impact to neighbouring LNG Facility or other industrial sites even in the most severe events. In some cases the 50 x 10^{-6} risk contour extends beyond the property boundary, but only a little way and along the seaward side of the facility.

263. This means that a serious accident involving loss of LNG and an explosion at one plant would be extremely unlikely to cause problems at the neighbouring LNG Facility.

264. The quantitative risk assessment for the LNG facilities included the assessment of consequences of catastrophic failure. However, risks (likelihood) of deliberate harm, which includes an act of terrorism, has been excluded from the risk assessments, as Federal and state agencies in Australia are responsible for assessing threats including threats of deliberate harm on critical infrastructure such as the proposed LNG facilities and shipping operations. An assessment conducted at Gladstone by these agencies found that the introduction of the LNG Industry would not change the existing threat levels. Because of security considerations these assessments are not public documents.

Shipping including Ferry movements

265. If no Curtis Island access road and bridge is constructed, as is the current proposal, barge/ferry services would continue to transport personnel to Curtis Island during the operation of the LNG Facility as well as during construction.

266. At the moment there are nine regular scheduled barge/ferry return trips per week between Gladstone and South End on Curtis Island. Regular ferry operations between the mainland and Curtis Island would be increased significantly by the proposed construction and operation of LNG facilities on the island.

267. However scheduled ferry services are only a minor element in the overall movement of vessels in Gladstone Harbour/Port Curtis area. Vessel movements within the Port of Gladstone fall in the range of 70,000 to 80,000 movements per year.

268. If all currently proposed LNG facilities for Curtis Island proceed, shipping movements in the Port of Gladstone would increase by between 48.5 to 53.5 per cent above current levels. This would increase the risk to marine turtles and the Dugong. This cumulative impact has been taken into account in the proposed conditions of approval that it is envisioned would apply to each proposed LNG proposal.

Personnel on Curtis Island

269. If all four proposed LNG Facilities were to proceed, the need for a construction force (and later a smaller operational workforce) would lead to an addition to more than 10,000 people in temporary construction camps on Curtis Island. At present only around 40 people currently permanently live on Curtis Island, mainly at South Point.

270. This influx of people to Curtis Island, with many daily movements to and from the mainland, poses a number of risks to the environment from the introduction of weeds and pests such as cats, dogs, rats mice etc. While Curtis Island already has all of these - as well as feral cattle, horses, pigs and cane toads – uncontrolled movement of people and equipment would increase the risk of additional introductions, with resulting pressure on native flora and fauna (whether EPBC Act listed or otherwise) that contribute to the biodiversity and conservation values of Curtis Island in a regional and World Heritage and National Heritage site context. For similar reasons it is important that personnel accommodated on Curtis Island are restricted to the immediate site, and do not unnecessarily impact on the environment beyond the facility site through thoughtless behaviour. Each additional LNG Facility would add to these pressures and risks.

271. It is therefore recommended that a condition of approval for each LNG proposal be that a quarantine management plan be developed to the satisfaction of the Minister and once approved implemented, and that a suite of prohibitions and the provision of a mandatory induction program, including guidance as to the importance of Curtis Island environments, be developed to the satisfaction of the minister, and once approved implemented by each LNG Facility proponent.

Consideration of cumulative impacts

272. The Department has had regard to the cumulative impacts of these other proposals in formulating this Departmental Advice on the APLNG project. The Department has also had regard to the likelihood of the above projects proceeding. From discussions with the proponent and media reports, the Department is aware of recent commercial investments and agreements relating to the GLNG and APLNG project. The Department has no reason to believe that the GLNG, APLNG and Curtis Island LNG (CILNG) projects are not likely to proceed.

273. Reference to cumulative impacts of other proposed actions that have been referred under the EPBC Act as components of the overall APLNG project are also referred to in other Departmental Advices to which those referrals relate. The Departmental Advices relating to the APLNG project have been provided to the Minister at the same time, to enable a decision on each separate referral to have regard to the related impacts of each other referral.

274. In formulating this Departmental Advice, including the recommended conditions, the Department has also had regard to the proposed Western Basin Strategic Dredging and Disposal project (EPBC 2009/4904), proposed by the Gladstone Ports Corporation. That project is for a dredging program to deepen and widen existing channels and swing basins, and create new channels, swing basins and berth pockets. The purpose of that project is, in part, to accommodate the expected increases in shipping in and around the Port of Gladstone arising from various LNG projects.

Other Consequential or Indirect Impacts

275. The overall proposed APLNG Project involves the development of existing coal seam gas fields in the Surat Basin, western Queensland, the construction of a pipeline network and associated infrastructure and the construction of a LNG Facility and associated marine facilities on Curtis Island near Gladstone in Central Queensland and associated infrastructure and shipping. Cumulative and consequential social and economic impacts of the proposal as a whole are addressed further below.

276. The project will generate indirect and indirect employment (primarily in Queensland) during construction and operation. Whilst some of these positions are likely to be filled by people already within the region, many more are likely to come in from elsewhere in Queensland or Australia, and from overseas. This in turn will increase regional demand for goods, services and infrastructure such as new and upgraded roads, additional buildings (domestic residential, schools, hospitals and commercial buildings). Additional water and power supply will be required, potentially requiring the construction or upgrading of major structures (dams, power stations) and linking powerlines and pipelines. New or expanded sewage facilities and waste handling facilities including landfill sites may be required.

277. The increases in population and activity, and associated increases in infrastructure, are likely to also have consequential impacts on MNES, - that is, impacts which arise from the consequential activity of third parties (i.e. those other than the proponent). Consequential demands for facilities will, of necessity, take up areas of land. Depending on the locations of the expanded or new activities, there is potential for the habitats of EPBC Act listed threatened species or communities, listed migratory species and/or other matters protected by the EPBC Act to be impacted by such developments. Waste flows and emissions to air and water from the new or expanded facilities may also have environmental impacts.

278. At this stage, however, the extent and nature of likely consequential impacts is speculative. The proponents of any construction activity likely to have a significant impact on any matter protected by the EPBC Act will be required to comply with the requirements of the EPBC Act. Nonetheless some incidental incremental impacts from an increase in the utilisation of infrastructure, such as, for example, increased roadkill of native fauna from increased traffic flow on existing roads, would not necessarily be matters addressed by the EPBC Act.

279. There are also likely to be increased incremental pressures on recreational facilities, including national parks, state forests and similar areas, through increased visitation rates. This in turn increases the likelihood of direct damage as well as adding to the risk of the introduction (accidentally or otherwise) of weeds, pests and feral animals, increasing pressures on species living in the habitats of these parks and reserves, in turn adding to management costs. This form of incremental increase in pressure would be unlikely to involve proposed actions in terms of the EPBC Act. (The expected impacts and increased management load caused by the likely increase in visitation rates to the Great Barrier Reef Marine Park and the (Queensland) Great Barrier Reef Coast Marine Park has been taken into account in the proposed package of offsets and mitigation measures required proposed conditions of approval for this and other elements of the APLNG project, which includes additional funding for management of these Marine Parks.)

Mandatory Considerations

280. Under s.136 of the EPBC Act, in deciding whether or not to approve an action and what conditions to attach to the approval, the Minister must consider the following matters, insofar as they are not inconsistent with any other requirement of Subdivision B, Division 1 of Part 9 of the EPBC Act:

Matters relevant to any matter protected by the controlling provisions (s.136(1)(a))

281. The proposed actions were assessed under the bilateral agreement with Queensland, by a report by the Queensland Coordinator-General under Part 4 of the *State Development and Public Works Organisation Act 1971* (Queensland) and the State Development and Public Works Organisation Regulation 1999. This assessment process is used where the Coordinator-General declares, for the purposes of section 26 of the *State Development and Public Works Organisation Act 1971*, that the proposed action is a significant project for which an EIS is required. That report addresses impacts on matters of NES. The Coordinator-General's report has been considered in providing this advice and the associated briefing, including the recommended conditions.

282. While the Coordinator-General's report addressed impacts on matters of NES and summarised the relevant discussion in the EIS and supplemental information from APLNG, the report did not make any clear conclusions regarding the acceptability of these impacts. The report also concluded that there would not be significant impact on various EPBC matters, however the Department does not agree with all these conclusions as they are based on, for example, taking future offsets into account. The Department has therefore provided you with a range of additional information, and further considered those impacts in this advice and the associated briefing.

Economic and social matters (s.136(1)(b))

283. For the purpose of considering economic matters, the Department has considered economic matters relating to the APLNG Project as a whole, of which the proposed gas pipeline activities are a component. The Department considers that economic and social matters relevant to all of the referrals are equally relevant to the referrals considered separately.

Economic value of APLNG Project

284. Economic and social matters relating to the as a whole are addressed in the brief to which this advice is attached.

Factors to be taken into account

285. In considering the mandatory considerations set out in s.136(1) of the EPBC Act (that is, economic and social matters, and matters relevant to the controlling provisions for each proposed action) you must take into account the following matters set out in s.136(2) of the Act:

Principles of ecologically sustainable development (ESD)

286. The Department considers that the proposals would be consistent with the principles of ESD if the conditions and mitigation measures are imposed as recommended. The principles of ESD are set out in s.3A of the EPBC Act.

287. The Department has considered both the impacts on the relevant controlling provisions for each action and the long-term and short-term economic and social benefits and costs of the proposal in making its recommendations to approve, with conditions, the proposed actions.

288. The proposed action is likely to have impacts on the relevant controlling provisions. Some of the impacts (such as those on particular species) are difficult to predict with certainty. The Department does not consider that the likely impacts would, if properly managed and implemented according to the proposed conditions of approval, and if appropriately managed and conditioned by the State, create irreversible or serious environmental damage. In addition, the proponent is committed to avoiding impacts as far as possible through responsible environmental management.

289. There will be some impact on individual listed species but this would not constitute an adverse or unacceptable impact on the populations as a whole given the scale and duration of the proposed activities and the management and mitigation measures to be adopted. Any uncertainties in relation to such impacts are also addressed by the proposed conditions.

290. The conditions imposed on the proposed actions, including conditions for offsets for potential impacts, will ensure that there is no net loss of biodiversity relevant to the matters protected under the EPBC Act. In this respect, the Department has also considered the related mitigation measures and offsets proposals for other referrals relating to the APLNG Project. By requiring offsets (both in relation to this and other referrals for the project), the conservation values lost as a result of the proposals has been costed and compensated.

The assessment report

291. The Queensland Coordinator-General's report is an 'assessment report' which you must take into account under s.136 of the EPBC Act. The final report was provided to the Commonwealth on 9 November 2010. That report has been taken into account by the Department in providing advice and making recommendations on each proposal.

Other information and comments

292. Section 136(2)(f) requires that you take into account any relevant comments given to the Minister by another Minister in accordance with an invitation under section 131 or 131AA and 131A. In the brief to which this advice is attached, we have recommended that you write to relevant Ministers (and to the proponent) seeking comments on the proposed decision and conditions.

293. Section 136(2)(g) requires that you take into account any information given in accordance with a request for further information under section 132. No request for further information under s.132 was made in relation to the proposed pipeline.

Precautionary principle (s. 391)

294. Under s.391(1) of the EPBC Act, you must take account of the precautionary principle in making a decision whether or not to approve the taking of an action. You must therefore take account of this principle in making a decision on whether to approve each of the referrals which are the subject of the APLNG Project. The precautionary principle is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage. The Department considers that the proposed conditions are sufficient to manage and mitigate the relevant risks of environmental impacts associated with the referral to which this advice relates.

Person's environmental history (s.136(4))

295. In accordance with section 136(4) of the EPBC Act, the Minister may also consider whether the person proposing to take the action is a suitable person to be granted an approval, having regard to the person's history in relation to environmental matters and if the person is a body corporate, the history of its executive officers and if relevant, the history of the parent company and its executive officers in relation to environmental matters.

296. On the basis of the information available to the Department, APLNG or any associated company does not appear to be, or have been, subject to proceedings in relation to a conviction for an offence or ordered to pay a pecuniary penalty, under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of resources.

297. APLNG is a 50/50 joint venture between ConocoPhillips and Origin Energy. Both companies have a long history of conducting activities in a way that avoids or minimises potential impacts on the environment. APLNG state that the construction of the gas transmission pipeline will be contracted to Origin. Origin's successful environmental record is demonstrated in winning the Ethical Investor Magazine's 'Sustainable Company of the Year' for 2007. Origin has also received the 2007 APPEA Environment Award for the implementation of the Coal Seam Gas Produced Water Treatment Facility at Spring Gully.

298. Both ConocoPhillips and Origin Energy have corporate sustainability and environmental health and safety policies and programs in place and the proposed LNG plant and marine facilities will be managed under these policies and systems.

Minister not to consider other matters (s.136(5))

299. In deciding whether or not to approve the taking of an action, and what conditions to attach to an approval, you must not consider any matters that you are not required or permitted, by Subdivision B, Division 1, Part 9 of the EPBC Act, to consider. This departmental advice and the associated briefing, does not contain matters that you are not required or permitted to consider in making your decision.

Considerations in deciding on conditions (s.134(4))

300. In accordance with section 134(4) of the EPBC Act, in deciding whether to attach a condition to an approval, you must consider any relevant conditions that have been imposed, or you consider are likely to be imposed, under a law of a State or self-governing territory or another law of the Commonwealth on the taking of the action.

301. The Queensland Coordinator-General's evaluation report on the APLNG project set out conditions at
   - Appendix 1 – relating to the whole of project;
   - Appendix 2 – relating to the gas fields;
   - Appendix 3 – relating to the gas transmission pipeline; and
   - Appendix 4 – relating to the LNG facility.

302. Under section 134(4) of the EPBC Act, you must also consider information provided by APLNG. Documentation provided by the specified Proponent includes the EIS and the supplementary information. Other documentation provided by the Proponent, as relevant to this proposal, is set out below (under the heading 'References') and is described in this advice, in the brief and in other attachments which this advice forms part.

303. Under section 134(4) of the EPBC Act, the Minister must also consider the desirability of ensuring as far as practicable that the conditions are a cost effective means for the Commonwealth and the Proponent to achieve the object of the conditions.

304. The Department believes the conditions are practicable and cost effective. In formulating the proposed conditions of approval, the Department has had regard to relevant conditions imposed by the Queensland Coordinator-General.

Duration of proposed approval

305. If approved, the proposed action is likely to commence in late 2010 or early 2011. Each of the three LNG trains which the pipeline will service has an operational life of at least 20 years, with the last train commencing operation in 2018. The proposed duration of the approval is 50 years (i.e. having effect until 22 February October 2060). This timeframe will accommodate a longer production life for the three trains, and allow for any gas pipeline activity associated with a decommissioning and rehabilitation period.

Other considerations

306. Under ss. 137 and 137A of the EPBC Act, in deciding whether or not to approve an action and its attached conditions, you must not act inconsistently with:

   - Australia's obligations under the World Heritage Convention;
   - the Australian World Heritage management principles;
   - a plan prepared for the management of a declared World Heritage property;
   - the National Heritage management principles;

- an agreement to which the Commonwealth is party in relation to a National Heritage place; or
- a plan prepared for the management of a National Heritage place.

307. The Department considers that, provided the proposed conditions are imposed, that an approval of this action will not be inconsistent with ss. 137 and 137A of the EPBC Act.

308. Under ss. 139 of the EPBC Act, the Minister must also have regard to any approved conservation advice for a relevant listed threatened species or ecological community. Relevant conservation advices have been taken into account, referenced in the relevant discussion of impacts, and copies of relevant conservation advice are attached to the main brief. The Department considers that approval of the project would not be inconsistent with any recovery plan, threat abatement plan or approved conservation advice.

References

309. In formulating this advice, the Department has considered all relevant available documents. This includes, but is not limited to, the following:

- Attachment E1: Expected impacts of the LNG plant and marine facilities
- Attachment E2: Queenslanld Regional ecosystems classification system
- Attachment E3: World Heritage attributes of the Great Barrier Reef and potential impacts of proposal
- Attachment E4: Policy and planning context of Curtis Island within the World Heritage Area and National Heritage Place
- Attachment E5: Great Barrier Reef Intergovernmental Agreement
- the referral (EPBC 2009/4977) submitted by the proponent;
- the proponent's Environmental Impact Statement and Supplementary Environmental Impact Statement. (Both of those documents are together treated as a single environmental impact statement for the purpose of Part 8 of the EPBC Act);
- the Queensland Coordinator-General's Report relating to the APLNG Project (November 2010);
- Conservation advice relating to the species mentioned in this advice;
- Species Profile and Threats Database - SPRAT (DEWHA);
- Thorn, B.G. and J. Chappell 1975 Holocene sea levels relative to Australia. Search 6 :90-3;
- GN Batianoff and HA Dillewaard, Floristic analysis of the Great Barrier Reef continental islands, Queensland;
- Workshop Series 23, State of the Great Barrier Reef World Heritage Area workshop, 1997

Consultation

310. In addition to the proponent, the Approvals and Wildlife Division of the Department (responsible for administering the EPBC Act assessment) has consulted with a number of government agencies in relation to Gladstone LNG projects (including Santos and QGC):

- the Commonwealth Department of Resources, Energy and Tourism (DRET);
- the Commonwealth Department of Industry, Transport and Resources (DITR);
- the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF);
- the Commonwealth Department of Climate Change and Energy Efficiency (DCCEE);
- the Commonwealth Treasury;
- the Great Barrier Reef Marine Park Authority;
- Geoscience Australia and s. 22(1)(a)(ii)
- other relevant divisions of the Department of Environment, Water, Heritage and the Arts, including the Water Group; the Heritage Division; the Strategic Policy Division (the Environmental Economics Unit); and the Marine Division;
- the Queensland Department of Industry and Planning (DIP);
- the Queensland Department of Environment and Resources (DERM).

Conclusion

311. The proposed action and the proposed APLNG project as a whole, is substantial, and will interact with a number of matters of national environmental significance. The proposed conditions are designed to ensure that any impacts on these matters will be limited, and, if unavoidable, mitigated and compensated.

312. Constructing and operating the proposed LNG plant and marine facilities involves activities common to a range of industrial projects such as site clearing, construction, water and sewage treatment, waste management, air emissions, concrete batching, chemical storage. The management of these activities is well understood and would be regulated through a number of standard conditions under Queensland legislation and in particular through an environmental authority attached to a petroleum facilities licence for the site.

313. The majority of impacts on listed threatened species and communities, listed migratory species, World Heritage properties and National Heritage places from the construction and operation of the proposed LNG facility can be avoided or reduced to a large extent through good design. The residual potential impacts can be largely managed through the implementation of suitable environmental management strategies outlined in the draft environmental management plans, as refined by the recommended conditions of approval. There will nonetheless some unavoidable loss of natural vegetation and habitat for a range of fauna species.

314. In addition, a recommended condition of approval is that APLN must provide you with an Environment Offsets Plan for your consideration. The Plan will propose offsets for the loss of habitat and associated World Heritage and National Heritage values caused by the construction and operation of the LNG facility. If you approve this Plan it must be implemented by APLNG.

315. Among other requirements, the Plan requires APLNG to:

- Offset direct impacts by securing an offset property that contains attributes or characteristics at least corresponding with those of the LNG facility site at a ratio of no less than 5:1 of the LNG facility site area (that is, a property of at least 1,153 ha in total area, excluding the proposed reclamation area) and use its best endeavours to secure National Park status for the offset property
- Develop and implement a strategy for contributions to field management and visitor awareness of the Great Barrier Reef World Heritage Area. This strategy must provide for activities to support field management to address the increased pressures on the Great Barrier Reef World Heritage Area, including but not limited to, pressures on populations of vulnerable species, increased risks from shipping and increased use of the Area; be developed in consultation with the Great Barrier Reef Marine Park Authority, to give priority to objectives for the protection of the Great Barrier Reef Marine Park and World Heritage Area identified (from time to time), which may include (without limitation) patrols, support for incident response planning and preparedness, data collection, and assistance in visitor management; provide for the submission of periodic reports to the Great Barrier Reef Marine Park Authority on the activities conducted.
- Provide for a budget of at least $200,000 per annum for the life of the project (indexed at CPI) and in addition $100,000 per annum (indexed at CPI) for each operating LNG Train (commencing on commissioning of the relevant Train) to support implementation of the strategy.

316. The impacts of the proposal are considered to be acceptable having regard to the following:

- the relatively degraded character of southern Curtis Island. The EIS reports that vegetation within the project site has a long history of disturbance from grazing, thinning and exotic weed and feral animal invasion. The Great Barrier Reef Marine Park Authority has confirmed this view in discussions with the Department;
- the proposed facility is adjacent to the heavily industrialized Port of Gladstone;
- the EIS finds that area does not act as core habitat for any terrestrial species listed under the EPBC Act. The EPBC Act species considered most likely to be present within the LNG facility is the Water Mouse, and conditions relating to this species have been proposed. These conditions propose that the proponent be required to undertake further targeted survey work for the species in the footprint of the LNG facility; quantify the total habitat loss of the species; and if required, propose adequate mitigation or offset measures. The Department considers that these conditions will satisfactorily mitigate the impact of this proposal on the Water Mouse.

- the proposed conditions would require a substantial package of direct and indirect offsets in relation to the World and National Heritage values of the area, as discussed above in this section.

317. The proponent is well-resourced, and experienced in dealing with regulatory requirements for major projects, and a high level of compliance with the conditions is expected.

318. The Department considers that, based on the available evidence and assessment, the impacts of the construction and operation of the LNG plant and associated marine facilities will not have unacceptable impacts on the relevant controlling provisions subject to compliance with the proposed conditions.

319. With the proposed conditions and mitigation measures, we consider that the impacts of the proposed action are acceptable, and recommend that you propose to approve the proposed APLNG facility on Curtis Island.

Departmental Advice EPBC No 2009/4977

Attachment E1

Assessment of likely impacts on Matters Protected under the EPBC Act arising from the proposed Australia Pacific LNG Project - Development of a LNG Plant and Ancillary Onshore and Marine Facilities on Curtis Island - EPBC No 2009/4977

Controlling Provision	Provision Trigger	APLNG EIS Reference (Including supplementary information) with short synopsis	Coordinator General Report Reference with short synopsis	Conclusion on acceptability
Listed threatened species and communities (sections 18 & 18A)				
	ECOLOGICAL COMMUNITIES	(23.4.2) As described at section 23.3.2 vegetation on and adjacent to the LNG facility site area is not analogous with any threatened ecological community as defined under the EPBC Act. As such, it is considered that the development of the LNG facility will not impact upon threatened ecological communities as defined under the EPBC Act. (4.10.2) Based on available mapping and confirmed through field assessment there is no vegetation on or adjacent to the LNG facility that is a threatened ecological community as defined under the EPBC Act. Therefore development of the proposed LNG facility will not impact	(10.3.5 p187) The EIS identified (section 23.3.2) through the EPBC protected matters search tool, this ecological community listed as 'endangered' under the EPBC Act as potentially existing within the proposed LNG facility. However, based on available mapping and field assessments, the EIS identified that there are no threatened ecological communities within or adjacent to the LNG facility (section 23.4.3). Therefore development of the proposed LNG facility will not impact upon any threatened communities. (9.2.1) No threatened communities listed under the EPBC Act are present within the LNG facility.	The only listed community considered likely to be present at or near the site of the referred action at the time the referral was analysed by Departmental officers and the controlled action decision made was likely presence of Littoral Rainforests and Coastal Vine Thickets of Eastern Australia. However in undertaking work for the EIS APLNG identified Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions, and Weeping Myall Woodlands as potentially existing within the proposed LNG facility site, in addition to Littoral Rainforests and Coastal Vine Thickets of Eastern Australia. Santos did find a small area of Littoral Rainforest/Coastal Vine Thicket in investigating the proposed site of an LNG plant immediately to the south of the APLNG site. However, APLNG did not locate examples of the three potentially occurring communities or any other listed EPBC community during field survey work. The Department agrees with the CG conclusion that the proposed APLNG LNG facility will not impact upon any listed communities.

		upon threatened communities.	The proposed LNG facility requires clearance of approximately 156ha of remnant vegetation, however no clearance of 'threatened' communities (EPBC Act), no 'endangered' RE (VMA), no vegetation with high biodiversity values and no high value regrowth vegetation (VMA) will be cleared.	
	Littoral Rainforest and Coastal Vine Thickets of Eastern Australia **Critically Endangered**	See comments in relation to ecological communities above	See comments in relation to ecological communities above	
	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions **Endangered**	See comments in relation to ecological communities above	See comments in relation to ecological communities above	
	Weeping Myall Woodlands **Endangered**	See comments in relation to ecological communities above	See comments in relation to ecological communities above	
	BIRDS			
	Epthianura crocea macgregori** Yellow Chat (Dawson) **Critically Endangered**	Vol 4 Chap 8, Section 8.3.4 Field assessment of the potential habitat of the Dawson sub species of the yellow chat found that this habitat did not meet the requirements for this species.	(10.3.1) The EIS identified through desktop searches (section 23.3.2) 14 terrestrial fauna species listed as threatened under the EPBC Act as potentially existing within the proposed LNG facility (Table	No Yellow Chats were recorded during field surveys. The marine plains and associated grassland on the southern side of the saltpan were identified as potentially suitable habitat for the Dawson yellow chat. However heavy grazing of these marine plains and associated grassland by horses and cattle has reduced the suitability of this habitat. Important refuge habitat in the form of rush-beds, are also understood to be absent. The Department considers that impacts on this species are unlikely.

		Endangered, vulnerable and rare (EVR) fauna species (Table 8.8) (Volume 5 Attachment 16, Appendix D Flora; Appendix I Fauna). A full list of species identified on site is provided in the technical report	23.10). However, the EIS identified eight of these 14 species as likely to occur within the LNG facility area: • Brigalow scaly-foot (*Paradelma orientalis*) • Yakka skink (*Egernia rugosa*) • Squatter pigeon southern subspecies (*Geophaps scripta*) • Red Goshawk (*Erythrotriorchis radiates*) • Northern quoll (*Dasyurus hallucatus*) • Grey-headed flying-fox (*Pteropus poliocephalus*) • Large-eared pied bat (*Chalinolobus dwyeri*) • False water-rat (*Xeromys myoides*). Of these eight fauna species, one is listed as ‘endangered’ (Northern quoll), and the remaining seven are listed as ‘vulnerable’ under the EPBC Act. The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.4.3). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. Although not assessed as significant, the EIS recognises	

			that potential impacts of the LNG facility on terrestrial flora and fauna are likely to be primarily associated with introduction and/or spread of invasive weeds or pests, leaching of pollutants or release of sediment into retained areas of vegetation, air emission impacts, edge effects, fragmentation, altered drainage patterns, habitat loss, degradation, fragmentation, and loss of connectivity due to the physical clearing of vegetation. Mitigation and management measures are designed to limit these impacts on MNES.	
	Erythrotriorchis radiatus Red Goshawk **Vulnerable**	(23.4) The possible presence of the species and likely impacts are discussed. The conclusion reached is that the lack of historical records and the absence of a suitable freshwater waterbody indicate the LNG facility site area does not support an important population. There is additional discussion of the species in Vol 4 Chap 8 APLNG EIS See also Endangered vulnerable rare fauna species (Table 8.8) Vol 4 Chap 8 APLNG EIS	See above	Not recorded in surveys on site. There are no records of the red goshawk within the wider study area and the absence of a suitable freshwater waterbody indicate the LNG facility site does not support an important population and is unlikely to be an important area for the survival of this species. Given the proposed footprint of the plant, the mobility of the species, the extent of similar suitable habitat within the wider area, the Department considers that impacts on this species are unlikely.

	*Geophaps scripta scripta** Squatter Pigeon (southern) **Vulnerable**	(23.4) The possible presence of the species and likely impacts are discussed. The conclusion reached is that the lack of historical records and the absence of a suitable freshwater waterbody indicate the LNG facility site area does not support an important population. There is additional discussion of the species in APLNG EIS Vol 4 Chap 8 P36	See above (10.3.1)	Not recorded in surveys on site, but is known to be present on Curtis Island. The Squatter Pigeon is a nomadic, highly mobile species with a wide distribution. Within the Curtis Island and Gladstone area there is a large extent of similar habitat available. The lack of permanent freshwater means the study area (the western side of Cutis Island Industrial precinct) is unlikely to support an important population of the species. Considering the habitat within the LNG facility site area and the extent of similar habitat in the wider area it is considered unlikely the proposed development would lead to the decline of any possible local population. The Department considers that impacts on this species are unlikely
	Macronectes giganteus Southern Giant-Petrel **Endangered**	No specific reference	See above (10.3.1)	Curtis Island does not form part of the breeding or feeding range of the Southern Giant-Petrel. Individuals of the species are unlikely to occur in areas impacted by the proposed LNG plant or ancillary marine facilities. There are no records of occurrence of the species in the project area. The Department considers impacts on this species to be unlikely.
	Pterodroma neglecta neglecta Kermadec Petrel (western) **Vulnerable**	Vol 4 Chap 8 APLNG EIS (table 8.8) (APLNG EIS Terrestrial Ecology) Noted as a species whose presence is possible.	See above (10.3.1)	Curtis Island is not a part of the feeding or nesting range of the Kermadec Petrel. Individuals of the species are unlikely to occur in areas impacted by the proposed LNG plant or ancillary marine facilities. There are no records of occurrence of the species in the project area. The Department considers impacts on this species to be unlikely.
	Rostratula australis Australian Painted Snipe	No specific reference	See above (10.3.1)	The Australian Painted Snipe requirement for tall reeds and freshwater is not met on the site. Individuals of the species may occasionally visit the LNG plant or ancillary marine facilities proposed site. Not recorded in surveys on site.

	Vulnerable			The Department considers impacts on this species to be unlikely.
	*Turnix melanogaster*** Black-breasted Button-quail **Vulnerable**	No specific reference	See above (10.3.1)	The Black-breasted Button-quail preferred habitat is low canopy, closed rainforest or monsoon forest, vine thickets and drier shrubby scrubs such as hoop pine, brigalow, belah and bottletree thickets where there is a dense leaf litter. These specific communities do not occur on the site and very little habitat with similar characteristics exists at the proposed site of the LNG plant or ancillary marine facilities. Grazing and other disturbances from pest animals may deter the species from visiting the site. There is superior habitat on the mainland and elsewhere on Curtis Island. It is therefore unlikely that there would be any impacts on this species.
	MAMMALS			
	*Balaenoptera musculus*** Blue Whale **Endangered**	(23.4) No specific mention of Blue whale.	Section 10.3.2 p185 No specific mention of Blue whale. The EIS identified through desktop searches (EIS section 23.3.3) 15 marine fauna species (excluding birds) listed as migratory or threatened under the EPBC Act known to occur or likely to occur in the offshore area of the LNG facility (Table 23.11). The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the migratory or threatened	The Blue Whale is a largely an oceanic species only rarely seen in Queensland offshore waters. Activities on the proposed site of the LNG plant or ancillary marine facilities will not impact on the Blue whale. However the increase in shipping as a result of export LNG vessels travelling from Curtis Island to importing countries will increase the risk of some individuals of several cetacean species being injured or killed by collision with an LNG vessel, or by pollution of waters following a shipping accident. Such incidents are likely to be very infrequent. It is therefore unlikely that there would be any impact on this species.

			marine fauna species (section 23.4.4). The result determined there are no significant impacts predicted for threatened marine fauna species. Although not assessed as significant, the EIS recognises that potential impact of the LNG facility on marine fauna species could potentially include habitat reclamation, boat strike, noise and light emissions, dredging and waste water discharge. Mitigation and management measures are designed to limit these impacts on MNES.	
	*Chalinolobus dwyeri** Large-eared Pied Bat, Large Pied Bat **Vulnerable**	(23.4) There is no important population of large-eared pied bat identified for this area and no database record. The closest identified important population is at Shoalwater Bay. Vol 4 Chap 8 APLNG EIS Terrestrial Ecology Endangered vulnerable rare fauna species (Table 8.8) P20-21 Not sighted on Curtis Island P37. The LNG facility site is potentially within the foraging range of the large-eared pied bat, coastal sheathtail bat and the grey-headed flying-fox. However, these species are unlikely to roost within the LNG facility site. Considering	See above (10.3.1)	The LNG facility site is potentially within the foraging range of the large-eared pied bat**.** However, it has not been recorded in surveys and the species is unlikely to roost within the LNG facility site, nor are there suitable maternity sites in the area (mines or caves). Considering the extent of similar habitat within the wider Curtis area and the foraging range of the species, it is unlikely that there would be any impact on this species.

		the extent of similar habitat within the wider study area and the foraging range of these species, it is considered that potential impact on these species is minimal.		
	*Dasyurus hallucatus**** Northern Quoll **Endangered**	(23.4) A lack of records indicates there is no habitat present that is critical to the breeding cycle of a population. The LNG facility site area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would result in overall species decline. Nor would it result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat It is understood the most significant threatening process that may lead to potential long term decline in any possible northern quoll population is the presence and expansion in range of the cane toad. Cane toad present on site. Vol 4 Chap 8 APLNG EIS	See above (10.3.1)	It is considered unlikely that the Northern Quoll occurs in the area of the proposed LNG plant and associated marine facilities, given the presence of cane toad at the site and the lack of evidence of the species in any of the fauna surveys undertaken on behalf of several proponents of proposed LNG plants planned for this part of Curtis Island. The species has not been recorded on Curtis Island. The Department considers impacts on the species to be unlikely.

		Terrestrial Ecology Endangered vulnerable rare fauna species (Table 8.8)P20-21 Not sighted on Curtis Island There is additional discussion of the species in Vol 4 Chap 8 APLNG EIS Terrestrial Ecology p38		
	*Megaptera novaeangliae*** Humpback Whale **Vulnerable**	APLNG EIS Volume 4: LNG Facility Chapter 10: Marine Ecology p17 One of several cetacean species identified in the EPBC protected matters database search that do not occur at or adjacent to the proposed development location as they are principally oceanic species.	See above (Section 10.3.2)	Individuals of this species are known to aggregate and breed offshore from the Port of Gladstone. However it is unlikely that individuals of the species would be present in the waters in the vicinity of the LNG plant site, which is inshore and relatively shallow (apart from shipping channels). However the increase in shipping as a result of export LNG vessels travelling from Curtis Island to importing countries will increase the risk of some individuals of several cetacean species being injured or killed by collision with an LNG vessel, or by pollution of waters following a shipping accident. Such incidents are likely to be very infrequent. It is therefore unlikely that there would be any impact on this species.
	*Pteropus poliocephalus** Grey-headed Flying-fox **Vulnerable**	(23.4) The grey-headed flying-fox is highly mobile, moving up and down the east coast of Australia in response to the availability of food. This mobility indicates this is a single interbreeding population. APLNG concludes that, considering the proximity of the nearest known camp, the size of the area impacted and the extent of similar habitat within the wider area it is	(10.3.1) The EIS identified through desktop searches (section 23.3.2) 14 terrestrial fauna species listed as threatened under the EPBC Act as potentially existing within the proposed LNG facility (Table 23.10). However, the EIS identified eight of these 14 species as likely to occur within the LNG facility area: • Brigalow scaly-foot (*Paradelma orientalis*)	The grey-headed flying-fox is highly mobile, moving up and down the east coast of Australia in response to the availability of food. This mobility indicates there is a single interbreeding population. There is no identified important population of this species. APLNG states that there is a grey-headed flying-fox camp on the mainland south of Gladstone, however this camp is more than 15km away from the LNG facility site area. It is also at the northern extent of the range of the species. The LNG facility site is potentially within the foraging range of the grey-headed flying-fox**.** However, it has not been recorded in surveys and the species is unlikely to roost within the LNG facility site. Considering the extent of similar habitat within the wider Curtis area and the foraging range of the grey-headed flying-fox, it is unlikely that there would be any impact on this species.

		considered unlikely that development will impact on the species. There is additional discussion of the species in Vol 4 Chap 8 APLNG EIS Terrestrial Ecology Endangered vulnerable rare fauna species (Table 8.8)P20-21 Not sighted on Curtis Island P37	• Yakka skink (*Egernia rugosa*) • Squatter pigeon southern subspecies (*Geophaps scripta*) • Red Goshawk (*Erythrotriorchis radiates*) • Northern quoll (*Dasyurus hallucatus*) • Grey-headed flying-fox (*Pteropus poliocephalus*) • Large-eared pied bat (*Chalinolobus dwyeri*) • False water-rat (*Xeromys myoides*). Of these eight fauna species, one is listed as 'endangered' (Northern quoll), and the remaining seven are listed as 'vulnerable' under the EPBC Act. The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.4.3). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. Although not assessed as significant, the EIS recognises that potential impacts of the LNG facility on terrestrial flora and fauna are likely to be primarily associated with introduction and/or spread of invasive weeds or pests, leaching of pollutants or release	

			of sediment into retained areas of vegetation, air emission impacts, edge effects, fragmentation, altered drainage patterns, habitat loss, degradation, fragmentation, and loss of connectivity due to the physical clearing of vegetation. Mitigation and management measures are designed to limit these impacts on MNES.	
	Xeromys myoides Water Mouse, False Water Rat **Vulnerable**	(23.4) A number of important populations of false water-rat have been identified in protected areas along the central and south eastern Queensland coast. The mangrove habitat, marine couch plain and associated sandbar across the front of the saltpan provides potential habitat at the LNG facility site area. This area is directly impacted through the construction of the wharf facilities and may be impacted through edge effects from the remainder of the LNG facility. Edge effects relevant for this species include an altered hydrological regime and the potential increase of feral species such as cat and rodents. If a population of false water-rats occurred at this location it is likely to be impacted by the proposed development.	(10.3.1) The EIS identified through desktop searches (section 23.3.2) 14 terrestrial fauna species listed as threatened under the EPBC Act as potentially existing within the proposed LNG facility (Table 23.10). However, the EIS identified eight of these 14 species as likely to occur within the LNG facility area: • Brigalow scaly-foot (*Paradelma orientalis*) • Yakka skink (*Egernia rugosa*) • Squatter pigeon southern subspecies (*Geophaps scripta*) • Red Goshawk (*Erythrotriorchis radiates*) • Northern quoll (*Dasyurus hallucatus*) • Grey-headed flying-fox (*Pteropus poliocephalus*) • Large-eared pied bat (*Chalinolobus dwyeri*) • False water-rat (*Xeromys myoides*).	Based on field examination and desk top analysis the proponent considers that while the Water Mouse may potential occur within the LNG and marine facilities site it is unlikely to be present. Further if individuals do occur on site no essential habitat for this species has been identified in the LNG facility site area or wider area. feral species such as cat and rodents. However, if a population of false water-rats did occur at this location it is likely that it would be impacted by the proposed development. Evidence from Stradbroke Island indicates that Water Mouse nests are built in mounds within the reed zone. Animals forage widely through the reeds and mangroves, avoiding the drier wallum (the term 'wallum' covers two broad vegetation types found on the infertile soils of south-east Queensland's coastal lowlands: the open (dry) heathland and shrubland on coastal dunes and plains, and the closed (wet) heathland and sedgelands on coastal plains). Subsequent to the EIS, additional work, reported in June-July 2010, identified a mound that has the potential to be a 'nesting' mound of the Water Mouse on the APLNG site, although it is recognised that identification of such structures as definitely Water Mouse mounds is very difficult. Another proponent of a similar LNG project, QGC, produced a Water Mouse Management Plan (available at http://www.qgc.com.au/_dbase_upl/WaterMouse20101122.pdf) in October 2010, in which mounds identified as possible water

		The LNG facility site area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species. There is additional discussion of the species in Vol 4 Chap 8 APLNG EIS Terrestrial Ecology Endangered vulnerable rare fauna species (Table 8.8)P20-21 Not sighted on Curtis Island. Subsequent to EIS additional work, reported in June-July 2010 identified a mound was that has the potential to be a 'nesting' mound of the Water Mouse (*Xeromys myoides*).	Of these eight fauna species, one is listed as 'endangered' (Northern quoll), and the remaining seven are listed as 'vulnerable' under the EPBC Act. The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.4.3). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. Although not assessed as significant, the EIS recognises that potential impacts of the LNG facility on terrestrial flora and fauna are likely to be primarily associated with introduction and/or spread of invasive weeds or pests, leaching of pollutants or release of sediment into retained areas of vegetation, air emission impacts, edge effects, fragmentation, altered drainage patterns, habitat loss, degradation, fragmentation, and loss of connectivity due to the physical clearing of vegetation. Mitigation and management measures are designed to limit these impacts on MNES.	mouse mounds on the APLNG and Santos sites are considered more likely to be structures built by crabs. While there is a low probability that an important population the Water Mouse is present at the proposed APLNG LNG plant and marine facilities site, a possible 'nesting' mound has been located, and potential habitat – mangrove forest, marine couch plain and associated sandbar across the front of the saltpan – is present. This is an area which would be directly impacted through the construction of the proposed wharf facilities and might be impacted through edge effects from the remainder of the LNG facility. Indirect effects relevant for this species include an altered hydrological regime and the potential increase of feral species such as cat and rodents. If a population of the water mouse occurred at this location it is likely to be impacted by the proposed development. Proposed activities are not expected to have an unacceptable impact on this species, however, to protect any local population of the Water Mouse it is recommended that a condition of approval be that further studies be undertaken to confirm absence/presence at the site and a specific plan of management to protect the species be developed and implemented if a population of the species is found.

	REPTILES			
	*Caretta caretta*** Loggerhead Turtle **Endangered**	(23.4) Discussion of potential presence and impacts. For the Project, slow moving vessels such as tugs, barges, and LNG ships are considered to pose an inherently low risk of boat strike to dugong and marine turtles in Port Curtis. Australia Pacific LNG will continue to work with relevant government agencies and other industries that are, or proposing to operate fast transport activities to develop practical "whole of basin" approaches to mitigation. Australia Pacific LNG will establish a process for visual observations and recording of dugongs and cetaceans at and adjacent to the study area The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population. There is additional discussion of the species in APLNG EIS Vol 4 Chap 10 Marine Ecology P14	(9.2.4) The EIS identifies Flatback turtles, Green turtles and Loggerhead turtles as likely to nest in the vicinity of the proposed LNG facility. These are listed as 'vulnerable' and 'endangered' under the NC Act. The proposed LNG facility has the potential to cause injury and/or mortality to dugong and marine turtles through boat strike. However due to the use of slow moving vessels for the project, the LNG facility is considered to pose a low risk of boat strike to marine fauna. Where fast ferries are proposed to service the LNG facility, the EIS estimates the risk of boat strike at a medium level providing mitigation measures are in place. (10.3.2) The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the migratory or threatened marine fauna species (section 23.4.4). The result determined there are no significant impacts predicted for threatened marine fauna species.	The Departmental Species Profile and Threats Database (SPRAT) states that approximately 70% of breeding in the eastern Australian stock of the Loggerhead Turtle occurs at just five rookeries: Mon Repos, Wreck Rock, Wreck Island, Erskine Island and Tryon Island. Occasional nesting of loggerhead turtles is recorded from Facing and Curtis Islands, although not on the inshore, west facing side of Curtis Island. Marine turtles nest on mainland coastal beaches and offshore islands. They do not nest in estuarine areas such as those at and adjacent to the area of the proposed development location at Laird Point. Previous reports indicate that the Loggerhead Turtle uses Port Curtis as habitat for migration and feeding (p. 3-5 Appendix G, GLNG Project EIS). Flaring from LNG facilities and other lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The landscape and topography of the APLNG proposed LNG plant site - low hills and ridges - provides opportunities for careful siting of some structures to minimise light spill. It is planned to use ground flares (rather than tall flare stacks) which should avoid any risk of direct light spill from flaring being visible from any known marine turtle nesting beach. APLNG propose a range of measures to reduce light spill from the proposed LNG plant and associated marine facilities, although there are occupational health and safety considerations that also need to be taken into account. Even with all reasonable measures in place there will be some contribution to the loom of light in the sky above Curtis Island at night if the APLNG facilities are built. However, the light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. The APLNG contribution would likely be minor in this context, and it is unlikely that the facility would result in any disruption to the breeding cycle of the small number of loggerhead turtles that

		Table 10.9 (p36-38) summarises the key potential risks, the mitigation actions to reduce the impact of the risk, and the residual risk. Considering all constituents in combination, the residual risks are ranked as low and medium. A full description of the risk assessment methodology is given in Volume 1 Chapter 4.	Although not assessed as significant, the EIS recognises that potential impact of the LNG facility on marine fauna species could potentially include habitat reclamation, boat strike, noise and light emissions, dredging and waste water discharge. Mitigation and management measures are designed to limit these impacts on MNES.	may nest on Curtis Island. If not properly managed, stormwater runoff, reverse osmosis brine and sewage waste water discharge could alter the quality of the marine environment in the vicinity of the proposed LNG plant to the extent that marine turtles are impacted. However well understood mechanisms for ensuring these discharges are kept at levels such that rapid dispersion to background concentrations of constituents are proposed and would be enforced through proposed conditions of approval recommended by the Department. Some feeding habitat would be lost through construction of the MOF and further habitat disturbed as a result of proposed dredging of the approach channel. However, much larger areas of suitable feeding habitats are found throughout Port Curtis and elsewhere in the central Queensland region. Vessel traffic associated with the construction and servicing of the proposed LNG facility has the potential to cause injury and/or mortality to marine turtles through boat strike. Slow moving vessels pose a low risk of boat strike to turtles and other marine fauna. However, fast ferries that are proposed to service the LNG facility pose somewhat greater risk to individual turtles (as well as Dugong and cetaceans). The impact from increased vessel operation is proposed to be mitigated through maintaining constant watch and changing course/reducing boat speeds as necessary. Dredging may result in injury and/or death of individuals due to collision/interactions with dredging vessels and apparatus and/or other construction vessels. Qld DERM (EPA) has records of loggerhead turtles found dead in Gladstone Harbour in 2000 and 2002 during dredging operations. Mitigation measures that can be applied to dredging works include the use of silt curtains, timing of dredging with the tidal cycle and the use of turtle exclusion devices. The Department has recommended that conditions be placed on

				the proponent to ensure that the impact of flaring and lighting, dredging activities and vessel movements are kept to an acceptable level, and to ensure ongoing monitoring and management of marine turtles potentially affected by the proposed LNG plant and related activities. The loggerhead turtle is a circum-tropical species listed as endangered by the IUCN. The proposed LNG facility and associated activities are unlikely to reduce the global area of occupancy of the loggerhead turtle. With the mitigation measures proposed and recommended conditions of approval in place the Department considers the likely impacts on the Loggerhead Turtle to be low and acceptable.
	*Chelonia mydas*** Green Turtle **Vulnerable**	(23.4) Discussion of potential presence and impacts. Nesting beach habitat will not be physically impacted by the LNG facility. Seagrass beds are the critical foraging habitat for the species. However the area impacted by the development does not contain significant seagrass cover. The major seagrass beds in Port Curtis occur elsewhere. While habitat will be lost as a result of constructing the MOF, and further habitat disturbed as a result of dredging of the approach channel, it is not of a sufficient scale to affect the survival of any marine turtle species. Further, the area to be	(9.2.4) The EIS identifies Flatback turtles, Green turtles and Loggerhead turtles as likely to nest in the vicinity of the proposed LNG facility. These are listed as 'vulnerable' and 'endangered' under the NC Act. The proposed LNG facility has the potential to cause injury and/or mortality to dugong and marine turtles through boat strike. However due to the use of slow moving vessels for the project, the LNG facility is considered to pose a low risk of boat strike to marine fauna. Where fast ferries are proposed to service the LNG facility, the EIS estimates the risk of boat strike at a medium level providing mitigation measures	Occasional nesting of green turtles is recorded from Facing and Curtis Islands, but these are not major nesting sites. The east coast population of green turtles is split into a southern and a northern stock, with the key breeding sites being Heron Island and Raine Island respectively. Port Curtis is, however, important habitat for migration and feeding. Green turtles have been seen by researchers during field surveys and it has been reported that The Narrows and Calliope River mouth are major foraging areas. Individual green turtles have been observed within seagrass meadows, especially Pelican Banks, where they were often 'stranded' at low tide (p.12 Appendix L Part 3 GLNG EIS Supplement) Seagrass beds are the critical foraging habitat for the species. However the area impacted by the proposed APLNG development does not contain significant seagrass cover. The major seagrass beds in Port Curtis occur elsewhere. The other potential impacts of the proposed LNG plant and associated facilities and activities and mitigation options in relation to the Loggerhead Turtle discussed above are also relevant to the Green Turtle.

		reclaimed and disturbed does not constitute high value green turtle habitat. It is concluded that the proposal is unlikely to have a significant impact on the species There is additional discussion of the species in APLNG EIS Vol 4 Chap 10 Marine Ecology P14 Table 10.9 (p36-38) summarises the key potential risks, the mitigation actions to reduce the impact of the risk, and the residual risk. Considering all constituents in combination, the residual risks are ranked as low and medium. A full description of the risk assessment methodology is given in Volume 1 Chapter 4.	are in place. (10.3.2) The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the migratory or threatened marine fauna species (section 23.4.4). The result determined there are no significant impacts predicted for threatened marine fauna species. Although not assessed as significant, the EIS recognises that potential impact of the LNG facility on marine fauna species could potentially include habitat reclamation, boat strike, noise and light emissions, dredging and waste water discharge. Mitigation and management measures are designed to limit these impacts on MNES.	The IUCN listed as endangered Green Turtle is widely distributed throughout tropical and sub-tropical waters. The proposed LNG facility and associated activities are unlikely to reduce the global area of occupancy of the green turtle. With the mitigation measures proposed and recommended conditions of approval in place the Department considers the likely impacts on the Green Turtle to be low and acceptable.
	Densonia maculata Ornamental snake **Vulnerable**	Vol 4 Chap 8 APLNG EIS Terrestrial Ecology APLNG EIS Endangered vulnerable rare fauna species (Table 8.8) P20-21 Not sighted on Curtis Island P36-37 Discussed as one of four EVR reptile species identified as potentially occurring within the LNG facility site.	No specific mention of this species in CG report. See Section (10.3.1)	The Ornamental snake is a nocturnal species that occurs in Brigalow (*Acacia harpophylla*) woodland growing on clay and sandy soils, riverside woodland, and open forest growing on natural levees, particularly where deep cracking clays prone to gilgai formation (microrelief of small depressions alternating with mounds) are present. The species has not been recorded on Curtis Island. It was not identified as a species likely to occur or be impacted by the proposed LNG plant when the proposed action was referred to the Department under the EPBC Act, but was identified as one of four endangered, rare or vulnerable reptile species potentially occurring within the LNG facility site from desk top

		It is concluded that the LNG site does not meet the requirements of this species		analysis by APLNG. Field assessment of the potential habitat of the ornamental snake found that the LNG site habitat did not meet the requirements of this species. It is therefore unlikely that there would be any impact on this species.
	*Dermochelys coriacea**** Leathery Turtle, Leatherback Turtle, Luth **Vulnerable**	(23.4) A general discussion of potential impacts on marine fauna including turtles is provided, as described above in relation to the Loggerhead and Green Turtle. APLNG is of the view that Leatherback turtle (*Dermochelys coriacea*) is generally oceanic and unlikely to occur in Port Curtis	No specific mention of this species in CG report. General discussion of potential impacts, mitigation and risk to marine fauna including turtles at 9.2.4, and 10.3.2 as described above in relation to the Loggerhead and Green Turtle.	Leatherback turtles (*Dermochelys coriacea*), Hawksbill turtles *(Eretmochelys imbricata)* and Olive Ridley turtles *(Lepidochelys olivacea*) are not known to nest in the Port Curtis area. Individuals may migrate through the area, but significant numbers of individuals are unlikely in the Project area. The potential impacts of the proposed LNG plant and associated facilities and activities, and mitigation options in relation to the Loggerhead Turtle and Green Turtle discussed above are also relevant to the Leatherback Turtle. Proposed conditions in relation to the Green Turtle and Loggerhead Turtle (above) would also protect these species. (The Leatherback Turtle is IUCN listed as critically endangered.) The Department considers the likely impacts on this species to be low and acceptable.
	Egernia rugosa Yakka Skink **Vulnerable**	(23.4) Discussion of potential presence and impacts. Given the proposed development footprint and the extent of similar habitat within the wider area and provided that pre-clearing surveys by qualified fauna personnel are conducted, it is considered unlikely that LNG facility activities would lead to the decline of a potential local population, whether or not such	(10.3.1) The EIS identified through desktop searches (section 23.3.2) 14 terrestrial fauna species listed as threatened under the EPBC Act as potentially existing within the proposed LNG facility (Table 23.10). However, the EIS identified eight of these 14 species as likely to occur within the LNG facility area: • Brigalow scaly-foot	The Yakka Skink is usually found in open dry sclerophyll forest or woodland with core habitat found within the Mulga Lands and Brigalow Belt South Bioregions. It has not been recorded on Curtis Island or Calliope Shire, however, may be due to a lack of general survey effort within the region and the difficulty of observing this species in the field. The proponent states that given the difficulty in detecting this species, it is possible that it occurs within the LNG plant study area, although it was not found in surveys, and plans to take a precautionary approach in that where suitable habitat exists, the species will be assumed to be present. Nonetheless, if individuals are present on the site it will be difficult to avoid severe disruption or loss of habitat for them, although impact would be mitigated by pre-clearing surveys by qualified fauna

		a population would be considered an important population. There is additional discussion of the species in Vol 4 Chap 8 APLNG EIS Terrestrial Ecology APLNG EIS Endangered vulnerable rare fauna species (Table 8.8)P20-21 Not sighted on Curtis Island P36-37 One of four EVR reptile species have been identified as potentially occurring within LNG site	(*Paradelma orientalis*) • Yakka skink (*Egernia rugosa*) • Squatter pigeon southern subspecies (*Geophaps scripta*) • Red Goshawk (*Erythrotriorchis radiates*) • Northern quoll (*Dasyurus hallucatus*) • Grey-headed flying-fox (*Pteropus poliocephalus*) • Large-eared pied bat (*Chalinolobus dwyeri*) • False water-rat (*Xeromys myoides*). Of these eight fauna species, one is listed as 'endangered' (Northern quoll), and the remaining seven are listed as 'vulnerable' under the EPBC Act. The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.4.3). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. Although not assessed as significant, the EIS recognises that potential impacts of the LNG facility on terrestrial flora and fauna are likely to be primarily associated with introduction and/or spread of invasive weeds or pests, leaching of pollutants or release	personnel being conducted to identify, capture and move any individuals in danger, as proposed by APLNG and required by proposed conditions of approval. Taking into account the proposed development footprint and the much greater extent of similar habitat within the wider area it is unlikely that LNG plant and associated facility construction activities would lead to the decline of a potential local population, whether or not such a population would be considered an important population. The proposed package of habitat offsets to be imposed in the proposed conditions of approval will be required to include habitat for this species, based on the proponent's reasonable worst case scenario. The planned offset package will likely be for the whole of the CSG/LNG project and not separated into the different components of the project. The Department considers that the likely impacts on the species would be low and acceptable.

			of sediment into retained areas of vegetation, air emission impacts, edge effects, fragmentation, altered drainage patterns, habitat loss, degradation, fragmentation, and loss of connectivity due to the physical clearing of vegetation. Mitigation and management measures are designed to limit these impacts on MNES.	
	*Eretmochelys imbricate*** Hawksbill Turtle **Vulnerable**	A general discussion of potential impacts on marine fauna including turtles is provided at (23.4), as described above in relation to the Loggerhead and Green Turtle.	No specific mention of this species in CG report. General discussion of potential impacts, mitigation and risk to marine fauna including turtles at 9.2.4, and 10.3.2 as described above in relation to the Loggerhead and Green Turtle.	Hawksbill turtles *(Eretmochelys imbricata)*, Leatherback turtles (*Dermochelys coriacea*),and Olive Ridley turtles *(Lepidochelys olivacea*) are not known to nest in the Port Curtis area. Individuals may migrate through the area, but significant numbers of individuals are unlikely in the Project area. The potential impacts of the proposed LNG plant and associated facilities and activities, and mitigation options in relation to the Loggerhead Turtle and Green Turtle discussed above are also relevant to the Hawksbill Turtle. Proposed conditions in relation to the Green Turtle and Loggerhead Turtle (above) would also protect these species. The Department considers the likely impacts on this species to be low and acceptable.
	*Lepidochelys olivacea*** Pacific Ridley, Olive Ridley **Endangered**	A general discussion of potential impacts on marine fauna including turtles is provided at (23.4), as described above in relation to the Loggerhead and Green Turtle.	No specific mention of this species in CG report. General discussion of potential impacts, mitigation and risk to marine fauna including turtles at 9.2.4, and 10.3.2 as described above in relation to the Loggerhead and Green Turtle.	Olive Ridley turtles *(Lepidochelys olivacea*), Hawksbill turtles *(Eretmochelys imbricata)* and Leatherback turtles (*Dermochelys coriacea*) are not known to nest in the Port Curtis area. Individuals may migrate through the area, but significant numbers of individuals are unlikely in the Project area. The potential impacts of the proposed LNG plant and associated facilities and activities, and mitigation options in relation to the Loggerhead Turtle and Green Turtle discussed above are also relevant to the Olive Ridley Turtle. Proposed conditions in relation to the Green Turtle and

				Loggerhead Turtle (above) would also protect these species. The Department considers the likely impacts on this species to be low and acceptable.
	*Natator depressus*** Flatback Turtle **Vulnerable**	(23.4) See reference above in relation to the Loggerhead and Green turtles.	(9.2.4) See reference above in relation to the Loggerhead and Green turtles.	The endemic Flatback turtle (*Natator depressus*) nests on the eastern beaches of Curtis, Facing and Hummock Hill Island. The South End area of Curtis Island is the key Flatback turtle nesting area in the region and it is identified nationally as a medium density rookery. The species does not nest on the inshore, west facing side of Curtis Island. The Flatback turtle uses Port Curtis as habitat for migration and feeding and indicviduals of the species could potentially be impacted by activities associated with the construction and operation of the proposed LNG plant and marine facilities. These potential impacts and mitigation options in relation to the Loggerhead Turtle and Green Turtle discussed above are also relevant to the Flatback Turtle. Proposed conditions in relation to the Green Turtle and Loggerhead Turtle (above) would also protect the species. The Department considers the likely impacts on this species to be low and acceptable.
	*Paradelma orientalis** Brigalow Scaly-foot **Vulnerable**	(23.4) The eucalypt woodland within the LNG facility site area is considered suitable habitat for a population of brigalow scaly-foot. Considering the extent of similar suitable habitat within the wider area and provided effective pre-clearing surveys are conducted by a suitably qualified fauna spotter/catcher it is considered unlikely the LNG facility will lead to a long term decrease in the size of an important population.	(10.3.1) The EIS identified through desktop searches (section 23.3.2) 14 terrestrial fauna species listed as threatened under the EPBC Act as potentially existing within the proposed LNG facility (Table 23.10). However, the EIS identified eight of these 14 species as likely to occur within the LNG facility area: • Brigalow scaly-foot (*Paradelma orientalis*)	The brigalow scaly-foot is a nocturnal species found in a wide variety of dry open forest and woodland habitats. This species was not identified during field surveys in the study area. SPRAT indicates the species is known from Gladstone but not Curtis Island. If this species occurs within the LNG facility site then individuals are likely to be impacted through potential unearthing during construction and loss of habitat. Due to its cryptic nature, it is unlikely that pre-clearance surveys would detect this species. Nonetheless impact might be mitigated to some extent by pre-clearing surveys by qualified fauna personnel being conducted to identify, capture and move any individuals in danger, as proposed by APLNG and required by proposed conditions of approval Taking into account the proposed development footprint and

		There is additional discussion of the species in Vol 4 Chap 8 APLNG EIS Terrestrial Ecology APLNG EIS Endangered vulnerable rare fauna species (Table 8.8)P20-21 Not sighted on Curtis Island P36-37 One of four EVR reptile species have been identified as potentially occurring within the LNG facility site.	• Yakka skink (*Egernia rugosa*) • Squatter pigeon southern subspecies (*Geophaps scripta*) • Red Goshawk (*Erythrotriorchis radiates*) • Northern quoll (*Dasyurus hallucatus*) • Grey-headed flying-fox (*Pteropus poliocephalus*) • Large-eared pied bat (*Chalinolobus dwyeri*) • False water-rat (*Xeromys myoides*). Of these eight fauna species, one is listed as 'endangered' (Northern quoll), and the remaining seven are listed as 'vulnerable' under the EPBC Act. The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the threatened terrestrial flora and fauna (section 23.4.3). The result determined there are no significant impacts predicted for threatened terrestrial flora and fauna species. Although not assessed as significant, the EIS recognises that potential impacts of the LNG facility on terrestrial flora and fauna are likely to be primarily associated with introduction and/or spread of invasive weeds or pests, leaching of pollutants or release of sediment into retained areas	the much greater extent of similar habitat within the wider area it is unlikely that LNG plant and associated facility construction activities would lead to the decline of a potential local population, whether or not such a population would be considered an important population. The proposed package of habitat offsets to be imposed in the proposed conditions of approval will be required to include habitat for this species, based on the proponent's reasonable worst case scenario. The planned offset package will likely be for the whole of the CSG/LNG project and not separated into the different components of the project. The Department considers that the likely impacts on the species would be low and acceptable.

			of vegetation, air emission impacts, edge effects, fragmentation, altered drainage patterns, habitat loss, degradation, fragmentation, and loss of connectivity due to the physical clearing of vegetation. Mitigation and management measures are designed to limit these impacts on MNES.	
	SHARKS			
	*Pristis zijsron** Green Sawfish, Dindagubba, Narrowsnout Sawfish **Vulnerable**	APLNG EIS Volume 4: LNG Facility Chapter 10: Marine Ecology 10.2.11 p20 The green sawfish (*Pristis zijsron*) is recorded in shallow inshore coastal environments including estuaries. However detailed records of the occurrence of the species from 1912 to 2004 identify no individuals of the species as being recorded in the Gladstone region during that period (Stevens et al. 2005). Thererfore cponcluded that no impact is likely	10.2.1 (pipeline) in CG report P180 The EIS identifies two marine fauna species which are not also migratory species (section 23.10.5): Green sawfish (*Pristis zijsron*) • Whale shark (*Rhincodon typus*). Neither of these threatened marine fauna species are considered likely to occur in the pipeline crossing area therefore are not assessed any further.	The Green Sawfish (*Pristis zijsron*) and the Whale Shark (*Rhincodon typus*) have the potential to occur or migrate within the area, however Green Sawfish are predominantly found north of Cairns in the Gulf of Carpentaria, and the Whale Shark is a predominantly an offshore species. It is unlikely that significant numbers of individuals of these species will utilise the waters of the Port of Gladstone. The construction and operational activities proposed, including dredging, vessel movement and operational discharges, are highly unlikely to impact on these species.
	*Rhincodon typus*** Whale Shark **Vulnerable**	APLNG EIS Volume 4: LNG Facility Chapter 10: Marine Ecology 10.2.11 p20 The green sawfish (*Pristis zijsron*) is recorded in shallow inshore coastal environments including estuaries. However detailed records of the occurrence of the species from 1912 to 2004 identify no individuals of the	10.2.1 (pipeline) in CG report P180 The EIS identifies two marine fauna species which are not also migratory species (section 23.10.5): Green sawfish (*Pristis zijsron*) • Whale shark (*Rhincodon typus*). Neither of these threatened marine fauna species are	The Whale Shark (*Rhincodon typus*) and Green Sawfish (*Pristis zijsron*) have the potential to occur or migrate within the area, however Green Sawfish are predominantly found north of Cairns in the Gulf of Carpentaria, and the Whale Shark is a predominantly an offshore species. It is unlikely that significant numbers of individuals of these species will utilise the waters of the Port of Gladstone. The construction and operational activities proposed, including dredging, vessel movement and operational discharges, are highly unlikely to impact on these species.

		species as being recorded in the Gladstone region during that period (Stevens et al. 2005).	considered likely to occur in the pipeline crossing area therefore are not assessed any further.	
	PLANTS			
	*Asplenium pellucidum** Translucent Spleenwort **Vulnerable**	No specific mention of this species in APLNG EIS APLNG EIS V4Chap8 Terrestrial Ecol P16 Table 8.4 lists Scheduled flora species known or likely to occur in the wider study area NOTE The current known distribution and preferred habitats of all species potentially present in broader region are also provided in the technical report (Volume 5 Attachment 16, Section 3.2.3).	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through construction, operation and decommissioning of the proposed LNG plant and associated marine facilities.
	*Atalaya collina** **Endangered**	No specific mention of this species in APLNG EIS APLNG EIS V4Chap8 Terrestrial Ecol P16 Table 8.4 lists Scheduled flora species known or likely to occur in the wider study area NOTE The current known distribution and preferred habitats of all species potentially present in broader region are also provided in the technical report (Volume 5 Attachment 16, Section 3.2.3).	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through construction, operation and decommissioning of the proposed LNG facility.

	*Bosistoa selwynii** Heart-leaved Bosistoa **Vulnerable**	APLNG EIS V4Chap8 Terrestrial Ecol P16 Table 8.4 lists Scheduled flora species known or likely to occur in the wider study area indicates that this species was not sighted and is not known from site. NOTE The current known distribution and preferred habitats of all species potentially present in broader region are also provided in the technical report (Volume 5 Attachment 16, Section 3.2.3).	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	*Bosistoa selwynii* and *Bosistoa transversa* have been determined to be the same species. Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through construction, operation and decommissioning of the proposed LNG facility.
	*Bosistoa transversa** Three-leaved Bosistoa **Vulnerable**	See *Bosistoa selwynii* reference above	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	*Bosistoa selwynii* and *Bosistoa transversa* have been determined to be the same species. Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through construction, operation and decommissioning of the proposed LNG facility.
	*Bulbophyllum globuliforme** Miniature Moss-orchid **Vulnerable**	APLNG EIS V4Chap8 Terrestrial Ecol P16 Table 8.4 lists Scheduled flora species known or likely to occur in the wider study area indicates that this species was not sighted and is not known from site. NOTE The current known distribution and preferred habitats of all species potentially present in broader region are also provided in the technical report (Volume 5	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through construction, operation and decommissioning of the proposed LNG plant and associated marine facilities.

		Attachment 16, Section 3.2.3).		
	*Cupaniopsis shirleyana**** Wedge-leaf Tuckeroo **Vulnerable**	APLNG EIS V4Chap8 Terrestrial Ecol P16 Table 8.4 lists Scheduled flora species known or likely to occur in the wider study area indicates that this species was not sighted and is not known from site. NOTE The current known distribution and preferred habitats of all species potentially present in broader region are also provided in the technical report (Volume 5 Attachment 16, Section 3.2.3).	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through construction, operation and decommissioning of the proposed LNG plant and associated marine facilities.
	*Cycas megacarpa*** Large-fruited zamia palm **Endangered**	(23.4) This species was not recorded on site during survey efforts and there are no historical records of this species occurring on or directly adjacent to the LNG facility site area. The site does however contain suitable habitat for this species and it is possible, although highly unlikely, that a small population or individual trees are present on site. Given the absence of known large populations on the surrounding land and that all recognised important populations occur on mainland Australia, it is considered highly unlikely that any population occurs on site.	(9.2.1) No threatened flora species were recorded during the EIS field survey and there are no historical records of these species occurring on Curtis Island; however the EIS considers the proposed LNG facility site to support suitable habitat for two of these species including the large-fruited zamia palm (*Cycas megacarpa*) and quassia (*Quassia bidwillii)*. Although the LNG facility site supports suitable habitat for two threatened species likely to be present - *Cycas megacarpa* and *Quassia bidwillii* - the potential habitat areas of these species on site are not	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area which included the LNG and associated marine facilities and a larger surrounding area on Curtis Island. However, potential suitable habitat for the large-fruited zamia palm (*Cycas megacarpa*) was located. Nonetheless the absence of known large populations on the surrounding land and the fact that all recognised important populations occur on mainland Australia, it is considered highly unlikely that any population occurs on site. There are therefore unlikely to be impacts on the species through construction, operation and decommissioning of the proposed LNG plant and associated marine facilities.

			considered to form part of any critical or essential habitat area for these species due to the lack of known populations on the island and isolation from existing populations on the mainland. As such, the EIS concluded the proposed LNG facility site to not contribute significantly to the overall available habitat and range of the species. (10.3.1) The EIS identified through desktop searches (section 23.3.2) seven terrestrial flora species listed as threatened under the EPBC Act as potentially existing within the proposed LNG facility. However, the EIS only identified two flora species listed as threatened under the EPBC Act, known to be present on Curtis Island (section 23.3.2): • Large-fruited zamia palm (*Cycas megacarpa*) • Quassia (*Quassia bidwillii*). These are listed as 'endangered' and 'vulnerable' respectively under the EPBC Act. No threatened flora species listed under the EPBC Act were identified on site during the field survey and there are no historical records of these species occurring on or	

			adjacent to the site.	
	*Cycas ophiolitica**** **Endangered**	No specific mention of this species in APLNG EIS	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through construction, operation and decommissioning of the proposed LNG plant and associated marine facilities.
	*Parsonsia larcomensis** **Vulnerable**	No specific mention of this species in APLNG EIS	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through construction, operation and decommissioning of the proposed LNG plant and associated marine facilities.
	*Quassia bidwillii** Quassia **Vulnerable**	(23.4) Searches for this species have failed to confirm its presence within the study area. Site specific searches will be conducted for this species in suitable habitat proposed to be disturbed. As the species has not been located and is only predicted to occur within the study area, with the implementation of the proposed mitigation and offset measures if individuals are located, a long-term decrease in the size of an important population is not considered likely as a result of the LNG facility. There is additional discussion of the species in APLNG EIS V4Chap8 Terrestrial Ecol P31	(9.2.1) No threatened flora species were recorded during the EIS field survey and there are no historical records of these species occurring on Curtis Island; however the EIS considers the proposed LNG facility site to support suitable habitat for two of these species including the large-fruited zamia palm (*Cycas megacarpa*) and quassia (*Quassia bidwillii*). Although the LNG facility site supports suitable habitat for two threatened species likely to be present - *Cycas megacarpa* and *Quassia bidwillii*, the potential habitat areas of these species on site are not considered to form part of any critical or essential habitat area for these species due to the lack of known populations on the island and isolation from	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area which included the LNG and associated marine facilities and a larger surrounding area on Curtis Island. There are no historical records of these species occurring on or adjacent to the site. However, potential suitable habitat for *Quassia bidwillii* was located. As approximately 0.1% of the potential habitat of the species in the bioregion falls within the study area, no habitat critical to the survival of this species will be disturbed. As the species is considered unlikely to be present it is unlikely that the LNG facility will impact on the species. The proposed package of habitat offsets to make up for the loss of vegetation communities on Curtis Island which would be imposed in the proposed conditions of approval will likely include habitat for this species.

			existing populations on the mainland. As such, the EIS concluded the proposed LNG facility site to not contribute significantly to the overall available habitat and range of the species . (10.3.1) The EIS identified through desktop searches (section 23.3.2) seven terrestrial flora species listed as threatened under the EPBC Act as potentially existing within the proposed LNG facility. However, the EIS only identified two flora species listed as threatened under the EPBC Act, known to be present on Curtis Island (section 23.3.2): • Large-fruited zamia palm (*Cycas megacarpa*) • Quassia (*Quassia bidwillii*). These are listed as 'endangered' and 'vulnerable' respectively under the EPBC Act. No threatened flora species listed under the EPBC Act were identified on site during the field survey and there are no historical records of these species occurring on or adjacent to the site.	
	Taeniophyllum muelleri Minute Orchid,	APLNG EIS Table 8.4 Scheduled flora species known or likely to occur in the wider	No specific mention of this species in CG report. General discussion at (9.2.1) (10.3.1)	Field survey found no vegetation species listed under the EPBC Act occurring within or in the vicinity of the study area. There are therefore unlikely to be impacts on these species through

	Ribbon-root Orchid **Vulnerable**	study area Not sighted or known from site.		construction, operation and decommissioning of the proposed LNG plant and associated marine facilities.
Listed migratory species (sections 20 & 20A)	**MIGRATORY TERRESTRIAL SPECIES**	Vol 4 Chap 8 General APLNG EIS Migratory species Fifty-two migratory species were identified through desktop review of the wider study area (Table 8.10). Based on their habitat preference, 39 of these species potentially utilise habitat within the Project area. These are listed in: Table 8.10 Potential migratory birds occurring within the LNG facility site Page23-24		
	BIRDS			
	Haliaeetus leucogaster White-bellied Sea-Eagle **Migratory**	(23.4) These large raptors occur on coastal and inland water bodies. Disturbance associated with the LNG facility may reduce foraging activity in and around the LNG facility site. APLNG EIS Vol 4 Chap 8 Terrestrial Ecol Table 8.10 Recorded on site	CG Report APLNG Section 10.3.2 p186 The EIS identified 56 birds listed as migratory under the EPBC Act known to occur or possibly occur within the LNG facility area (EIS section 23.3.4). Seven out of the 56 birds identified, were confirmed during field surveys of the LNG facility area: • Eastern reef egret (*Egretta sacra*) • White-bellied sea eagle (*Haliaeetus leucogaster*) • Rainbow bee-eater (*Merops ornatus*)	General comment that applies to all terrestrial migratory species: The assessment of significance made by the proponent concluded that the proposal would not have a significant impact on migratory species because: 1. the small number of individuals that utilise the subject site; 2. the quality of habitat within the subject site compared to the larger area of better quality nearby habitat; and 3. the likelihood that small numbers of birds would continue to utilise parts of the site during the construction and operational phases of the project. Although individuals may be lost or displaced and the local population reduced, the Department does not disagree with this conclusion in respect of terrestrial migratory species potentially on site. However these species and the habitat that currently supports them do contribute to the biodiversity/conservation

			• Whimbrel (*Numenius phaeopus*) • Pacific golden plover (*Pluvialis fulva*) • Caspian tern (*Sterna caspia*) • Eastern curlew (*Numenius madagascariensis*). In addition to the seven confirmed species, suitable habitat to support an additional 34 bird species is considered to be present in the LNG facility area (Table 23.12). Given the extent of suitable habitat available in the wider Port Curtis area, the EIS states that it is unlikely that the LNG facility will impact significantly on migratory birds (EIS section 23.4.4). The EIS claims that there should be no degradation of any adjacent habitat providing management guidelines are implemented.	World Heritage and National Heritage values of Curtis Island as part of the Great Barrier Reef World Heritage area. For these reasons it is recommended that suitable habitat for these species be included in the package of offsets to be imposed as a condition of approval
	Hirundapus caudacutus White-throated Needletail **Migratory**	APLNG EIS Vol 4 Chap 8 One of 39 species identified by APLNG as potentially utilising habitat within the LNG and related facilities site, but not recorded on site in field surveys. Full list is at Table 8.10 Page23-24	CG Report APLNG Section 10.3.2 p186	See above
	Hirundo rustica Barn Swallow **Migratory**	APLNG EIS Vol 4 Chap 8 One of 39 species identified by APLNG as potentially utilising	CG Report APLNG Section 10.3.2 p186	See above

		habitat within the LNG and related facilities site, but not recorded on site in field surveys. Full list is at Table 8.10 Page23-24		
	Merops ornatus Rainbow Bee-eater **Migratory**	APLNG EIS Vol 4 Chap 8 Terrestrial Ecol Table 8.10 Recorded on site (23.4) The Rainbow bee-eater is likely to be significantly affected by invasive species, should breeding occur on site. Rainbow bee-eaters nest in burrows in soil and sand banks. Feral predators and cane toads, which are known to prey on eggs and nestlings (Boland 2004b), are already established in the study area. The control of foxes, cats and dogs has been identified as a management objective. Management of feral species should ensure that there is no increase in feral species activity in the LNG facility site.	CG Report APLNG Section 10.3.2 p186 The EIS identified 56 birds listed as migratory under the EPBC Act known to occur or possibly occur within the LNG facility area (EIS section 23.3.4). Seven out of the 56 birds identified, were confirmed during field surveys of the LNG facility area: • Eastern reef egret (*Egretta sacra*) • White-bellied sea eagle (*Haliaeetus leucogaster*) • Rainbow bee-eater (*Merops ornatus*) • Whimbrel (*Numenius phaeopus*) • Pacific golden plover (*Pluvialis fulva*) • Caspian tern (*Sterna caspia*) • Eastern curlew (*Numenius madagascariensis*). In addition to the seven confirmed species, suitable habitat to support an additional 34 bird species is considered to be present in the LNG facility area (Table 23.12). Given the extent of suitable	See above In addition note that the Department recommends that one condition of approval be the implementation of management plans that include quarantine, weed and feral animal control measures. These should minimise impact of feral pests on breeding success of Rainbow Bee-eater individuals that may utilise the LNG site.

			habitat available in the wider Port Curtis area, the EIS states that it is unlikely that the LNG facility will impact significantly on migratory birds (EIS section 23.4.4). The EIS claims that there should be no degradation of any adjacent habitat providing management guidelines are implemented.	
	Monarcha melanopsis Black-faced Monarch **Migratory**	APLNG EIS Vol 4 Chap 8 One of 39 species identified by APLNG as potentially utilising habitat within the LNG and related facilities site, but not recorded on site in field surveys. Full list is at Table 8.10 Page23-24	CG Report APLNG Section 10.3.2 p186	See above
	Monarcha trivirgatus Spectacled Monarch **Migratory**	APLNG EIS Vol 4 Chap 8 One of 39 species identified by APLNG as potentially utilising habitat within the LNG and related facilities site, but not recorded on site in field surveys. Full list is at Table 8.10 Page23-24	CG Report APLNG Section 10.3.2 p186	See above
	Myiagra cyanoleuca Satin Flycatcher. **Migratory**	APLNG EIS Vol 4 Chap 8 One of 39 species identified by APLNG as potentially utilising habitat within the LNG and related facilities site, but not recorded on site in field surveys. Full list is at Table 8.10 Page23-24	CG Report APLNG Section 10.3.2 p186	See above

	Pandion christatus Eastern Osprey **Migratory**	(23.4) These large raptors occur on coastal and inland water bodies. Disturbance associated with the LNG facility may reduce foraging activity in and around the LNG facility site. An eastern osprey nest has been identified on North Passage Island.	CG Report APLNG Section 10.3.2 p186	See above Marine facilities are no longer proposed to be located close to North Passage Island.
	Rhipidura rufifrons Rufous Fantail **Migratory**	APLNG EIS Vol 4 Chap 8 One of 39 species identified by APLNG as potentially utilising habitat within the LNG and related facilities site, but not recorded on site in field surveys. Full list is at Table 8.10 Page23-24	CG Report APLNG Section 10.3.2 p186	See above
	MIGRATORY WETLAND SPECIES			
	BIRDS (Including shorebirds)	(23.4) A General discussion of potential impacts on shorebirds is presented as follows: <u>Loss of important habitat</u> There will be a loss of approximately 24 ha of salt pan and salt marsh and 2.4ha of mangroves. Recent field surveys have shown that these areas are utilised as foraging habitat by some shorebird species. The area directly affected has not been identified as a significant feeding area or roosting site (EPA 1999). It is		Building the LNG plant and associated marine and other facilities would result in the loss of approximately 24 ha of salt pan and saltmarsh and 2.4ha of mangroves. Recent field surveys have shown that these areas are utilised as foraging habitat by some shorebird species. Nonetheless the LNG facility area is not core habitat for any EPBC Act listed migratory species. Similar vegetation communities and topography is found elsewhere in the region. Given the low number of individuals sighted and the presence of large areas of suitable habitat in surrounding areas, it is unlikely that there will be an impact on these species as a result of the proposed LNG plant and marine facilities. However, the cumulative impact of several similar LNG plant proposals along the west coast of southern Curtis Island and related dredging and reclamation activities are likely to have

		considered that this loss of foraging habitat would not significantly decrease the foraging habitat available for shorebirds within the wider Port Curtis area. Indirectly, disturbance from the construction and operation of this LNG facility (and related activities such as dredging for access) may reduce the usability of the adjacent undisturbed habitat. This is discussed below. <u>Degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site</u> Activities resulting in the potential degradation of habitat utilised by shorebirds in the study area are the construction of the LNG facility including the wharf and impacts associated with the LNG facility, such as the dredging to enable shipping access to the wharf. The construction of the LNG facility will impact on habitat utilised by some shorebirds in this area. The proposed footprint covers the majority of the existing saltpan on site. This saltpan is utilised by some migratory shorebirds. The		some impacts on the distribution and overall population of shorebird species that requires monitoring and management to ensure sufficient roosting and foraging habitat is retained in the Port Curtis area to protect and enhance the populations of shorebirds that use the area. A recommended condition of approval is that APLNG be required to undertake targeted survey work for the migratory birds in the footprint of the proposed LNG plant and associated marine facilities. The proponent should quantify total habitat loss and, if required, propose adequate mitigation or offset measures. This further work could be undertaken as part of a 'whole of Port' migratory bird monitoring and management program.

		construction of the wharf facilities will impact on the mudflats where these facilities are constructed. There is potential for some shorebird species to continue to forage in areas adjacent to the LNG facility area (outside of the development footprint). The dredging and reclamation works associated with the Western Basin Dredging and Disposal Project has the potential to impact habitat for migratory shorebirds within the Port Curtis area. The impact of these works is being assessed through the EIS being undertaken by GPC for the Western Basin Dredging and Disposal Project and is summarised in Section 23.4.5. <u>Increased disturbance leading to a substantial reduction in migratory shorebirds using the site</u> Disturbance may result in a reduction of available foraging time and may cause shorebirds to expend energy which is required for migration. The habitat areas of most importance when considering potential disturbance levels are roosting sites and feeding grounds. Disturbance of roosting sites may result in		

		unnecessary expenditure of energy to relocate to a safer location. Shorebirds have a limited opportunity to forage during the low tide times. Disturbance can prevent birds from foraging effectively (Bamford et al. 2008). Of the various forms, small aircraft and helicopter disturbance is seen as the most severe and long lasting. Close approaches from the water generally disturb more birds than approaches from the land. This is due to the majority of the shore birds being close to the water's edge when foraging or roosting. Disturbance from the land is generally a result of movement along the tidal flat which includes people and animals, particularly dogs (Davidson and Rothwell 1993). Studies undertaken on shorebirds in the Dutch Wadden Sea suggest that shorebirds are impacted by high sound levels with the threshold for noise impact considered to be 120 dB(A). Birds impacted by noise move away from the area (Smit and Visser 1993). For the LNG facility site disturbance may occur during construction and / or operation. The primary mode of access to		

		the proposed facility will be via a boat. Although a helipad will be constructed on site, there will be minimal use of helicopters. The construction period potentially involves a high level of disturbance with increased activity on land, water and potentially in the air (albeit that there will be limited helicopter access to the island). It is assumed that increased activity and potentially loud intermittent noise during construction may result in a significant level of disturbance. Although there are shorebirds present year round, including some first year birds, for the migratory birds the area would be most significantly utilised from November through to March each year. Once operational, LNG facility activities may cause disturbance in the wider Port Curtis area as a result of increased shipping activity, smaller boats undertaking ferry roles and generally increased activity around the LNG facility. High levels of operational activity around the immediate facility will potentially disturb shorebird		

		foraging activity on this area of the mudflat. Only limited helicopter access is expected during operation. Shorebirds have differing levels of tolerance to disturbance, with species such as eastern curlew and bar-tailed godwit having particularly low tolerance levels (Davidson and Rothwell 1993). Buffer zones of 150 – 200m around identified important habitat have been determined as necessary for minimisation of disturbance of those less disturbance-tolerant shorebird species (Paton et al. 2000). A reduction in the use of the mudflat immediately adjacent to the wharf facility is likely for those less disturbance tolerant species of shorebirds. However there is a suitable distance between the LNG facility and the identified major feeding and roosting locations within the wider Port Curtis area for the activity of the wharf not to disturb these areas. Providing a buffer to boating activity around the identified important feeding and roosting sites is maintained, it is likely there will be minimal disturbance to these areas as a result of the operational activity		

		of this plant. Direct mortality of birds leading to a substantial reduction in migratory shorebirds using important habitat Given the mobility of shorebirds, it is considered unlikely that the construction and operation of this LNG facility will result in direct mortality of shorebirds in the study area. Shorebirds are likely to move away from disturbance during the construction period. A potential indirect impact is the increased access to the area by feral predators. Feral dogs, cats and foxes have previously been recorded on Curtis Island. A biosecurity management plan as described in Volume 4 Chapter 8 will be developed to control and prevent the establishment of invasive species. Also discussed in 4.2.2 Migratory shorebirds		
	Actitis hypoleucos Common Sandpiper **Migratory**	No specific mention of this species in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above

	Ardea alba Great Egret, White Egret **Migratory**	(23.4) The Great egret is common and widespread in a variety of habitats. The Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. The Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the LNG facility.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Ardea ibis Cattle Egret **Migratory**	(23.4) The Great egret is common and widespread in a variety of habitats. The Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. The Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the LNG facility. One of 39 species identified by APLNG as potentially utilising habitat within the LNG and related facilities site, but not recorded on site in field surveys. Full list is at APLNG EIS Vol 4 Chap 8 Table 8.10 Page23-24	No specific mention of this species in CG report. General discussion at Section 10.3.2	Potential impacts from the proposed LNG marine facilities are unlikely as the species is widespread and its preferred habitat is unlikely to be impacted. See also general discussion above

	Arenaria interpres Ruddy Turnstone **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Calidris acuminata Sharp-tailed Sandpiper **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Calidris canutus Red Knot **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Calidris ferruginea Curlew Sandpiper **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Calidris ruficollis Red-necked Stint **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Calidris tenuirostris Great Knot **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Charadrius bicinctus Double-banded Plover **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Charadrius leschenaultia Greater Sand Plover **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above

	Charadrius mongolus Lesser Sand Plover **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Gallinago hardwickii Latham's Snipe, Japanese Snipe **Migratory**	(23.4) There is no important habitat for Latham's snipe in the LNG facility site i.e. there are no naturally occurring open freshwater wetlands in the LNG facility site. Some habitat may be created in drainage lines due to heavy rain events but would be highly ephemeral. Foraging opportunities for the species would be very sporadic.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Heteroscelus brevipes Grey-tailed Tattler **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Limicola falcinellus Broad-billed Sandpiper **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Limosa lapponica Bar-tailed Godwit **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Limosa limosa Black-tailed Godwit **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above

	Nettapus coromandelianus albipennis Australian Cotton Pygmy-goose **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Numenius madagascariensis Eastern Curlew **Migratory**	APLNG EIS Vol 4 Chap 8 Terrestrial Ecol Table 8.10 Recorded on site	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Numenius minutus Little Curlew, Little Whimbrel **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Numenius phaeops Whimbrel **Migratory**	APLNG EIS Vol 4 Chap 8 Terrestrial Ecol Table 8.10 Recorded on site	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Pluvialis fulva Pacific Golden Plover **Migratory**	APLNG EIS Vol 4 Chap 8 Terrestrial Ecol Table 8.10 Recorded on site	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Pluvialis squatarola Grey Plover **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Rostratula benghalensis s. lat. Painted Snipe **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Sula leucogaster Brown Booby **Migratory**	(23.4) This marine species is likely at the LNG facility site only as an occasional visitor. No important habitat for the species will be modified,	No specific mention of this species in CG report. General discussion at Section 10.3.2	This marine species is likely at the LNG and associated marine facilities site only as an occasional visitor. No impact on the species is likely.

		destroyed or isolated by the LNG facility.		
	Sterna albifrons Little Tern **Migratory**	(23.4) The study area contains suitable foraging and roosting habitat for the three species. A sand bar provides possible breeding habitat for little tern but this will not be directly affected by the LNG facility. Considering the suitable habitat potentially impacted by this development and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the LNG facility would be considered important habitat for these species. Of these species only little tern is likely to be significantly affected by invasive species, should breeding occur on site. Little tern is subject to predation and trampling of nests by livestock. Feral predators and horses and cattle are already established in the study area. The control of foxes, cats and dogs has been identified as a management objective. Management of feral species should ensure that there is no increase in feral species activity	No specific mention of this species in CG report. General discussion at Section 10.3.2	Given the low number of individuals sighted and the presence of large areas of suitable habitat in surrounding areas, it is unlikely that there will be an impact on these species as a result of the proposed LNG plant and associated marine facilities.

		in the LNG facility site.		
	Sterna caspia Caspian Tern **Migratory**	(23.4) The study area contains suitable foraging and roosting habitat for the three species. A sand bar provides possible breeding habitat for little tern but this will not be directly affected by the LNG facility. Considering the suitable habitat potentially impacted by this development and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the LNG facility would be considered important habitat for these species.	No specific mention of this species in CG report. General discussion at Section 10.3.2	Given the low number of individuals sighted and the presence of large areas of suitable habitat in surrounding areas, it is unlikely that there will be an impact on these species as a result of the proposed LNG plant and associated marine facilities.
	Sterna hirundo Common Tern **Migratory**	(23.4) The study area contains suitable foraging and roosting habitat for the three species. A sand bar provides possible breeding habitat for little tern but this will not be directly affected by the LNG facility. Considering the suitable habitat potentially impacted by this development and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the LNG facility would be considered important habitat for these species.	No specific mention of this species in CG report. General discussion at Section 10.3.2	Given the low number of individuals sighted and the presence of large areas of suitable habitat in surrounding areas, it is unlikely that there will be an impact on these species as a result of the proposed LNG plant and associated marine facilities.

	Tringa stagnatilis Marsh Sandpiper **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	Xenus cinereus Terek Sandpiper **Migratory**	No specific mention in APLNG EIS. General discussion of shorebirds at 23.4. See also 4.2.2 Migratory shorebirds.	No specific mention of this species in CG report. General discussion at Section 10.3.2	See general discussion above
	MIGRATORY MARINE BIRDS			
	Apus pacificus Fork-tailed Swift **Migratory**	APLNG EIS Vol 4 Chap 8 Table 8.10 Page 23-24. One of 39 species identified by APLNG as potentially utilising habitat within the LNG and related facilities site, but not recorded on site in field surveys.	No specific mention of this species in CG report. General discussion at Section 10.3.2	Impacts from the proposed LNG plant and marine facilities are unlikely as this species habitat is widespread and it is unlikely to occur in the Gladstone region. Its preferred habitat is unlikely to be affected.
	Ardea alba Great Egret, White Egret **Migratory**	**See above under Migratory Wetland Species**	**See above under Migratory Wetland Species**	**See above under Migratory Wetland Species**
	Ardea ibis Cattle Egret **Migratory**	**See above under Migratory Wetland Species**	**See above under Migratory Wetland Species**	**See above under Migratory Wetland Species**
	Macronectes giganteus Southern Giant-Petrel **Migratory**	**See comments above (Listed threatened species and communities).**	**See comments above (Listed threatened species and communities).**	**See comments above (Listed threatened species and communities).**
	Sterna albifrons Little Tern **Migratory**	**See above under Migratory Wetland Species**	**See above under Migratory Wetland Species**	**See above under Migratory Wetland Species**
	MIGRATORY MARINE SPECIES			

	MAMMALS			
	Balaenoptera edeni Bryde's Whale **Migratory**	APLNG EIS Volume 4: LNG Facility Chapter 10: Marine Ecology p17 Due to the inshore nature of the proposed project location it is considered the following cetacean species identified in the EPBC protected matters database search do not occur at or adjacent to the proposed development location as they are principally oceanic species: minke whale (*Balaenoptera acutorostrata*), humpback whale (*Megaptera novaeangliae*), Bryde's whale (*Balaenoptera edeni*), Risso's dolphin (*Grampus griseus*), spotted dolphin (*Stenella attenuata*), common dolphin (*Delphinus delphis*) and the killer whale (*Orcinus orca*).	10.3.2 p185 The EIS identified through desktop searches (EIS section 23.3.3) 15 marine fauna species (excluding birds) listed as migratory or threatened under the EPBC Act known to occur or likely to occur in the offshore area of the LNG facility (Table 23.11). However, the EIS identified nine of these 15 species as known to occur or likely to occur within the LNG facility marine area: • Saltwater crocodile (*Crocodylus porosus*) • Flatback turtle (*Natator depressus*) • Green turtle (*Chelonia mydas*) • Loggerhead turtle (*Caretta caretta*) • Olive Ridley turtle (*Lepidochelys olivacea*) • Hawksbill turtle (*Eretmochelys imbricate*) • Dugong (*Dugong dugon*) • Indo-Pacific humpback dolphin (*Sousa chinensis*) • Australian snubfin dolphin (*Orcaella heinsohni*). Of these species, two are listed as 'endangered' under the EPBC Act: • Loggerhead turtle (*Caretta caretta*) • Olive Ridley turtle (*Lepidochelys olivacea*).	Bryde's Whale has not been well surveyed within Australian waters. Their distribution is primarily assumed from incidental sightings, beach-cast animals, and whaling data for all areas. The Departmental SPRAT database states that it is thought the species prefers waters with a temperature of 20 degrees C. Data from CSIRO indicates that the long-term average ocean temperature at Gladstone is 24 degrees. Therefore, the Department considers it very unlikely that this species would utilise the Port of Gladstone and it is unlikely that there would be any impact on this species.

			In addition, three species are listed as 'vulnerable' under the EPBC Act: • Flatback turtle (*Natator depressus*) • Green turtle (*Chelonia mydas*) • Hawksbill turtle (*Eretmochelys imbricate*). The remaining four species are listed as migratory under the EPBC Act. The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the migratory or threatened marine fauna species (section 23.4.4). The result determined there are no significant impacts predicted for threatened marine fauna species. Although not assessed as significant, the EIS recognises that potential impact of the LNG facility on marine fauna species could potentially include habitat reclamation, boat strike, noise and light emissions, dredging and waste water discharge. Mitigation and management measures are designed to limit these impacts on MNES.	
	*Balaenoptera musculus*** Blue Whale **Migratory**	**See comments above (Listed threatened species and communities).**	**See comments above (Listed threatened species and communities).**	**See comments above (Listed threatened species and communities).**

	Dugong dugon Dugong **Migratory**	(23.4) When vessel based activities overlap with habitats utilised by dugong and marine turtles they are at particular risk from boat strike which can cause significant injury or mortality. Marine turtles and dugong are vulnerable to boat strike when they are at the surface breathing and resting between dives. Vessel speed and water depth are the main factors affecting the risk of boat strikes with faster vessels in shallower water posing a greater risk. For the Project, slow moving vessels such as tugs, barges, and LNG ships are considered to pose an inherently low risk of boat strike to dugong and marine turtles in Port Curtis. Australia Pacific LNG will continue to work with relevant government agencies and other industries that are, or proposing to operate fast transport activities to develop practical "whole of basin" approaches to mitigation. Australia Pacific LNG will establish a process for visual observations and recording of dugongs and cetaceans at and adjacent to the study area. Activities associated with	(9.2.4) The EIS identifies a number of marine fauna species of state conservation significance which may exist within the proposed LNG facility region. These include: • dugong—listed as 'vulnerable to extinction' under the NC Act and 'vulnerable' under the International Union for the Conservation of Nature (IUCN). The area adjacent to the proposed LNG facility site is declared a 'Dugong Protection Area B' under the NC Act. 'Dugong Protection Area B' is the second most important area under the legislation and represents less significant but still important habitat. The proposed LNG facility has the potential to cause injury and/or mortality to dugong and marine turtles through boat strike. However due to the use of slow moving vessels for the project, the LNG facility is considered to pose a low risk of boat strike to marine fauna. Where fast ferries are proposed to service the LNG facility, the EIS estimates the risk of boat strike at a medium level providing mitigation measures	The Dugong is likely to be found within the Port of Gladstone, however there is no published literature documenting their occurrence in the vicinity of the proposed LNG facility. If constructed and operated in accord with well understood management regimes and proposed conditions of approval, the land based activities involved in constructing and operating the land based elements of the proposed LNG plant are unlikely to significantly impact on surrounding waters, and therefore on this marine species. Dugongs are potentially impacted by destruction of, and alienation from, seagrass habitat. While the Port Curtis region is not identified as supporting large populations of dugongs, the construction activities associated with construction of marine facilities and associated dredging, could temporarily impact movement of dugong and cetaceans to feeding areas. Vessel movement has the potential to cause injury and/or mortality to dugong and marine turtles through boat strike. The discussion above in relation to potential impacts on marine turtles and proposed mitigation measures (for instance in relation to the Loggerhead Turtle (Listed threatened species and communities) is also relevant. With recommended mitigation measures proposed in place unacceptable impact on the dugong is not likely.

		construction in the marine environment and operations, in particular vessel movements, have the potential to displace dugong and cetaceans from critical habitat and interrupt critical behaviours through the creation of underwater noise. There are a number of underwater noise sources that may impact on cetaceans and dugong. These include pile driving and vessel traffic. Percussive piling for the construction of the MOF jetty is most likely to be of a frequency and volume that will cause disturbance to dolphins. It is considered that disturbance to dolphins will occur during the construction phase as a result of pile driving, however, dolphins will again utilise the area once construction activities cease. The overlap of dolphin populations with areas of high vessel activity suggests at least, in part, they habituate to boating activities. Noise generated by vessel activity can also change the behaviour of dugong and result in alienation from important habitat. In the case of Port Curtis, existing high value dugong (seagrass) habitat occurs in areas unaffected by the current development. The use of	are in place. Dugong and cetaceans may be impacted by underwater noise created as a result of the proposed LNG facility activities. Behaviour changes and displacement from critical habitat can occur as a result of underwater noise. The EIS predicts that underwater noise impacts on dolphins will be limited to the construction phase. The EIS also suggests that impacts on dugongs will be low due to adjacent habitat areas unaffected by the LNG facility impacts are available in the region. (10.3.2) The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the migratory or threatened marine fauna species (section 23.4.4). The result determined there are no significant impacts predicted for threatened marine fauna species. Although no assessed as significant, the EIS recognises that potential impact of the LNG facility on marine fauna species could potentially include habitat reclamation, boat strike, noise and light emissions,	

		mitigating strategies including the option of use of bubble curtains (forcing air from compressors into an enclosure around the noise source), pile cap cushions and applying "soft starts" to pile driving will be implemented. Soft starts refer to the increasing of pile energy gradually over a period of time. Monitoring of the usage of the area adjacent to the LNG facility by dolphins and dugong will be undertaken prior, during and after construction. The principal aim of this monitoring is to determine if animals are displaced from habitat and whether this impact persists through time. It is considered that no important dugong habitat will be destroyed or isolated as a result of the proposed development. Areas of seagrass that may be impacted by the development of the LNG facility are not considered to be areas of important habitat. It is considered unlikely that an invasive species that is harmful to dugong will be introduced due to the LNG facility. There is the potential for alienation of dugong from habitats due to ferry operations	dredging and waste water discharge. Mitigation and management measures are designed to limit these impacts on MNES.	

		and construction activities in general. Mitigation measures are proposed to limit the scale of any disturbance from construction activities (refer to Volume 4 Chapter 10). It is considered unlikely that the Project would seriously disrupt the lifecycle of an ecologically significant proportion of the population of the species. The predicted mean and maximum increases in salinity due to the cumulative discharges (for this and other proposed projects on Curtis Island) of desalination brine are well within the natural ambient salinity variations and would not be detrimental to the marine environment and therefore would not result in any measurable impact to dugong. APLNG EIS Vol4 Chap 10 P13, P23 Dugongs are potentially impacted by destruction of, and alienation from, seagrass habitat. While the Port Curtis region is not identified as supporting large populations of dugongs, the construction of marine facilities can temporarily impact movement of dugong and cetaceans to feeding areas. Dugong survey information currently available does not provide data at a scale suitable for assessing dugongs' use of the		

		Western Basin area (GPC 2009). Supplemental Information (Marine Ecology 4.1.1) The regionally small loss of seagrass meadows adjacent to the south-western shoreline of Curtis Island may have some impact on several species of conservation importance known to utilise shallow, inshore habitats and seagrass beds in the area of the proposed development.		
	*Megaptera novaeangliae*** Humpback Whale **Migratory**	**See comments above (Listed threatened species and communities).**	**See comments above (Listed threatened species and communities).**	**See comments above (Listed threatened species and communities).**
	Orcaella brevirostris Irrawaddy Dolphin **Migratory**	Australia (APLNG workshop presentation June 2010) It is now known that the Irrawaddy dolphin does not occur in Australia. Previously the Australian endemic Snubfin dolphin was identified incorrectly as the widely distributed Irrawaddy dolphin (*Orcaella brevirostris*). (23.4) Activities associated with construction in the marine environment and operations, in particular vessel movements, have the potential to displace dugong and cetaceans from critical habitat and interrupt critical behaviours through the creation of underwater noise.	No specific reference, general discussion of marine species presented in section 9.2.4.	Sightings of Irrawaddy dolphin in the past are likely to have been of the Australian endemic Snubfin dolphin. It seems likely that the Irrawaddy dolphin does not occur in Australian waters and therefore the proposed action will not have an impact on the species. See *Orcaella heinsonii* - Australian Snubfin Dolphin – discussion below.

		There are a number of underwater noise sources that may impact on cetaceans and dugong. These include pile driving and vessel traffic. Percussive piling for the construction of the MOF jetty is most likely to be of a frequency and volume that will cause disturbance to dolphins. It is considered that disturbance to dolphins will occur during the construction phase as a result of pile driving, however, dolphins will again utilise the area once construction activities cease. The overlap of dolphin populations with areas of high vessel activity suggests at least, in part, they habituate to boating activities. Noise generated by vessel activity can also change the behaviour of dugong and result in alienation from important habitat. In the case of Port Curtis, existing high value dugong (seagrass) habitat occurs in areas unaffected by the current development. The use of mitigating strategies including the option of use of bubble curtains (forcing air from compressors into an enclosure around the noise source), pile cap cushions and applying “soft starts” to pile driving will be implemented. Soft starts refer to the increasing of pile energy		

		gradually over a period of time. Monitoring of the usage of the area adjacent to the LNG facility by dolphins and dugong will be undertaken prior, during and after construction. The principal aim of this monitoring is to determine if animals are displaced from habitat and whether this impact persists through time. No important dolphin habitat is being destroyed or isolated as a result of the proposed development. It is considered unlikely that an invasive species that is harmful to dolphins will be introduced due to the LNG facility. There is the potential for alienation of dolphins from habitat during construction activities. Mitigation measures are proposed to limit the scale of any disturbance from construction activities (refer to Volume 4, Chapter 10). Suitable habitats that dolphins can utilise within Port Curtis are outside the area likely to be impacted by the LNG facility. The predicted mean and maximum increases in salinity due to the cumulative discharges (for this and other		

		proposed Projects on Curtis Island) of desalination brine are well within the natural ambient salinity variations and would not be detrimental to the marine environment and therefore would not result in any measurable impact to dolphins.		
	Orcaella heinsonii Australian Snubfin Dolphin **Migratory (listed as** *Orcaella brevirostris* Irrawaddy Dolphin)	(23.4) Activities associated with construction in the marine environment and operations, in particular vessel movements, have the potential to displace dugong and cetaceans from critical habitat and interrupt critical behaviours through the creation of underwater noise. There are a number of underwater noise sources that may impact on cetaceans and dugong. These include pile driving and vessel traffic. Percussive piling for the construction of the MOF jetty is most likely to be of a frequency and volume that will cause disturbance to dolphins. It is considered that disturbance to dolphins will occur during the construction phase as a result of pile driving, however, dolphins will again utilise the area once construction activities cease. The overlap of dolphin populations with areas of high vessel activity suggests at least, in part, they	(9.2.4) The EIS identifies the Indo-Pacific humpback dolphin, the Australian snubfin dolphin and the Bottlenose dolphin as species known to occur adjacent to the proposed LNG facility. (10.3.2) The EIS includes an assessment of the proposed impact of the LNG facility against the significant impact criteria for the migratory or threatened marine fauna species (section 23.4.4). The result determined there are no significant impacts predicted for threatened marine fauna species. Although not assessed as significant, the EIS recognises that potential impact of the LNG facility on marine fauna species could potentially include habitat reclamation, boat strike, noise and light emissions, dredging and waste water discharge. Mitigation and management measures are designed to limit	While individuals of this species occasionally frequent the their regular presence is unlikely. If constructed and operated in accord with well understood management regimes and proposed conditions of approval, the land based activities involved in constructing and operating the land based elements of the proposed LNG plant are unlikely to significantly impact on surrounding waters, and therefore on this marine species. Construction of marine facilities and associated dredging, could temporarily impact movement of cetaceans and displace them from normally used feeding areas. Vessel movement has the potential to cause injury and/or mortality to cetaceans through boat strike, although the overlap of dolphin populations with areas of high vessel activity suggests at least, in part, they habituate to boating activities. The discussion above in relation to potential impacts on marine turtles and proposed mitigation measures (for instance in relation to the Loggerhead Turtle (Listed threatened species and communities) is also relevant. With recommended mitigation measures proposed in place unacceptable impact on the Australian Snubfin Dolphin is not likely.

		habituate to boating activities. Noise generated by vessel activity can also change the behaviour of dugong and result in alienation from important habitat. In the case of Port Curtis, existing high value dugong (seagrass) habitat occurs in areas unaffected by the current development. The use of mitigating strategies including the option of use of bubble curtains (forcing air from compressors into an enclosure around the noise source), pile cap cushions and applying “soft starts” to pile driving will be implemented. Soft starts refer to the increasing of pile energy gradually over a period of time. Monitoring of the usage of the area adjacent to the LNG facility by dolphins and dugong will be undertaken prior, during and after construction. The principal aim of this monitoring is to determine if animals are displaced from habitat and whether this impact persists through time. No important dolphin habitat is being destroyed or isolated as a result of the proposed development. It is considered unlikely that an invasive species that is harmful to dolphins will be introduced	these impacts on MNES.	

		due to the LNG facility. There is the potential for alienation of dolphins from habitat during construction activities. Mitigation measures are proposed to limit the scale of any disturbance from construction activities (refer to Volume 4, Chapter 10). Suitable habitats that dolphins can utilise within Port Curtis are outside the area likely to be impacted by the LNG facility. The predicted mean and maximum increases in salinity due to the cumulative discharges (for this and other proposed Projects on Curtis Island) of desalination brine are well within the natural ambient salinity variations and would not be detrimental to the marine environment and therefore would not result in any measurable impact to dolphins. Supplemental Information (Marine Ecology 4.1.1) The regionally small loss of seagrass meadows adjacent to the south-western shoreline of Curtis Island may have some impact on several species of conservation importance known to utilise shallow, inshore habitats and seagrass beds in the area of the proposed		

		development. .		
	Orcinus orca Killer Whale, Orca **Migratory**	APLNG EIS Volume 4: LNG Facility, Chapter 10: Marine Ecology p17 One of the species that APLNG consider does not occur at or adjacent to the proposed development location as it is an inshore location and the killer whale (*Orcinus orca*) is principally an oceanic species. (As are the minke whale (*Balaenoptera acutorostrata*), humpback whale (*Megaptera novaeangliae*), Bryde's whale (*Balaenoptera edeni*), Risso's dolphin (*Grampus griseus*), spotted dolphin (*Stenella attenuata*), and the common dolphin (*Delphinus delphis*) A general discussion of marine species provided in 23.4	No specific reference, general discussion of marine species presented in section 9.2.4.	While individuals of this species may very occasionally frequent the area their regular presence is unlikely as the Killer Whale is principally an oceanic species. The Department does not consider any impact on the Killer Whale to be likely.
	Sousa chinensis Indo-Pacific Humpback Dolphin **Migratory**	(23.4) Activities associated with construction in the marine environment and operations, in particular vessel movements, have the potential to displace dugong and cetaceans from critical habitat and interrupt critical behaviours through the creation of underwater noise.	(9.2.4) The EIS identifies the Indo-Pacific humpback dolphin, the Australian snubfin dolphin and the Bottlenose dolphin as species known to occur adjacent to the proposed LNG facility. (10.3.2) The EIS includes an assessment of the proposed impact of the LNG facility against the	Recent research reported in relation to the Gladstone Ports Corporation Western Basin Dredging and Disposal project indicates that Port Curtis supports a geographically isolated population of Indo-pacific humpback dolphins. The size of this population is estimated to be 85 individuals and connectivity with other populations is thought to be low. This indicates that Port Curtis provides important habitat throughout the lifecycle for a local population of the Indo-pacific Humpback Dolphin. The planned LNG plant and associated marine facilities

		Discussion as for Australian Snubfin Dolphin above	significant impact criteria for the migratory or threatened marine fauna species (section 23.4.4). The result determined there are no significant impacts predicted for threatened marine fauna species. Although not assessed as significant, the EIS recognises that potential impact of the LNG facility on marine fauna species could potentially include habitat reclamation, boat strike, noise and light emissions, dredging and waste water discharge. Mitigation and management measures are designed to limit these impacts on MNES.	would directly affect a very small are of Port Curtis with no habitat known to be critical to this species of dolphin. Individuals of this species may occasionally frequent the area in the immediate vicinity of the proposed LNG plant and marine facilities. If constructed and operated in accord with well understood management regimes and proposed conditions of approval, the land based activities involved in constructing and operating the land based elements of the proposed LNG plant are unlikely to significantly impact on surrounding waters, and therefore on this marine species. Construction of marine facilities and associated dredging, could temporarily impact movement of cetaceans.. Vessel movement has the potential to cause injury and/or mortality to cetaceans through boat strike, although the overlap of dolphin populations with areas of high vessel activity suggests at least, in part, they habituate to boating activities. The discussion above in relation to potential impacts on marine turtles and proposed mitigation measures (for instance in relation to the Loggerhead Turtle (Listed threatened species and communities) is also relevant. With recommended mitigation measures proposed in place unacceptable impact on the Indo-Pacific Humpback Dolphin is not likely.
	REPTILES			
	*Caretta caretta*** Loggerhead Turtle **Migratory**	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)
	*Chelonia myda**s* Green Turtle **Migratory**	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)
	Crocodylus porosus *Estuarine Crocodile,* Salt-	(23.4) No important saltwater crocodile habitat will be destroyed or isolated as a result of the	(10.3.2) The EIS includes an assessment of the proposed impact of the LNG facility against the	While the potential for crocodiles to occur in the area cannot be ruled out, no signs (slides or footprints) have been detected during the course of the survey work undertaken by any of the proponents of LNG plants proposed to be located

	water Crocodile **Migratory**	proposed development. It is considered unlikely that an invasive species that is harmful to saltwater crocodile will be introduced due to the LNG facility. There is the potential for alienation of saltwater crocodile from habitats due to ferry operations and construction activities in general. Impacts from the brine discharge from the desalination facility are not considered to be of a sufficient magnitude above background values to result in any measurable impacts to saltwater crocodile.	significant impact criteria for the migratory or threatened marine fauna species (section 23.4.4). The result determined there are no significant impacts predicted for threatened marine fauna species. Although not assessed as significant, the EIS recognises that potential impact of the LNG facility on marine fauna species could potentially include habitat reclamation, boat strike, noise and light emissions, dredging and waste water discharge. Mitigation and management measures are designed to limit these impacts on MNES.	on the south western corner of Curtis Island. At least one proponent has stated that local sources report that crocodiles have not been recorded in the area during the past several decades. Curtis Island does not represent core habitat for the species. The Department therefore considers that impacts on this species are unlikely
	*Dermochelys coriacea*** Leathery Turtle, Leatherback Turtle, Luth **Migratory**	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)
	*Eretmochelys imbricate*** Hawksbill Turtle **Migratory**	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)
	*Lepidochelys olivacea*** Pacific Ridley, Olive Ridley **Migratory**	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)
	*Natator depressus*** Flatback Turtle **Migratory**	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)

	SHARKS			
	*Rhincodon typus*** Whale Shark **Migratory**	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)	Discussed above (Also a listed threatened species)
World Heritage properties (section 12 & 15A)	**Great Barrier Reef**	APLNG EIS Volume 4, Chapter 23, Section 23.4 (Abbreviated to 23.4) Impacts discussed and the conclusion reached that construction and operations of the LNG facility will not cause any values of the GBRWHA to be lost, degraded or damaged.	CG Report Chapter 10, Section 10.3.3 (Abbreviated to 10.3.3) The EIS includes an assessment of the proposed impact of the pipeline against world heritage and national heritage values (section 23.4.2). The potential impacts to the world heritage values of the Great Barrier Reef as a result of the construction of the LNG facility include: • outstanding example representing a major stage of the earth's evolutionary history • outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment • contain unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty • provide habitats where populations of rare and endangered species of plants and animals still survive. The result of the assessment determined the impacts on world	The following statement appears in Section 10.3.3 of the CG Report: "Below the mean low water mark, the marine environment is considered located within the Great Barrier Reef World Heritage Area." In fact both Curtis Island, above mean low watermark, as well as marine waters are part of the Great Barrier Reef World Heritage Area. Curtis Island is one of more than 550 continental islands in the GBRWHA. The total area of these continental islands is about 1627 km^2 or 0.1% of Queensland's terrestrial land area. Curtis Island is the largest of these with an area of 46,600 ha. This is approximately 0.1339% of the total area of the GBR WHA, and 28.641% of the total area of all continental Islands within the GBR Clearing of natural vegetation at the LNG plant and associated marine facilities would have a minor local impact on some ecological and biological processes such as • loss of feeding and/or breeding grounds for international migratory seabirds, cetaceans, and sea turtles; due to: • habitat loss: open forest and woodland; mangroves and seagrass of ecological importance to many terrestrial and marine species; • temporary turbidity increases resulting from dredging and construction activities. However these are not considered to reach the level that could be considered unacceptable in terms of WH criterion IX (significant ongoing ecological and biological processes) or criterion X (significant natural habitat for in-situ conservation

			heritage and national heritage values predicted as a result of the proposed LNG facility to be not of significance or negligible (section 23.4.2). Impacts will be associated primarily with construction rather than operation of the LNG facility and will include modification of stormwater drainage, vegetation removal and associated habitat loss, visual amenity, and noise and air emissions. These impacts are considered minor and mitigation and management measures are designed to limit these impacts on MNES.	of biological diversity). There would be limited local impact on attributes that contribute to criterion VIII (significant geomorphic or physiographic features) of the GBR WHA (for instance through cut and fill operations, land reclamation, and dredging). Sediment limitation devices and other mitigation measures would be utilised to minimise the potentially negative environmental impacts of the earthmoving and dredging activities proposed. The local minor changes to geomorphic and physiographic features resulting from implementation of the proposed activities are not considered to reach the level that could be considered unacceptable in terms of WH criterion VIII. If the proposed LNG facility is built there will be a locally significant direct impact on the natural beauty and aesthetic importance of Curtis Island and thus some diminution of the overall aesthetic landscape values of the GBRWHA (i.e. World Heritage value criterion VII) because of the change from a natural to a built environment with large structures, flares and lighting visible from some distance away. However, the southern end of Curtis Island is very close to Gladstone and several existing major industrial plants on the mainland lie within less than 10 km of the Curtis Island Industry Precinct (CIIP). Given that the facilities would likely be subject to strict conditions to reduce as far as possible their negative aesthetic presence and would be confined to the industrial area on the western (harbour) side of Curtis island, the Department considers that the likely impacts on the overall aesthetic landscape values of the GBRWHA (criterion VII) would not be unacceptable. The Department does not considered the proposed action likely to result in an unacceptable level of impact on the values and attributes of the GBRWHA as a whole. Two

				similar proposals to construct LNG plants and related facilities, on sites immediately to the south of the planned APLNG plant, were approved under the EPBC Act in late 2010.
National Heritage places (section 15B & 15C)	**Great Barrier Reef**	Addressed as World Heritage matters. See explanatory note under Departmental Conclusion on Acceptability column	Addressed as World Heritage matters. See explanatory note under Departmental Conclusion on Acceptability column	**NOTE**. Curtis Island and the Narrows (the northern reaches of the channel between Curtis Island and the mainland) are part of the Great Barrier Reef World Heritage Area and National Heritage Place. World Heritage and National Heritage values are interrelated in that on 15 May 2007, under the *Environment and Heritage Legislation Amendment Act (No. 1) 2003,* a determination was made that the Australian World Heritage properties included in the World Heritage List, including the GBRWHA, would be included in the National Heritage List for those world heritage values that the World Heritage Committee had identified each property as having. For the GBRWHA the World Heritage Values as currently categorised are (vii), (viii), (ix), and (x), corresponding with National Heritage Criteria (a), (b), (c), (d), and (e).

Notes:

Where species are classified under more than one EPBC category (eg Listed Threatened and Listed Migratory) only one set of comments is provided.
*Species name** indicates that there is a Conservation Advice in place for the species.
*Species name*** indicates that there is a Recovery Plan in place for the species. Both Conservation Advices and Recovery Plans are in effect for some species this is indicated thus *Species name****.
Recovery Plans are accessible at the following address: http://www.environment.gov.au/biodiversity/threatened/recovery-list-common.html
Conservation Advices (Fitzroy NRM Region) are accessible at the following address: http://www.environment.gov.au/cgi-bin/sprat/public/conservationadvice.pl

The following Threat Abatement Plans are also of relevance:

- <u>Threat abatement plan for competition and land degradation by rabbits</u>

- Threat abatement plan for dieback caused by the root-rot fungus *Phytophthora cinnamomi*
- Threat abatement plan for predation by European red fox
- Threat abatement plan for predation by feral cats
- Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs
- Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares

IUCN = The International Union for the Conservation of Nature

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Proposed Approval

To develop, construct, operate and decommission the Coal Seam Gas Field component of the Australia Pacific LNG Project in the Walloons gas fields within the Surat Basin in south central Queensland as described in referral EPBC 2009/4974.

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

person to whom the approval is granted	**Australia Pacific LNG Pty Limited** (APLNG)
proponent's ABN	ABN: 68 001 646 331
proposed action	To develop, construct, operate and decommission the coal seam gas (CSG) resources in the Walloons gas fields within the Surat Basin in south central Queensland with up to 10,000 CSG wells, to supply natural gas for the related proposal for the APLNG natural gas liquefaction and export facility (LNG facility) to be located on Curtis Island: • as described in the proponent's referral received under the EPBC Act on 6 July 2009; and • as described in the proponent's Environmental Impact Statement and supplementary information provided pursuant to section 35(2) of the QLD SDPWO Act
decision	To approve the proposed action for each of the following controlling provisions: • Wetlands (Ramsar) (sections 16 and 17B, EPBC Act) • Listed threatened species and communities (sections 18 and 18A, EPBC Act) • Listed migratory species (sections 20 and 20A, EPBC Act)
conditions of approval	This approval is subject to the conditions specified below.
expiry date of approval	This approval has effect until 22 February 2060
name and position	The Hon Tony Burke MP Minister for Sustainability, Environment, Water, Population and Communities
signature	Not for signature (draft only)
date of decision	No date (draft only)

Conditions

Project area

1. The project area is the area identified at Figure 1, within the Walloons gas fields will have a maximum gas field development area of 572,700 ha, within the following petroleum tenures (as they are at the date of the decision to which these conditions are attached):
   - Authority to prospects (ATP) 606P Combabula, 663P Gilbert Gully, 692P Kainama North, 972P Ramyard, 973P Carinya;
   - Petroleum leases (PL) 209 Woleebee, 215 Orana, 226 Talinga (excluding the approved 90TJ/d);
   - Petroleum lease applications (PLA) 216 Dalwogan, 225 Kainama, 265 Condabri Central, 266 Condabri South, 267 Condabri North, , 272 Orana North, 289 Kainama North, .

Infrastructure limits

2. Impacts must be limited to a maximum of 10,000 production wells and impacts related to associated gas field development.

Constraints Planning and Field Development

Protocol for Constraints Planning and Field Development

3. Before the commencement of gas field development, the proponent must develop a Constraints Planning and Field Development Protocol (the Protocol).

4. The Protocol must apply for the life of the project and include the principles of:
   a. avoiding direct and indirect adverse impacts on MNES;
   b. mitigating and managing direct and indirect impacts to minimise cumulative adverse impacts on matters of national environmental significance (MNES);
   c. active site remediation and rehabilitation of impacted areas to promote and maintain long-term recovery of MNES.

5. The Protocol must:
   a. classify the following as being within the proponent's highest environmental constraint class - Sensitivity Category 1 (or should the proponent's classification be revised, an equivalent high environmental constraints class):
      i. all listed threatened ecological communities;
      ii. all listed flora species; and
      iii. those listed threatened and migratory fauna species habitats as identified in management plans required under these conditions,

which where relevant may be described in terms of specific niche habitat types;

Note: The proponent's approach to environmental constraints and description of sensitivity categories including sensitivity category 1 and related impact avoidance and mitigation is described in volume 2, chapter 23 of the proponent's Environmental Impact Statement (publicly released 20 March 2010). The protocol conditions do not apply to the other constraints that the proponent has included in environmental constraint class - sensitivity category 1 unless these are relevant to MNES.

b. take into account all current survey data and available information and maps of all MNES relevant to the project area as described within environmental constraint class sensitivity category 1 ;

c. require the undertaking and documentation of planning and pre-clearance site assessments and field ecological surveys in proposed gas field development areas where constraint class sensitivity category 1 is mapped, likely, or found. The pre-clearance site assessments and field ecological surveys must identify and assess options relating to potential gas field development impacts on MNES and provide recommendations to inform the proponent's decision to develop the project area;

d. to avoid direct and indirect adverse impacts on MNES, including fragmentation and edge effects, the proponent is required to determine the location of proposed infrastructure in accordance with the following:

   i. preferentially avoid native vegetation that constitutes a listed ecological community and/or may provide habitat for listed species and utilise previously cleared or previously utilised areas;

   ii. exclude exploration and production wells from within areas identified as environmental constraint class sensitivity category 1 unless their location within environmental constraint class sensitivity category 1 is justified as an exception given other constraints and the impact on any MNES will be minimal, short term and recoverable; and

   Note: Directional drilling and multiple drill holes from one well pad are options to avoid well site and related infrastructure disturbance to environmental constraint class sensitivity category 1 .

   iii. either:

      I. exclude other <u>non linear</u> infrastructure from the no impact zone; or

      II. where the location of other non linear infrastructure in the no impact zone is justified given other constraints and cannot be avoided, only authorise the siting of that infrastructure in that zone where field ecological surveys demonstrate that there will be minimal, short term and recoverable, or <u>no</u> adverse impact on any MNES, including habitat for any listed species;

   iv. either:

      I. exclude <u>linear</u> infrastructure from the impact risk zone; or

      II. where the location of linear infrastructure in the impact risk zone is justified given other constraints and cannot be avoided, only authorise the siting of that infrastructure in that zone where field ecological surveys demonstrate that there will be <u>minimal</u> adverse impact on any MNES, including habitat for any listed species.

      Note: Justification is reportable in accordance with condition 13 a) vii). The management plan requirements under condition 8 h) may also indicate that a species or its habitat can co-exist with specific types of gas field infrastructure and operations.

e. require the proponent to plan for and decide the extent that proposed linear infrastructure may have adverse impacts on MNES in accordance with the following:

   i. all linear disturbance within environmental constraints class sensitivity category 1 for MNES and the impact risk zone must be:

      I. limited to 12 metres in width for a single water flowline;

      II. limited to 18 metres in width for a trunkline with one water gathering line and one parrellel gas gathering line;

      III. limited to 25 metres in width for multiple trunklines where there are three parallel gas or water gathering lines;

      IV. limited to an additional 7 metres for each additional trench for water or gas lines.

      Note 1: These widths include provision for a utility corridor and access track.

   ii. In exceptional circumstances only (eg. river crossings, where there are abnormal access constraints into a gas processing facility and when within close proximity to other proponent's linear infrastructure), increased corridor widths within areas of MNES may be required. In those circumstances a risk based site assessment will be completed to determine disturbance to MNES, identify management measures to minimise impacts to MNES and to justify the additional disturbance to MNES. The assessment will be available to the Department prior to any disturbance.

   iii. gas and water trunkline rights of way, water distribution pipeline rights of way, and other major linear infrastructure disturbance corridors within environmental constraints class sensitivity category 1 and the impact risk zone must be:

      I. limited to 30 m in width where there are one or two gas and water trunklines, underground 33kV power lines and fibre optic cables in parallel;

      II. limited to 30 metres plus an additional 4 metres for every additional gas or water trunkline in parallel with the initial one or two gas or water trunklines, underground 33kV power lines and fibre optic cable;

      III. limited to disturbance within the identified infrastructure corridors.

      IV. where feasible, gas trunklines, pipelines for associated water and other transmission lines must be co-located to reduce total disturbance on MNES.

      Note: Any area of a disturbance referred to in this condition would be subtracted from the disturbance limits specified elsewhere in these conditions.

f. support bioregional corridors for listed threatened species and migratory species, and connectivity for listed threatened ecological communities;

g. ensure site assessments and field ecological surveys:

   i. are undertaken in accordance with the Department's survey guidelines in effect at the time of the survey. This information can be obtained from http://www.environment.gov.au/epbc/guidelines-policies.html#threatened;

ii. take into account and reference previous ecological surveys undertaken in the area and relevant new information on likely presence or absence of MNES;

iii. are undertaken by a suitably qualified ecologist approved by the Department;

iv. document the survey methodology, results and significant findings in relation to MNES.

v. apply best practice site assessment and ecological survey methods appropriate for each listed threatened species, migratory species, their habitat and listed ecological communities;

Note: Best practice includes applying the optimum timing and frequency of site assessments and surveys to determine presence or absence of listed threatened species or migratory species or their habitat, or a listed threatened ecological community.

vi. apply the mapping of environmental constraints class sensitivity category 1; the infrastructure location requirements; minimum no impact zones; impact risk zones; and the width requirements for linear infrastructure corridors described in e);

vii. reports are published by the proponent on the internet 20 business days before clearance of native vegetation in an infrastructure impact area and provided to the Department on request;

h. require species and ecological community management plans which include:

i. relevant avoidance and mitigation measures to be applied;

ii. measures for protecting each listed threatened species and migratory species and their habitat, and each listed threatened ecological community not previously assessed by the proponent, should one or more be found in the project area at any time over the life of the project. Any such management plans must be developed in a timeframe to be approved by the Department. Notification of additional MNES found must be provided to the Department in writing within 10 business days. Measures must include the development of a management plan consistent with requirements under condition 8; and

i. ensure constraints planning and field development decisions are made in accordance with the Protocol (including any relevant species and ecological community management plans) before final selection of specific sites for gas field development within the project area.

6. The Protocol must ensure relevant information on MNES is available and used by the proponent to support field development and management decisions throughout the life of the project.

Management plans for listed species and ecological communities

7. Before commencement of each major stage of gas field development the proponent must develop management plans for that area, which include terrestrial ecology habitat management guidelines, addressing each listed species and listed ecological community that, as indicated through assessment or more recent information, may be potentially impacted by gas field development within the project area, or external to the project area, as a

result of gas field development. The management plans must address as a minimum, the ecological communities and species and their habitat as specified in Tables 1, 2, and 3 of these conditions:

Note 1: The proponent may develop management plans to align with the requirements of the Queensland Government where there are species and ecological communities covered by both Queensland requirements and the requirements of this approval.

Note 2: Major stages of development are to be notified under condition 90.

Table 1: Species management plans required before commencement	
Listed fauna species	**EPBC Act status**
Dasyurus hallucatus (Northern Quoll)	Endangered
Chalinolobus dwyeri (Large-eared Pied Bat, Large Pied Bat)	Vulnerable
Nyctophilus timoriensis (South-eastern form) (Eastern Long-eared Bat)	Vulnerable
Turnix melanogaster (Black-breasted Button-quail)	Vulnerable
Erythrotriorchis radiatus (Red Goshawk)	Vulnerable
Rostratula australis (Australian Painted Snipe)	Vulnerable
Geophaps scripta scripta (Squatter Pigeon (Southern))	Vulnerable
Pedionomus torquatus (Plains-wanderer)	Vulnerable
Lathamus Discolor (Swift Parrot)	Endangered
Delma torquata (Collared Delma)	Vulnerable
Tympanocryptis pinguicolla (Grassland earless dragon)	Endangered
Adclarkia dawsonensis (Boggomoss Snail)	Critically endangered
Listed flora species	**EPBC Act status**
Eriocaulon carsonii (Salt Pipewort)	Endangered
Xerothamnella herbacea (Herbaceous xerothamnella)	Endangered
Tylophora linearis (Slender tylophora)	Endangered
Microcarpaea agonis (Microcarpea)	Endangered
Prostanthera sp. Dunmore (Dunmore mint- bush)	Vulnerable
Acacia chinchillensis (Chinchilla Wattle)	Vulnerable
Acacia currani (Curly-barked Wattle)	Vulnerable

Acacia lauta (Tara Wattle)	Vulnerable
Acacia wardellii (Thomby Range Wattle)	Vulnerable
Calytrix gurulmundensis (Gurulmundi fringe myrtle)	Vulnerable
Eucalyptus virens (Shiny-leaved ironbark)	Vulnerable
Pterostylis cobarensis (Cobar greenhood orchid)	Vulnerable
Homopholis belsonii (Belson's panic grass)	Vulnerable
Philotheca sporadica (The waxflower)	Vulnerable
Cadellia pentastylis (Ooline)	Vulnerable
Macrozamia fearnsidei (Central Queensland zamia palm)	Vulnerable
Listed migratory species	**EPBC Act status**
Hirundapus caudacutus (White-throated needletail)	Migratory
Apus pacificus (Fork-tailed swift)	Migratory
Ardea alba/Ardea modesta (Eastern great egret/great or white egret)	Migratory
Bubulcus ibis/ Ardea ibis (Cattle egret)	Migratory
Plegadis falcinellus (Glossy Ibis)	Migratory
Pandion haliaetus/Pandion cristatus (Eastern Osprey)	Migratory
Haliaeetus leucogaster (White-bellied sea-eagle)	Migratory
Pluvialis fulva (Pacific golden plover)	Migratory
Rostratula australis (Australian painted snipe)	Vulnerable Migratory
Gallinago hardwickii (Latham's snipe)	Migratory
Limosa limosa (Black-tailed godwit)	Migratory
Limosa lapponica (Bar-tailed godwit)	Migratory
Numenius phaeopus (Whimbrel)	Migratory
Tringa nebularia (Common greenshank)	Migratory
Tringa stagnatilis (Marsh sandpiper)	Migratory
Actitis hypoleucos (Common sandpiper)	Migratory
Calidris acuminata (Sharp-tailed sandpiper)	Migratory
Tringa glareola (Wood sandpiper)	Migratory
Calidris ruficollis (Red-necked stint)	Migratory

Calidris ferruginea (Curlew sandpiper)	Migratory
Philomachus pugnax (Ruff)	Migratory
Sterna caspia /*Hydroprogne caspia* (Caspian tern)	Migratory
Merops ornatus (Rainbow bee-eater)	Migratory
Anthochaera phrygia (Regent honeyeater)	Endangered Migratory
Rhipidura rufifrons (Rufous fantail)	Migratory
Monarcha melanopsis (Black-faced monarch)	Migratory
Myiagra cyanoleuca (Satin flycatcher)	Migratory
Acrocephalus australis/A. stentoreus (Australian reed-warbler/Clamorous Reed-Warbler)	Migratory

Note: Table 1 is derived from Volume 2: Gas Fields, Chapter 23: Matters of National Environmental Significance including Section 23.4 EPBC Act significant impact criteria assessment; Section 23.5 Threatened Species; Table 23.3 Likely occurrence of threatened flora species within the study area; Table 23.4 Likely occurrence of threatened terrestrial fauna species within the study area; Section 23.6 Listed migratory species; and Table 23.5 Likely occurrence of migratory terrestrial species within the study area of the APLNG EIS of March 2010; and from listed threatened species profiles available on the Department's website.

8. The management plans required under condition 7 must be developed by a qualified ecologist approved in writing by the Department and as a minimum address the following as is relevant to each MNES:

   a. current legal status (under EPBC Act);

   b. known distribution;

   c. known species' populations and their relationships within the region;

   d. extent of ecological community fragmentation within the region and if appropriate minimum patch size for that community;

   e. to support field identification and ecological surveys, description of the relevant characteristics of the ecological community;

   f. species' biology, reproduction and description of general habitat;

   g. to support field identification and ecological surveys, description of the species' habitat, which may be described in terms of essential habitat and microhabitat, associations with geology, soils, landscape features, associations with other native fauna and/or flora or ecological communities, and specific niche habitat descriptions;

      Note: Constraints mapping may be limited by available data for many species and may therefore be inadequate to map habitat requirements for planning and management purposes, or to indicate presence without on ground assessment. Condition 8 g) requires the essential components of a species' habitat to be described where relevant to support field identification and environmental constraints decision making. This should include essential habitat components for widely distributed species present in low numbers and for other species likely to be present but not often observed.

   h. threats to MNES relating to the development and management of land within the gas fields including from the development, operation and decommissioning of infrastructure within the gas fields; and from groundwater extraction and aquifer depressurisation, CSG water use and disposal, whether the threat is within or outside the gas field development area;

Note: This part of a management plan may also indicate that a species or its habitat can co-exist with specific types of gas field operations.

i. relevant management practices and methods to minimise impact and recover from impact that should include:

   i. site rehabilitation timeframes, standards and methods;

   ii. use of sequential clearing to direct fauna away from an impact zone;

   iii. re-establishment of native vegetation in linear infrastructure corridors;

   iv. welfare and safe handling of fauna specimens requiring relocation from impact sites;

   v. handling practices for flora specimens;

   vi. translocation practices and monitoring for translocation success;

   vii. monitoring methods including for rehabilitation success and recovery;

j. surface and ground water quality and quantity requirements, including relevant downstream environmental quality parameters;

k. reference relevant conservation advice, recovery plans, or other policies, practices, standards or guidelines relevant to MNES published or approved from time to time by the Department.

Note: The management plans must include sufficient detail to inform field development decisions, ongoing management and decommissioning, and management external to the project area to minimise impacts on MNES through the life of the project.

Note 1: To the extent that the requirements of condition 8 are satisfied for each species, a single plan may be prepared to address a group of species which have similar ecological characteristics and habitat needs. Other conditions also require species or ecological community management plans to be developed in certain circumstances in accordance with condition 8.

9. Each species and ecological community management plan must be submitted for the approval of the Minister. Commencement of each major stage of gas field development within the project area must not occur without written approval of a plan for addressing each listed species and ecological community within the proposed area of development. The proponent may undertake activities that are critical to commencement that are associated with mobilisation of plant and equipment, materials, machinery and personnel prior to the start of development only if such activities will have no adverse impact on MNES, and only if the proponent has notified the Department in writing before an activity is undertaken. Approved species and ecological community management plans must be implemented.

10. The proponent must establish a program for routine review of the species and ecological community management plans to be undertaken by a qualified ecologist approved by the Department (with other experts as appropriate) to take into account any new information available to the proponent, including any information and advice provided by Commonwealth or Queensland Government agencies, or available from other CSG proponents.

11. The Minister may require through a request in writing the periodic review of the species and ecological community management plans, either by the

Department; or alternatively by an independent qualified ecologist, or other experts, approved by the Department.

12. Independent review of plans will be at the financial expense of the proponent. Once independently reviewed, plans must be submitted for written approval by the Department. Approved plans must be implemented.

Record of impacts

13. If an impact occurs (which may include a presumed impact where the species is presumed to be present) to a MNES during gas field development, operation, or decommissioning the proponent must:
    a. record the impact by reference to:
        i. the location, specific site and type of infrastructure or activity;
        ii. each MNES subject to disturbance;
        iii. the related site assessment or field ecological survey documentation and recommendations, or the decision that the particular MNES was presumed to be present;
        iv. the disturbance limit set under condition 25;
        v. the total area of actual disturbance;
        vi. the remaining disturbance limit for each affected MNES;
        vii. the reasons for the decision including justification for the action taken, description of the efforts taken to avoid impact, and explanation why other constraints might justify the impact on MNES;
        viii. actions and commitments by the proponent to remediate, rehabilitate, or make good any unauthorised disturbance; and

        Note: This condition applies to any adverse impact on MNES, whether or not a disturbance limit has been set, and whether or not the impact has been decided by the proponent under the Protocol based on other physical constraints.
    b. record the information to a standard which can be independently audited.

Site remediation, rehabilitation and recovery plan

14. Where a direct or indirect impact has occurred to MNES (which may include a presumed impact where the species is presumed to be present) the proponent must under the Protocol apply remediation, rehabilitation and recovery measures appropriate for each MNES to restore connectivity or rehabilitate disturbed areas to pre-clearance quality or better, and to minimise cumulative impacts throughout the life of the project.

15. Before commencement of gas field development the proponent must develop a Remediation, Rehabilitation, Recovery and Monitoring Plan. The Plan must:
    a. include site remediation measures including timeframes and standards for preventing erosion and stabilising disturbed soil in impact areas;
    b. include measures to support recovery of listed species' habitat and recovery of listed ecological communities affected by gas field development;

c. include responses to threats to MNES from the proponent's operational activities and land management activities including the disposal and use of associated water, damage by livestock, and impacts from feral animals and weeds;

d. provide for fire prevention and management regimes during construction, operation, and decommissioning to protect MNES;

e. include performance measures and related monitoring to assess site remediation, rehabilitation and recovery;

f. provide for reporting on the implementation of the Remediation, Rehabilitation, Recovery and Monitoring Plan including monitoring and performance to a standard which can be independently audited;

g. reference relevant conservation advice, recovery plans, species management plans, or policies, practices, standards or guidelines endorsed or approved from time to time by the Department.

Note: The proponent may develop the plan to satisfy the requirements of both the Queensland Government and these conditions as indicated in condition 100 b).

16. The Remediation, Rehabilitation, Recovery and Monitoring Plan must be submitted for the approval of the Minister. Commencement of gas field development must not occur without approval of this Plan. The proponent may undertake activities that are critical to commencement that are associated with mobilisation of plant and equipment, materials, machinery and personnel prior to the start of development only if such activities will have no adverse impact on MNES, and only if the proponent has notified the Department in writing before an activity is undertaken. The approved Remediation, Rehabilitation, Recovery and Monitoring Plan must be implemented.

17. The proponent must establish a program to routinely review the Remediation, Rehabilitation, Recovery and Monitoring Plan by an independent qualified ecologist, or other experts, approved by the Department to take into account any new information available to the proponent, including any information and advice provided by Commonwealth or Queensland Government agencies, or available from other CSG proponents.

18. The Minister may require through a request in writing the periodic review of the Remediation, Rehabilitation, Recovery and Monitoring Plan by the Department, or alternatively by an independent qualified ecologist, or other experts, approved by the Department. Plans must be approved by the Department in writing.

19. Independent review of plans will be at the financial expense of the proponent. Once independently reviewed, plans must be submitted for written approval by the Department. Approved plans must be implemented.

Approval and Review of Protocol

20. The Protocol must be submitted for the approval of the Minister. Commencement of gas field development must not occur without written approval of the Protocol. The proponent may undertake activities that are critical to commencement that are associated with mobilisation of plant and

equipment, materials, machinery and personnel prior to the start of development only if such activities will have no adverse impact on MNES, and only if the proponent has notified the Department in writing before an activity is undertaken. The approved Protocol must be implemented.

21. The Protocol and related plans must be reviewed and updated by the proponent to take into account the findings of Cumulative Impact Assessment Reports required by the Queensland Government before each major stage of the proponent's gas field development; or following a written request from the Department. Reviewed and updated Protocols and plans must be submitted for the Minister's written approval. Once approved, updated Protocols and plans must be implemented.

    Note 1: relevant studies include the Queensland Water Commission *Cumulative Groundwater Model for the Surat and South Bowen Basin* and findings of the CSG Industry Monitoring Group (CIMG).

    Note 2: The review required following completion of the *Cumulative Impact Assessment Report* required by the Queensland Government may be done after approval of the Protocol. The Department may seek review of the Protocol to align with Queensland Government requirements to support efficiency and avoid duplication.

22. The proponent's review of the Protocol must take into account all relevant studies, policies, standards, guidelines and advice relating to CSG activity published or provided to the proponent by the Commonwealth or Queensland governments, or published or provided by other proponents undertaking similar activities, or published or provided by other parties, including any findings of an audit against conditions, or plans or other documentation required under the conditions of this approval.

23. The Department may require, through a request in writing, that the Protocol and related plans be revised or amended before approval. Any such request must be acted on within the time frame specified.

24. The approved Protocol must be incorporated into the proponent's management procedures, operational plans and other relevant documentation and kept current for the life of the project.

Disturbance limits

25. The maximum disturbance limits in Table 2 (below) apply to authorised unavoidable adverse impacts on MNES within the project area as a result of exploration, development, operation and decommissioning within the project area illustrated in Attachment 1, and external to it, ('whole of project' disturbance limits) and all associated activities..

Table 2: Disturbance limits for listed threatened ecological communities

Ecological community	EPBC Act status	Disturbance limit (ha)
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	75.41 ha

Table 2: Disturbance limits for listed threatened ecological communities		
Ecological community	**EPBC Act status**	**Disturbance limit (ha)**
Weeping Myall Woodland	Endangered	0 (No disturbance authorised)
The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin	Endangered	0 (No disturbance authorised)
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	4.36 ha
Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin	Endangered	0 (No disturbance authorised)

Note: Table 2 is derived from the *Australia Pacific LNG Environmental Offset Strategy* of 16 November 2010; Volume 2: Gas Fields, Chapter 23: Matters of National Environmental Significance including Section 23.4 EPBC Act significant impact criteria assessment of the *APLNG EIS of March 2010;* and from listed ecological community profiles available on the Department's website.

Table 3: Disturbance limits for listed species			
Species	**EPBC status**	**Disturbance limit (ha)**	**Indicative habitat**
Paradelma orientalis (Brigalow Scaly-foot)	Vulnerable	703.84* ha of potential habitat	Occurs in a wide range of (dry) forest and woodland habitats, including Brigalow woodland, Vine thicket regrowth and rocky habitats on sandstone ridges to flats and gently undulating plains with clay, loam or sand. Not tolerant of clearings. Specific habitat where species found includes remnant Brigalow woodland with sparse tussock grasses on grey cracking clay soils.
Egernia rugosa (Yakka Skink)	Vulnerable	66.77* ha of potential habitat	Open dry sclerophyll forest or woodland, Brigalow, shrublands, lancewood forests on sandy and open textured soils. Dense ground cover, cavities in soil-bound root systems of fallen trees and beneath

Table 3: Disturbance limits for listed species			
Species	**EPBC status**	**Disturbance limit (ha)**	**Indicative habitat**
			rocks, hollow logs and animal burrows are considered to provide suitable microhabitat for this species.
Furina dunmalli (Dunmall's Snake)	Vulnerable	238.63* ha of potential habitat	Brigalow (*Acacia harpophylla*) forest and woodland growing on cracking black clay and clay loam soils (usually on heavy clay soils). Also known to occur in eucalypt and callitris woodland with fallen timber and ground litter.

* Disturbance limits for Brigalow Scaly-foot and Yakka Skink and Dunmall's Snake potential habitat are derived as per the fauna habitat reduction methodology applied in *Australia Pacific LNG – Fauna habitat Calculations for the Gas Fields Q-LNG01-15-RP-0014 of 16 November 2010.*

Note1 : Table 3 is derived from *Volume 2: Gas Fields, Chapter 23: Matters of National Environmental Significance* including Section 23.4 *EPBC Act significant impact criteria assessment* of the *APLNG EIS of March 2010; Australia Pacific LNG – Fauna habitat Calculations for the Gas Fields Q-LNG01-15-RP-0014 of 16 November 2010;* and from listed threatened species profiles available on the Department's website.

Note 2: Habitat for species in Table 3 will be described in the management plan for each species as required under condition 8. The habitat described in Table 3 is for general context and indicative only.

26. The Gasfield activities must not have a significant impact on the Narran Lakes Wetlands.

Offsets

Plan to secure offsets

27. Within 9 months of the commencement of the action the proponent must prepare an Offset Plan to provide an offset area for the approved disturbance limits relating to MNES within the project area. The offset area to be secured must be an area of private land which includes at least:
    a. 66.77 ha of potential *Egernia rugosa* (Yakka Skink) habitat which includes micro habitat required for the species; and
    b. 703.84 ha of potential *Paradelma orientalis* (Brigalow Scaly-foot) habitat which includes micro habitat required for the species; and
    c. 37.84 ha of Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions; and
    d. 888.9 ha of Brigalow with representation of the following;
        i. 30% remnant Brigalow (*Acacia harpophylla* dominant and co-dominant); and

ii. 70% which is a combination of:

I. high value regrowth Brigalow; and

II. other Brigalow regrowth with potential for management to remnant Brigalow status.

Note: Offsetting requirements for some species' habitat may be accommodated within the Brigalow components if good quality habitat (according to the methodology described in *Australia Pacific LNG Fauna Habitat Calculations for the Gas Fields Q-LNG01-15-RP-0014 (of 16 November 2010)* is verified as present and includes specific habitat requirements for each relevant species.

28. The Offset Plan must include details of the offset area including: the timing and arrangements for securing properties, maps and site description, environmental values relevant to MNES, connectivity with other habitats and biodiversity corridors, a rehabilitation program, and mechanisms for long-term protection, conservation and management.

29. The Offset Plan must be submitted for the approval of the Minister within 6 months of the commencement of the action. The approved Offset Plan must be implemented.

30. If the approved Offset Plan cannot be implemented because of failure of arrangements to secure the necessary area of private land then the proponent must submit for the Minister's approval an alternative Offset Plan. The alternative Offset Plan must provide at least an equivalent environmental outcome to those specified under condition 27(a) to (d). The approved alternative Offset Plan must be implemented.

31. If the proponent proposes any action within a proposed offset area, other than actions related to managing that area as an offset property, approval must be obtained, in writing from the Department. In seeking Departmental approval the proponent must provide a detailed assessment of the proposed action including a map identifying where the action is proposed to take place and an assessment of all associated adverse impacts on MNES. If the Department agrees to the action within the proposed offset site, the area identified for the action must be excised from the proposed offset and alternative offsets secured of equal or greater environmental value in relation to the impacted MNES.

32. The proponent must secure the offset within 2 years of commencement.

Offset Area Management

33. Within 12 months of securing the offset area required under the approved Offset Plan, the proponent must develop an Offset Area Management Plan which must specify measures to improve the environmental values of the offset area in relation to MNES, including;

a. the documentation and mapping of current environmental values relevant to MNES of the area;

b. measures to address threats to MNES including but not limited to grazing pressure and damage by livestock and adverse impacts from feral animals and weeds;

c. measures to provide fire management regimes appropriate for the MNES;

d. management of revegetation areas to the stage where habitat is established or improved for listed species and revegetation areas meet the criteria for 'remnant status' for that threatened ecological community;

e. an objective that revegetation areas for Brigalow meet the criteria applicable at the time for 'remnant status', and measures to ensure application is made to have the revegetation areas reclassified as 'remnant vegetation' in accordance with the relevant Queensland legislation;

f. monitoring, including the undertaking of ecological surveys to assess the success of the management measures against identified milestones and objectives;

g. performance measures and reporting requirements against identified objectives, including trigger levels for corrective actions and the actions to be taken to ensure performance measures and objectives are met.

34. Within 12 months of securing the offset area the Offset Area Management Plan must be submitted for the approval of the Minister. The approved Offset Area Management Plan must be implemented.

Rehabilitation Area Offset

35. Within 2 years of the commencement of gas field development the proponent must secure a Rehabilitation Area Offset of at least 1102.86 hectares of privately held property to compensate for indirect adverse impacts on MNES. The proponent must:

a. obtain ownership or a legally binding agreement from a landowner over an area of property to re-establish areas in perpetuity of the threatened Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community, Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions and associated listed migratory and listed threatened species' habitat; and

b. notify the Department in writing within 30 business days of securing the Rehabilitation Area Offset.

Note: The Rehabilitation Area Offset is an additional area to the Offset area required under condition 27.

36. The Rehabilitation Area Offset must:

a. be within historical distributions of the ecological community (before clearing occurred) and as close as possible to the project area;

b. include intact elements of remnant and/or high value regrowth of the ecological communities; and

c. include or have potential for providing habitat and micro habitat requirements for listed migratory and threatened species (i.e. those in Table 3 that relate to this ecological community).

37. If, within 2 years of the commencement of gas field development the Rehabilitation Area Offset has not been secured, then the proponent must within 30 business days, notify the Minister and provide for the Minister's approval an alternative offset measure. The alternative must provide at least an equivalent environmental outcome to those specified in relation to the Rehabilitation Area Offset. The approved alternative must be secured and implemented in accordance with conditions 34 and 35 in a timeframe specified in writing by the Minister.

Rehabilitation Area Plan

38. Within 2 years of the commencement of gas field development, the proponent must prepare a Rehabilitation Area Plan for the offset required under condition 34.

39. The Rehabilitation Area Plan must provide for commitments and actions to lead to the increase in the spatial extent and improvement in the condition of existing remnants, and for the establishment of new self sustaining, functional 'remnant vegetation' communities, consistent with that which existed prior to clearing and with the capacity to provide habitat for the species identified in condition 25 as unavoidably impacted by the action.

40. The Rehabilitation Area Plan must include:

   a. details of the area to be rehabilitated including location and maps;

   b. documentation including mapping of current environmental values relevant to MNES of the area;

   c. where revegetation through planting seedlings and/or seeds is intended details of appropriate species and ratios of species relevant to historically occurring listed migratory and threatened species' habitat, Brigalow (Acacia harpophylla dominant and co-dominant) ecological community, and Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions ecological community;

   d. the source and provenance of the seed and/or seedlings which will be used;

   e. measures to address threats to MNES including but not limited to grazing pressure and damage by livestock and adverse impacts from feral animals and weeds;

   f. measures to provide fire management regimes appropriate for the MNES;

   g. monitoring measures including ecological surveys to measure the establishment and ongoing success of the revegetation based on a comparison with high quality habitat for listed migratory and threatened species and ecological community reference sites;

   h. performance measures and reporting requirements against identified objectives, including trigger levels for corrective actions and the actions to be taken to ensure performance measures and objectives are met.

41. Within 2 years of the commencement of gas field development the Rehabilitation Area Plan must be submitted for the approval of the Minister. The approved Rehabilitation Area Plan must be implemented.

42. To ensure the long term protection of the Rehabilitation Area the proponent must:

    a. manage Brigalow and Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions components of the Rehabilitation Area to a stage where they meet the respective criteria for 'remnant status' for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community and 'remnant status' for the Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions;

    b. when areas of revegetation meet criteria applicable at the time for 'remnant vegetation' ensure application is made to have the revegetation areas remapped and reclassified as 'remnant vegetation' in accordance with the relevant Queensland legislation. The management measures must continue to be implemented in areas not meeting the criteria for 'remnant status' until this has been achieved (or until approval to cease the management regime is provided by the Minister in writing);

    c. define corrective actions which will be undertaken if performance measures and reporting indicate that successful rehabilitation has not been achieved;

    d. identify persons responsible and arrangements for implementing the Rehabilitation Area Plan and for reporting on performance; and

    e. notify the Department in writing of the reclassification of areas within the Rehabilitation Area as 'remnant vegetation' within 30 business days of the reclassification occurring.

43. If the proponent proposes any action within a proposed offset area, other than actions related to managing that area as an offset property, approval must be obtained, in writing from the Department. In seeking Departmental approval the proponent must provide a detailed assessment of the proposed action including a map identifying where the action is proposed to take place and an assessment of all associated adverse impacts on MNES. If the Department agrees to the action within the proposed offset site, the area identified for the action must be excised from the proposed offset and alternative offsets secured of equal or greater environmental value in relation to the impacted MNES.

CSG Water Management

44. The proponent must:

    a. take all reasonable measures to ensure that CSG water, including extracted groundwater, treated or amended CSG water, and any associated waste water, brine crystals and/or solids generated as a result of treating or amending water have no significant impact on any MNES during or beyond the life of the project; and

    b. the proponent must ensure that aromatic hydrocarbons, such as 'BTEX' (that is, benzene, toluene, ethylbenzene and xylenes) are not used in hydraulic fracturing (fraccing) operations; and

    c. if any such impacts arise apply measures identified in the Coal Seam Gas Water Monitoring and Management Plan, or other requirements under these conditions, to mitigate or make good such impacts to the satisfaction of the Minister.

Coal Seam Gas Water Monitoring and Management Plan

Hydraulic connection

45. If the proponent demonstrates to the satisfaction of the Minister, on the advice of the expert panel, that an aquifer has negligible hydraulic connectivity to other aquifers, then groundwater drawdown limits and threshold values (for groundwater drawdown and quality) for response measures in these conditions do not apply to that aquifer.

46. To avoid doubt, monitoring and risk management requirements in the Stage 1 Coal Seam Gas Water Monitoring and Management Plan (Stage 1 CSG WMMP) and the Stage 2 Coal Seam Gas Water Monitoring and Management Plan (Stage 2 CSG WMMP) (outlined below) will continue to apply to any aquifer which the proponent has demonstrated to the satisfaction of the Minister, on the advice of the expert panel, has negligible hydraulic connectivity to other aquifers.

47. If the Minister, acting on advice of an expert panel, is satisfied that new evidence indicates a material change in hydraulic connectivity of an aquifer to which condition 45 applies, the Minister may notify the proponent, in writing, that condition 45 does not apply to that aquifer.

Default drawdown

48. Within 20 business days from the date of the project approval, or such longer period specified by the Minister in writing, the proponent must submit to the satisfaction of the Minister, modelled groundwater drawdown contour data and contour plots for each targeted aquifer.

49. The Minister, having regard to the minimum drawdown prediction from the proponent's Environmental Impact Statement and the information supplied under condition 47, will specify to the proponent, in writing, the default groundwater drawdown limit for each aquifer that will apply until the Minister's approval of the Stage 1 CSG WMMP. The proponent must not exceed the groundwater drawdown limits specified by the Minister.

Stage 1 CSG Water Monitoring and Management Plan

50. Within 6 months from the date of the project approval, the proponent must submit for the approval of the Minister a Stage 1 Coal Seam Gas Water Monitoring and Management Plan (Stage 1 CSG WMMP) which includes at least:

    Groundwater monitoring and management

    a. groundwater drawdown limits for each potentially impacted aquifer;

    b. a program and schedule for aquifer connectivity studies and monitoring of relevant aquifers to determine hydraulic connectivity;

c. a program and schedule for field piloting of aquifer reinjection of treated CSG water and other groundwater repressurisation techniques;

d. early warning indicators where drawdown thresholds are being approached.

Hydraulic fracturing

e. the estimated number, the spatial distribution and location of boreholes where hydraulic fracturing may be necessary, annual reviews of the estimate;

f. details of constituent components of any hydraulic fracturing agents and any other reinjected fluid(s), and their toxicity as total effluent toxicity and ecotoxicity, based on methods outlined in the National Water Quality Management Strategy

Surface water monitoring and management

g. an ongoing water quality and quantity surface water monitoring plan that includes at least:

   i. identification of the surface and aquatic systems to be monitored and their environmental values, water quality, and environmental characteristics, and the rationale for selection;

   ii. the number and locations of monitoring sites upstream and downstream of proposed discharge of CSG water (whether treated water, amended water or raw water), including test and reference sites upstream and downstream and before and after any proposed impacts;

   iii. the frequency of the monitoring and rationale for the frequency;

   iv. baseline data for each monitoring site for comparison of monitoring results over the life of the project;

   v. the approach to be taken to analyse the results including the methods to determine trends to indicate potential impacts;

   vi. threshold values that protect relevant MNES (such as reporting or control line values for additional investigation, more intensive management action, make good, and cease operations) at which management actions will be initiated to respond to escalating levels of risk and designed to protect water quality and the associated environmental values of surface and aquatic systems;

   vii. water treatment and amendment methods and standards;

   viii. water storage locations and volumes including any storage and volumes required to pilot or implement reinjection or other groundwater repressurisation techniques;

   ix. water use or disposal options and methods (whether for beneficial use or not) including frequency, volumes, quality and environmental values documented for each receiving environment;

   x. brine storage locations and volumes, and brine crystal waste management;

   xi. emergency water discharges, their volumes and quality;

   xii. references to standards and relevant policies and guidelines;

Response actions

h. mechanisms to avoid, minimise and manage risk of adverse impacts and response actions and timeframes that can be taken by the proponent if:

   i. threshold values for surface water quality and water environmental values specified in the CSG WMMP are exceeded;

   ii. there are any unforeseen emergency discharges; and

Reporting

i. performance measures, annual reporting to the Department, and publication of reports on the internet.

Note: A key objective of the CSG WMMP groundwater components is to maintain or restore aquifer pressure, as affected by CSG production, to levels that avoid risk of adverse impact on MNES.

51. The proponent must implement the Stage 1 CSG WMMP approved in writing by the Minister, on the advice of an expert panel. The proponent must not exceed the groundwater drawdown limits for each aquifer specified in the Stage 1 CSG WMMP. The Stage 1 CSG WMMP will apply until the commencement of the approved Stage 2 CSG WMMP.

Stage 2 CSG Water Monitoring and Management Plan

52. Within 18 months from the date of the approval of the action the proponent must submit for the approval of the Minister, a Stage 2 Coal Seam Gas Water Monitoring and Management Plan (Stage 2 CSG WMMP). The proponent must allow a further 3 months for the Minister's consideration of approval of the Stage 2 CSG WMMP including seeking advice from an expert panel.

53. In addition to the matters in the Stage 1 CSG WMMP, the Stage 2 CSG WMMP must also include:

Groundwater monitoring and management

a. an ongoing CSG water treatment program to ensure that any water to be used for re-injection, or used for other groundwater repressurisation options, is treated at least equal to the water quality of the receiving groundwater system or environment;

b. the method, data and the evidentiary standards necessary to support a conclusion that an aquifer from which CSG water is being extracted is not hydraulically connected to other aquifers;

c. a groundwater quality and quantity monitoring plan to monitor the aquifers underlying the project area using a statistically and hydrogeologically valid, best practice bore monitoring network across the project area, and at least;

   i. the aquifers to be monitored and the rationale for selection;

   ii. the number and locations of monitoring bores and their flow, pressure, head, and water quality characteristics;

iii. the frequency of the monitoring and rationale for the frequency;

iv. baseline data for each monitoring site for comparison of monitoring results over the life of the project;

v. the approach to be taken to analyse the results including the methods to determine trends to indicate potential impacts;

vi. groundwater drawdown threshold values and groundwater quality threshold values for each aquifer (based on regional groundwater modelling endorsed by the Minister) at which management actions (such as reporting or control line values for additional investigation, more intensive management action, make good, and cease operations) will be initiated to respond to escalating levels of risk, including increasing levels of drawdown, contamination of groundwater, or subsidence;

vii. references to standards and relevant policies and guidelines;

viii. mechanisms to monitor, avoid, minimise, manage, and respond to risks; and

ix. performance measures, annual reporting to the Department, and publication of reports on the internet;

Note 1: Threshold values will be identified in the plan and during the life of the approval and related conditions may be varied by the Minister on advice from an expert panel to reflect the best available data and scientific information.

Note 2: For clarity, the monitoring required under this condition may be undertaken jointly with others.

Response actions

d. an exceedence response plan that includes:

i. mechanisms to avoid, minimise and manage risk of adverse impacts and response actions and timeframes that can be taken by the proponent if:

I. threshold values for surface water quality and water environmental values specified in the CSG WMMP are exceeded;

II. threshold values specified in the CSG WMMP for aquifer drawdown or groundwater contamination are exceeded;

III. subsidence or surface deformation occurs which impacts on surface or groundwater hydrology;

IV. there are any unforeseen emergency discharges; and

ii. a program and timetable for repressurisation using re-injection of CSG water from hydraulically connected aquifers back into appropriate permeable aquifers and for other groundwater repressurisation options to re-establish pressure levels and water qualities to the satisfaction of the Minister on the advice of an expert panel, in conjunction with appropriate measures to forecast and proactively manage any short-term impacts.

Note: The design of these groundwater repressurisation activities should be informed by a regional-scale groundwater model.

Implementation of Stage 1 and Stage 2 CSG WMMP

54. The proponent must implement the approved Stage 2 CSG WMMP, no later than 24 months from the date of the project approval.

55. Three months before commencement of each subsequent major stage of the proponent's gas field development the proponent must submit a revised Stage 2 CSG WMMP for the consideration of approval of the Minister including seeking the advice of an expert panel.

56. The Coal Seam Gas Water Monitoring and Management Plan should be based on the proponent's planned staged development within the project area over the total life of the project consistent with approvals granted by the Queensland Government.

57. The proponent may only have, own, hold, take, or otherwise utilise sufficient CSG water as is required to undertake the approved activities within the approved project area.

    Note: The purpose of this condition is to ensure that water is only extracted to the extent necessary for the extraction of coal seam gas.

58. The Stage 1 and Stage 2 CSG WMMP as approved by the Minister in writing acting on advice of an expert panel and in accordance with the timing requirements under these conditions must be implemented.

    Note: The Queensland Coordinator-General also requires surface water and groundwater monitoring and management. The proponent may incorporate requirements into plans that meet both Queensland and Commonwealth requirements.

Revisions of Stage 1 and Stage 2 CSG WMMP

59. Consistent with an adaptive management approach the Stage 2 CSG WMMP must be reviewed and updated for each new stage of gas field development: to take into account of major updates to the Regional Groundwater Model; and to address findings of Cumulative Impact Assessment Reports required by the Queensland Government and these conditions of this approval.

60. A reviewed and updated Stage 2 CSG WMMP must be submitted to the Minister for written approval. Commencement of each new stage of gas field development must not occur without approval. The proponent may undertake activities that are critical to commencement that are associated with mobilisation of plant and equipment, materials, machinery and personnel prior to the start of development only if such activities will have no adverse impact on MNES, and only if the proponent has notified the Department in writing before the activity is undertaken. The approved CSG WMMP must be implemented for the relevant gas field area.

61. The Minister may, through a request in writing, require that the Stage 1 or Stage 2 CSG WMMP be revised or amended, which may include requirements for amendments to address independent expert advice. Any such request must be acted on within the timeframe specified.

    Note: The Minister may throughout the project life seek advice from experts, or an expert panel. As a consequence specific matters identified through such advice may need to be addressed in the Plan. Where such advice is sought the proponent would be provided with opportunity to submit information and respond to the specific matters identified, in order to ensure the Plan is based on the best available information. Review requirements will facilitate adaptive management, alignment with Queensland Government approval requirements, and account for potential cumulative impacts as new scientific information becomes available over the life of the project.

Regional groundwater model

62. To avoid or minimise direct or indirect adverse impacts on MNES, the proponent must:

    a. develop a regional scale, multi-layer, transient groundwater flow model of the cumulative effects of multiple CSG developments;

    b. develop and implement an adaptive management framework, applicable at both the project scale and regional-scale, that includes monitoring and mitigation approaches to assess and manage the impacts of CSG developments, which takes into account the groundwater model of cumulative impacts required under (a); and

    c. contribute data as requested over the life of the Project to inform a Basin-scale multi-layer, transient groundwater flow model of the cumulative effects of multiple CSG developments in the Surat and Bowen Basins.

    Note 1: In the absence of sufficient evidence to characterise and quantify potential impacts at the regional scale, this condition requires the model to be developed as an early warning system, informed by any other regional cumulative hydrological modelling, such that any hydrological changes can be identified at an early stage and appropriate, effective remedial actions implemented before irreversible environmental adverse impacts on MNES.

63. The model required under condition 62 (a) must:

    a. use the best hydrostratigraphic and hydrogeological information available at the time, to identify the likely cumulative impacts of multiple CSG developments across the Surat and Bowen Basins;

    b. detail all data relating to the hydraulic connectivity between aquifers and aquitards used to substantiate the model parameterisation;

    c. be calibrated against measured piezometer responses in areas where CSG development has commenced;

    d. in relation to the reporting of model outputs – conform to the recommendations of the former Murray Darling Basin Commission Groundwater Modelling Guidelines;

    e. include:

        i. water balances for the major aquifers affected by the CSG operations including the expected timeframe of any changes in water balance and pressure;

        ii. recharge versus extraction volumes for those aquifers;

        iii. details of justification for and assumptions regarding aquifer seal integrity (i.e. thickness and distribution of aquitards);

        iv. quantification of hydraulic connectivity between different units (aquifers and aquitards) through drill stem and pump testing; and

        v. quantification of the impacts of reinjection and other groundwater repressurisation techniques on aquifer water balances.

    f. provide for adaptive monitoring, through six-monthly reporting of monitoring results and new data, and annual updates of numerical simulation models and re-interpretation of results to relevant Queensland Government and Commonwealth agencies.

64. Subject to the approval of the Department, the requirement for a model under condition 62 (a) may be satisfied by the proponent's contribution to a regional groundwater model developed by the Queensland Water Commission (or its successor agency).

Note 1: Where the proponent is conditioned (here or elsewhere under the approval) to address a matter that may be most efficiently managed by another party, whether another CSG proponent or a Queensland Government agency, the proponent may discharge their responsibility under the condition by contributing financially and cooperating with other parties to meet the condition i.e. to develop a single representative regional model and/or to provided a single report from one or more proponents.

Note 2: It is understood that the Queensland Water Commission (QWC) will manage delivery of a cumulative groundwater model for the Surat and South Bowen Basins. It is anticipated that the requirements of condition 62 (a) may be satisfied by the development of a model by the QWC.

65. If the requirements under condition 62 (a) are not met by the proponent's contribution to the QWC model, the Department may specify a timeframe for the obligations under 62 (a) to be satisfied by the proponent.

Impact assessment, mitigation and monitoring

66. The proponent must provide to the Department a copy of the groundwater impacts assessment, mitigation and monitoring measures required under conditions 10, 11, 12 and 14, Part 2, Appendix 2 of conditions imposed by the Queensland Coordinator-General in his report dated November 2010.

67. In addition, as part of a staged process of adaptive management of CSG development, the proponent must also provide the following in relation to subsidence:

    a. baseline and ongoing geodetic monitoring programs to quantify deformation at the land surface within the proponent's tenures. This should link from the tenement scale to the wider region across which groundwater extraction activities are occurring and any relevant regional program of monitoring;

    b. modelling to estimate the potential hydrological implications of the predicted surface and subsurface deformation; and

    c. measures for linking surface and sub-surface deformation arising from CSG activities.

68. When requested by the Department, the proponent must provide to the Department all geodetic monitoring data and related information from the program. This data must be provided within 30 days of request, or in a timeframe agreed to by the Department in writing.

69. The mitigation and monitoring measures required under condition 66 must be submitted to the Minister for approval with a proposed implementation

schedule. The approved ,measures must be implemented in a timeframe specified by the Minister.

Springs assessment, mitigation and monitoring

70. As a precautionary approach, the proponent must within 12 months of approval, or such other timeframe specified in writing by the Minister, survey for, reconfirm, and notify the Minister of the presence or absence of any springs proximal to the project area and within 100 kilometres of modelled limits of aquifer draw-down. The survey:

    a. must include the spring complexes approximately 25km north and north-east of Roma within outcropping areas of the Gubberamunda Sandstone, complexes, approximately 50km north and north-west of Roma (including Six mile and Spring Ridge), and 100km west of Roma; and the high value spring complexes associated with the Hutton Sandstone and Precipice Sandstone units east of the Taroom and Injune townships including Lucky Last, Scotts Creek, Dawson River 8 and Cockatoo Creek springs; and

    b. may, with the written approval of the Minister comprise the proponent's contribution to a springs survey developed with input from the Department and undertaken by the Queensland Water Commission (or its successor agency).

    Note 1: This survey may include use of remote sensing and may be aligned or combined with similar survey requirements that are to be undertaken by other proponents or the Queensland Water Commission. To avoid doubt, the survey must report on both discharge and recharge springs, as EPBC listed species may occur in association with either.

    Note 2: Surveys required under this condition may be undertaken by the proponent alone or in partnership with other CSG proponents.

71. If presence of *The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin*, or listed threatened species that are reliant on springs, is confirmed by a survey under condition 70, then the proponent must (unless the proponent is not able to gain access to the spring, even with the assistance of relevant government agencies):

    a. for springs within the project area - within 1 month of survey completion protect the ecological community and/or listed threatened species from gas field development activities by establishing and maintaining a minimum 200 m employee/contractor exclusion zone from the relevant springs within the project area, unless such access is required in an emergency, for environmental management, or for monitoring purposes;

       Note: The Constraints Planning and Field Development Protocol will also apply.

    b. within 12 months of the survey completion provide to the Minister a management plan for all the relevant springs which includes:

       i. a specific monitoring and remediation program to protect the ecological community and/or listed threatened species and to monitor and address cumulative impacts within the project area and within modelled limits of aquifer draw-down that may arise from CSG water extraction, including identifying trigger levels and responses in the case of changes to groundwater flow or quality in each relevant spring;

       ii. a baseline analysis of four 3-monthly samplings to determine the seasonal presence or absence of all relevant springs, and to establish:

the existence, distribution and extent of listed threatened species; aquatic macro-invertebrates; aquatic plants; water quality characteristics; spring physical parameters including seasonal variation, depth, and flow rate; aquifer source including hydrochemical and isotopic analysis, and comparison of water levels with respect to source aquifer potentiometric surface;

iii. ongoing monitoring on a 6 monthly basis (to cover high and low rainfall seasons) over the life of the project in the region relevant to each spring;

iv. analysis and calibration of the monitoring results against the baseline data (collected under (ii) of this condition) as the CSG water and gas extraction occurs over the life of the project;

v. threshold values (such as reporting or control line values for additional investigation, more intensive management actions, make good, and cease operations) at which management actions will be initiated to respond escalating levels of impact and designed to protect *The community of native species dependent on the natural discharge of groundwater from the Great Artesian Basin* and listed threatened species in the case of changes to groundwater pressure, flow, or water quality in GAB springs;

vi. specific mechanisms to avoid, minimise, and manage risks, and response actions that can be taken by the proponent where:

   I. any threshold values for surface environmental values are exceeded;

   II. any threshold values for aquifer drawdown, water quality change, or aquifer contamination are exceeded;

   III. subsidence or surface deformation occurs, particularly if it impacts on surface or groundwater hydrology; and

   IV. any unforeseen emergency discharges occur;

vii. established best practice standards, policies and guidelines; and

viii. performance measures, reporting to the Department, and publication of reports on the internet.

Note: Individual species and ecological community management plans are also required in accordance with condition 8. The management plans may be developed by the proponent alone or in partnership with other CSG proponents.

72. Any management plan required under condition 71(b) must be submitted to the Minister for consideration of approval including seeking expert advice from an expert panel. The approved plan must be implemented within the timeframe specified by the Minister. The approved plan must be published on the internet within 20 business days of being approved by the Minister.

73. The results of the baseline analysis under condition 71(b) must be made available to the Queensland Water Commission as part of the proponents' obligations in respect of the regional groundwater model under condition 62 (a) and provided on request to the Department.

Notification of threshold breaches and response actions

74. Within 10 business days of the proponent identifying monitoring outcomes that indicate a risk of reduction in groundwater pressure or water quality, the proponent must notify the Minister in writing of the trend and the proponent's response action.

75. Within 10 days of a surface or groundwater threshold value (for example, water quality, environmental value, pressure, head, volume, or flow) being exceeded, the proponent must advise the Minister in writing of the circumstances, the threshold exceeded, the immediate action taken by the proponent, and proposed action to remedy the breach and avoid a subsequent breach.

76. Immediate action may include a range of measures including but not limited to further monitoring and investigation, the ceasing of water/gas extraction and/or water discharge or use in the area affected, or such other measures as are appropriate, until investigations can be completed to determine the cause and remedial action. The proponent's proposed response action must be notified to the Minister in writing.

77. The Minister may direct in writing that the proponent cease water/gas extraction and/or water discharge or use in the area affected, and if the Minister is not satisfied that the action proposed or taken by the proponent will remedy the situation, or make good any environmental loss, the Minister may direct the proponent to implement alternative action at the expense of the proponent.

    Note: The proponent will be provided with a reasonable opportunity to comment on any such direction before it is required to be implemented.

Notifications and requirements about construction, operation, brine management and environmental management plans

78. The proponent must notify the Department in writing when developing or reviewing construction, operational, groundwater, CSG water, brine management, salinity management, environmental management, or other plans where the scope of the plans relates to potential significant direct, indirect or cumulative adverse impacts on MNES, or involves management of MNES. The proponent must in the notification indicate the relevant components of such plans relating to MNES and their management, and the timeframe for development and approval of the plans under Queensland Government requirements.

79. Where the scope of the plans relates to potential significant adverse impact on MNES, or involves management of MNES the plans must be submitted to the Minister for approval of those components. Approved components of plans must be implemented.

    Note: Where efficiency will be enhanced the proponent may also prepare and align management plans required under these conditions with the requirements of the Queensland Government as long as the relevant matters under the conditions of this approval are clearly and adequately addressed.

Cumulative Impact Report

80. Any results from cumulative impact assessments relating to APLNG CSG activities undertaken by the proponent, the Queensland Water Commission (or its successor agency) or other third party; and any recommendations made by the CSG Industry Monitoring Group (CIMG) to meet Queensland Government approval requirements for APLNG must also be provided to the Minister within 1 week of being finalised, or in such other timeframe specified by the Minister.

81. In addition to provision of the cumulative impact assessment information required under condition 80, the proponent must also address the following, in relation to potential adverse impacts on MNES:

    a. cumulative impacts relating to all listed species and listed ecological communities within and outside project area, including *The community of native species dependant on natural discharge of groundwater from the Great Artesian Basin*;

    b. any surface water and groundwater environmental values, including groundwater pressures and groundwater hydrochemistry which, if altered, may have an impact on listed species and ecological communities within and outside project area;

82. Within 3 years of the date that the cumulative impact assessment report is completed by the Queensland Water Commission (or its successor agency), or alternatively by the proponent, or such other timeframe specified in writing by the Minister, the proponent must review that cumulative assessment and the report in the light of the most up-to-date information and the regional transient groundwater model required under condition 62 (a). The proponent must provide a report on the review to the Minister and at the same time publish the report on its website.

    Note: The assessment scope of the cumulative impact report is not limited to groundwater or surface water impacts. These conditions provide that, if the Minister believes that it is necessary or desirable for the better protection of a relevant controlling provision for the action, the Minister may request the proponent to make, within a period specified by the Minister, revisions to a plan approved under these conditions. The Minister may make such a request in the light of the cumulative impacts assessment, or the review of the cumulative impacts assessment. Section 136(1)(b) of the EPBC Act additionally provides that the Minister may revoke, vary or add to a condition of this approval if the action has a significant impact that was not identified in assessing the action, and if the Minister relevantly believes it is necessary.

Decommissioning Plan

83. Within five years of the commencement of gas field development, the proponent must develop a Decommissioning Plan. The Plan must:

    a. require the progressive removal or reuse of infrastructure where gas field operations cease during the project life;

    b. establish management practices and safeguards to minimise environmental disturbance;

    c. ensure MNES are not impacted by progressive decommissioning, or final decommissioning of gas field infrastructure;

d. define rehabilitation actions for the infrastructure sites following decommissioning including for:

   i. optimising habitat and habitat connectivity for MNES;

   ii. enhancing pre-construction environmental quality; and

   iii. ongoing management during rehabilitation.

84. The Decommissioning Plan must be submitted for the approval of the Minister. The approved Plan must be implemented.

Survey data

85. All survey data collected for the project must be collected and recorded so as to conform to data standards notified from time to time by the Department. When requested by the Department, the proponent must provide to the Department all species and ecological survey data and related survey information from ecological surveys undertaken for MNES. This survey data must be provided within 30 days of request, or in a timeframe agreed to by the Department in writing.

Publication of Protocol and Plans

86. The Protocol and all plans approved by the Minister under these conditions must be published on the proponent's website within 30 business days of approval by the Minister.

87. The Department may request the proponent to publish on the internet a plan in a specified location or format, and with specified accompanying text. The proponent must comply with any such request.

Notification of commencement

88. Within 20 business days of the commencement of the action, the proponent must advise the Department in writing of the actual date of commencement.

89. If, at any time after five years from the date of this approval, the Minister notifies the proponent in writing that the Minister is not satisfied that there has been commencement of the action, the action must not commence without the written agreement of the Minister.

90. The proponent must notify the Department in writing of the proposed dates for each subsequent major stage of gas field development at least 40 business days before their commencement, and within 20 business days notify actual commencement dates, and within 20 business days of any major variations to gas field development notify the variations.

Request for variation of plans by proponent

91. If the proponent wants to act other than in accordance with a plan approved by the Minister under these conditions, the proponent must submit a revised plan for the Minister's approval.

92. If the Minister approves the revised plan, then that plan must be implemented instead of the plan originally approved.

93. Until the Minister has approved the revised plan, the proponent must continue to implement the original plan.

Revisions to plans by the Minister

94. If the Minister believes that it is necessary or desirable for the better protection of a relevant controlling provision for the action, the Minister may request the proponent to make, within a period specified by the Minister, specified revisions to a plan approved under these conditions. Without limiting this condition, the Minister may also make such a request following a study under s.255AA of the *Water Act 2007*.

95. If the Minister makes a request for revision to a plan, the proponent must:
    a. comply with that request; and
    b. submit the revised plan to the Minister for approval within the period specified in the request.

96. The proponent must implement the revised plan on approval of the Minister.

97. Until the Minister has approved the revised plan, the proponent must continue to implement the original plan.

Minimum timeframes for consideration of plans

98. For any plan required to be approved by the Minister under these conditions, the proponent must ensure the Minister is provided at least 20 business days for review and consideration of the plan, unless otherwise agreed in writing between the proponent and the Minister.

Compliance with State environmental and other authorities

99. The proponent must comply with all environmental authorisations issued by the State, including conditions of an environmental authority issued under the EP Act.

Provision of State plans

100. If a condition of a State approval requires the proponent to provide a plan then the proponent must:

   a. provide the plan to the Department or Minister on request, within the period specified in the request; and

   b. prepare and combine plans that meet both Queensland Government requirements and the Commonwealth requirements under this approval where this is efficient. In doing so the proponent must clearly identify the respective responsibilities and how these are being addressed in relation to these conditions.

Timeframes

101. If these conditions require the proponent to provide something by a specified time, a longer period may be specified in writing by the Minister.

Auditing

102. On the request of and within a period specified by the Department, the proponent must ensure that:

   a. an independent audit of compliance with these conditions is conducted; and

   b. an audit report, which addresses the audit criteria to the satisfaction of the Department, is published on the Internet and submitted to the Department.

103. Before the audit begins, the following must be approved by the Department:

   a. the independent auditor; and

   b. the audit criteria.

104. The audit report must include:

   a. the components of the project being audited;

   b. the conditions that were activated during the period covered by the audit;

   c. a compliance/non-compliance table;

   d. a description of the evidence to support audit findings of compliance or non-compliance;

   e. recommendations on any non-compliance or other matter to improve compliance;

   f. a response by the proponent to the recommendations in the report (or, if the proponent does not respond within 20 business days of a request to do so by the auditor, a statement by the auditor to that effect);

   g. certification by the independent auditor of the findings of the audit report.

105. The financial cost of the audit will be borne by the proponent.

106. The proponent must:

a. implement any recommendations in the audit report, as directed in writing by the Department after consultation with the proponent;

b. investigate any non-compliance identified in the audit report; and

c. if non-compliance is identified in the audit report - take action as soon as practicable to ensure compliance with these conditions.

Note: The Department will discuss findings of audit reports with the proponent to ensure compliance with conditions and before the issue of any directions.

107. If the audit report identifies any non-compliance with the conditions, within 20 business days after the audit report is submitted to the Department the proponent must provide written advice to the Minister setting out the:

a. actions taken by the proponent to ensure compliance with these conditions; and

b. actions taken to prevent a recurrence of any non-compliance, or implement any other recommendation to improve compliance, identified in the audit report.

Note: Independent third party auditing may include audit of the proponent's performance against the requirements of any plan required under these conditions.

Reporting non-compliance

108. The proponent must, when first becoming aware of a non-compliance with these conditions, or a plan required to be approved by the Minister under these conditions:

a. report the non-compliance and remedial action to the Department within five business days;

b. bring the matter into compliance within a reasonable time frame specified in writing by the Department.

Record-keeping

109. The proponent must:

a. maintain accurate records substantiating all activities associated with or relevant to these conditions of approval, including measures taken to implement a plan approved under these conditions; and

b. make those records available on request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with these conditions.

Note: Audits or summaries of audits carried out under these conditions, or under section 458 of the EPBC Act, may be posted on the Department's website. The results of such audits may also be publicised through the general media.

Financial assurance

110. The proponent must:

   a. provide the Minister with a financial assurance in the amount and form required from time to time by the Minister for activities to which these conditions apply; and

   b. review and maintain the amount of financial assurance based on proponent reporting on compliance with these conditions, and any auditing of the activities.

111. The financial assurance is to remain in force until the Minister is satisfied that no claim is likely to be made on the assurance.

   Note: The financial assurance may be used for rehabilitation of habitat and other purposes not addressed adequately by the proponent during the life of the project.

Annual Environmental Return

112. The proponent must produce an Annual Environmental Return which:

   a. addresses compliance with these conditions;

   b. records any unavoidable adverse impacts on MNES, mitigation measures applied to avoid adverse impacts on MNES; and any rehabilitation work undertaken in connection with any unavoidable adverse impact on MNES;

   c. identifies all non-compliances with these conditions; and

   d. identifies any amendments needed to plans to achieve compliance with these conditions.

113. The proponent must publish the Annual Environmental Return on the Internet within 20 business days of each anniversary date of this approval.

   Note: In complying with this publication requirement, the proponent must ensure that it has considered relevant confidentiality and intellectual property rights of third parties.

Dictionary

114. In these conditions, unless otherwise indicated:

   Brigalow means for the purposes of the application of the Constraints Planning and Field Development Protocol the presence of the Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community includes Brigalow regrowth that retains the species composition and structural elements typical of that found in the undisturbed listed regional ecosystems but does not include:

   a. vegetation that has been comprehensively cleared (not just thinned) within the last 15 years;

   b. vegetation in which exotic perennial plants have more than 50% cover, assessed in a minimum area of 0.5 ha (100 m by 50 m); and

c. individual patches of Brigalow that are smaller than 0.5 ha;

Clearance of native vegetation means the cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning of native vegetation;

Commencement means any physical disturbance including clearance of native vegetation, new road work, and the establishment of well sites to develop the gas field project area (the project area is specified in condition 1). Commencement does not include:

a) minor physical disturbance necessary to undertake preclearance surveys or establish monitoring programs; or associated with the mobilisation of the plant, equipment, materials, machinery and personnel prior to the start of gas field development or construction.

b) activities that are critical to commencement that are associated with mobilisation of plant and equipment, materials, machinery and personnel prior to the start of development only if such activities will have no adverse impact on MNES, and only if the proponent has notified the Department in writing before an activity is undertaken.

Conditions means these conditions attached to the approval of the action;

CSG means coal seam gas;

Department means the Australian Government department responsible for administering Part 4 of the EPBC Act;

Sensitivity category 1 means habitat for listed threatened species and migratory species and listed ecological communities as described in management plans for these matters, and as identified through ecological field surveys. It includes matters for which there is a disturbance limit specified in Tables 2 and 3 under condition 25. For the purposes of these conditions, sensitivity category 1 does not include other constraints identified by the proponent unless these relate to MNES;

Expert panel means an expert panel appointed by the Minister;

EP Act means *Environmental Protection Act 1994* (Qld);

EPBC Act means the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*;

Gas field development means all activities associated with the development of the gas fields including (but not limited to) site clearance and site preparation; development of exploration and production wells; development of water and gas transmission pipelines; infrastructure access road construction; construction of workers accommodation and office facilities; construction of gas compression stations; construction of pumping stations; construction of water treatment facilities; and construction of water storage dams;

High value regrowth for the purposes of these conditions means mature native vegetation that hasn't been cleared since 31 December 1989.

Impact risk zone means the area within 200 metres from the perimeter of sensitivity category 1;

Linear infrastructure means linear infrastructure including (but not limited to) gas and water gathering lines, low and high pressure gas and water pipelines, roads and tracks, power lines and other service lines;

Listed means those species, ecological communities or other identified matters of environmental significance listed for protection under Part 3 of the EPBC Act;

Minister means the Minister responsible for Chapter 4 of the EPBC Act, and may include a delegate of the Minister under s.133 of the EPBC Act;

MNES means matters of national environmental significance, being the relevant matters protected under Part 3 of the EPBC Act;

No impact zone means the area within 300 metres from the perimeter of sensitivity category 1;

Non-linear infrastructure means infrastructure including (but not limited to) exploration and production wells, compressor stations, regulated dams, reverse osmosis plants, brine encapsulation facilities, workers camps, and maintenance facilities;

Plan includes a report, study, protocol, program, or strategy (however described);

Production means extraction of coal seam gas or associated water other than for exploration purposes;

Proponent means the holder of the approval to which these conditions relate, and includes any person acting on behalf of the proponent;

Referral means a referral under the EPBC Act including any variation of the referral.

Regulatory agency means agencies administering the EPBC Act and the EP Act (Qld);

Remnant vegetation for the purposes of these conditions means vegetation that can meet the following:

a. 50% of the predominant canopy cover that would exist if the vegetation community were undisturbed; and
b. 70% of the height of the predominant canopy that would exist if the vegetation community were undisturbed; and

c. Composed of the same floristic species that would exist if the vegetation community were undisturbed.

Trunkline rights of way means the linear construction footprint required to install gas and water trunklines, underground 33 kV power lines, above ground 33 kV power lines, fibre optic cable and gas and water gathering lines. Trunkline rights of way may contain between one and ten gas and water trunklines, between one and ten power lines, between one and ten fibre optic cables and between one and up to twelve gathering lines running in parallel;

Water distribution pipelines means pipeline used to transfer raw or treated water to a user of that water or to transfer brine between facilities that manage brine;

Water gathering lines means pipelines used to transfer water between wells and regional storage ponds;

Water trunklines means pipelines used to transfer water between regional storage ponds and water treatment plants.

115. Unless otherwise indicated, words in these conditions have the same meaning as in (in the following order of priority):

a. the EPBC Act; and

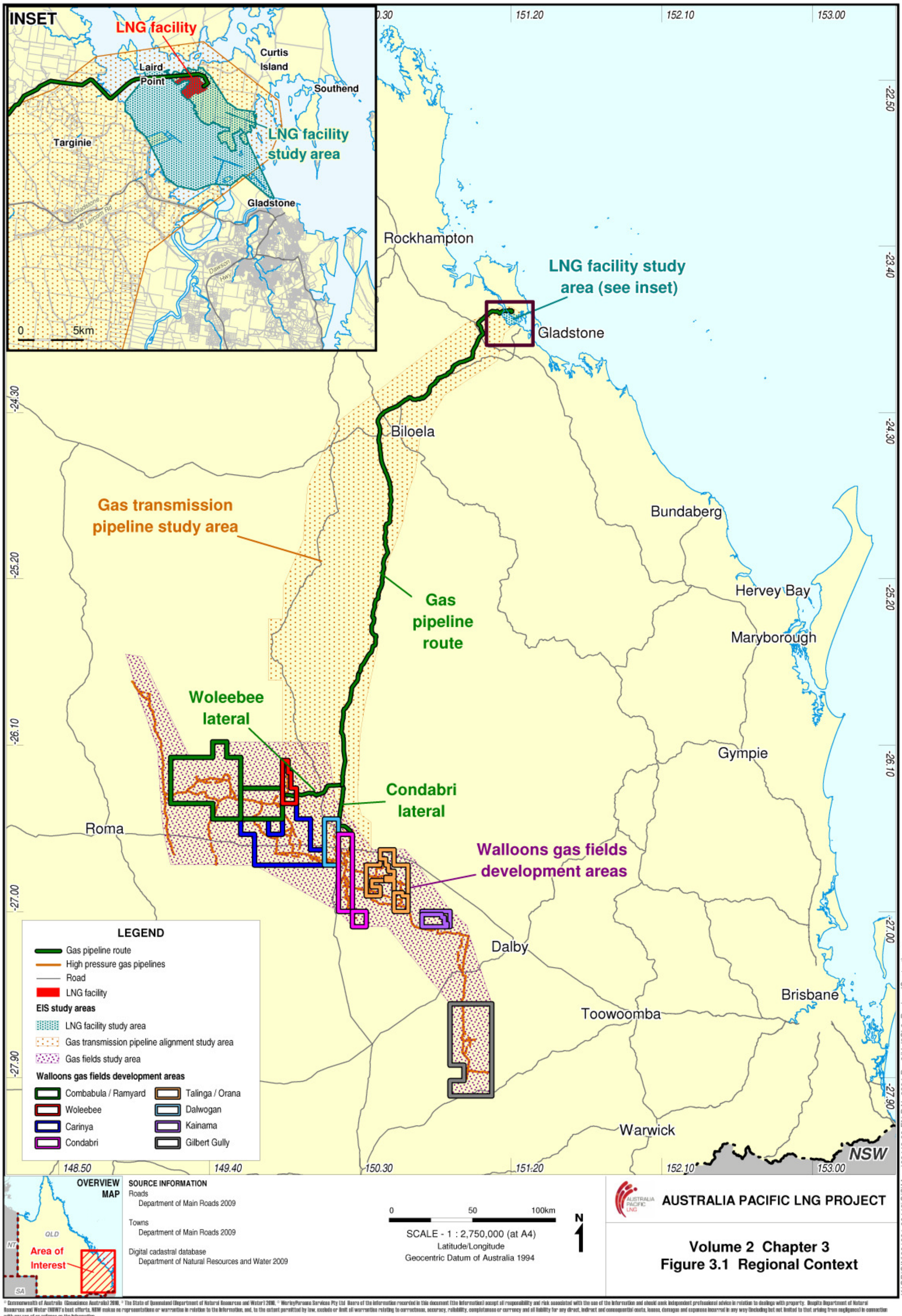
b. the EP Act.

116. Unless the contrary is indicated, in these conditions:

a. words in the singular number include the plural and words in the plural number include the singular;

b. condition headings and notes are inserted for convenient reference only and have no effect in limiting or extending the language of the condition to which they refer.

Figure 1 – Project area – APLNG gas field tenements



Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Proposed Approval

To develop, construct, operate and decommission a high pressure gas transmission pipeline network to link coal seam gas fields to a proposed LNG facility on Curtis Island as described in referral EPBC No 2009/4976

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

person to whom the approval is granted	Australia Pacific LNG Pty Ltd
proponent's ABN/ACN	ACN: 68001646331
proposed action	To develop, construct, operate and decommission a 447km high pressure gas transmission pipeline network to link coal seam gas fields in South-East Queensland to the proposed LNG Plant located on Curtis Island, adjacent to Gladstone, as described in the proponent's referral received under the Act on 3 August 2009.
decision	To approve the proposed action for each of the following controlling provisions: • World Heritage properties (sections 12 and 15A) • National Heritage Places (sections 15B and 15C) • Listed threatened species and communities (sections 18 and 18A) • Listed migratory species (sections 20 and 20A) To not approve pipeline options one and two (alternative pipeline routes identified in pg 11-12 Chapter 3, Volume 3 of the EIS) under s.133(1A) of the EPBC Act.
conditions of approval	This approval is subject to the conditions specified below.
expiry date of approval	This approval has effect until 22 February 2060.
name and position	The Hon Tony Burke MP Minister for Sustainability, Environment, Water, Population and Communities
signature	Not for signature (draft only)
date of decision	No date (draft only)

Conditions

Project area

1. The pipeline route and ROW is depicted in the map at Attachment 1.

Environmental Management Plan (excluding the Narrows)

2. The proponent must prepare an Environmental Management Plan to manage the impacts of construction, operation and decommissioning of the pipeline (other than in relation to the Narrows) on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage-listed Great Barrier Reef.

3. The Environmental Management Plan must include:
    a. provisions for detailed pre-clearance surveys by a suitably qualified ecologist along the entire length of the ROW, in accordance with conditions 5 to 10;
    b. measures to minimise native and riparian vegetation clearance and to minimise the impact on listed species, their habitat and ecological communities in accordance with management plans required for MNES under this approval;
    c. measures to manage the impact of clearing on each listed species and ecological community in accordance with management plans required for MNES under this approval;
    d. measures to regenerate vegetation on the ROW where natural regeneration is not successful to at least the condition it was prior to project activities;
    e. measures to minimise impacts on fauna during pipeline construction, including:
        i. measures to protect MNES in the areas of the ROW where trenching is being undertaken, including measures to exclude listed terrestrial fauna from gaining access to those areas of the ROW where trenching is currently being undertaken
        ii. mechanisms to allow fauna to escape from the pipeline trench;
        iii. daily morning surveys for trapped fauna;
        iv. mechanisms for a suitably qualified person to relocate fauna; and
        v. record keeping for all survey, removal and relocation activities.
    f. machinery wash down procedures and ongoing monitoring to minimise the spread and establishment of weeds in the ROW. Monitoring of weed infestations within disturbed areas must occur at least monthly during construction and then quarterly for a period of two years after completion of construction. Appropriate weed control measures must be implemented. After the two-year period, the frequency of monitoring may be reconsidered by the proponent, based on the success of control measures, the level of infestations and pipeline maintenance activities;
    g. measures to manage and control feral animals that may spread due to the establishment of the ROW;
    h. measures for the prevention of ignition sources to protect habitat values;
    i. measures for the management of acid sulfate soils.

4. The Environmental Management Plan must be submitted for the approval of the Minister. Commencement must not occur without approval. The approved plan must be implemented.

5. Before the clearance of native vegetation in the pipeline ROW, the proponent must:
   a. undertake pre-clearance surveys for the presence of listed threatened species and migratory species, their habitat and listed ecological communities.
   b. alternatively, where recent surveys have already been undertaken and those surveys meet the Department's requirements for surveys for the relevant MNES, the proponent may elect to develop management plans based on those surveys in accordance with the requirements of condition 8.

6. Pre-clearance surveys must:
   a. for each listed species, be undertaken in accordance with the Department's survey guidelines in effect at the time of the survey. This information can be obtained from the Department's website;
   b. be undertaken by a suitably qualified ecologist approved by the Department in writing;
   c. document the survey methodology, results and significant findings in relation to MNES;
   d. apply best practice site assessment and ecological survey methods appropriate for each listed threatened species, migratory species, their habitat and listed ecological communities.

7. Pre-clearance survey reports (which document the methods used and the results obtained) must be published by the proponent, on its website and be provided to the Department on request.

8. If a listed threatened species, migratory species or their habitat, or a listed ecological community is encountered during the surveys undertaken as required by condition 3 and is not specified in either condition 11 and 12, the proponent must submit a separate management plan for each species or ecological community. In relation to each listed species or ecological community, each plan must address:
   a. the relevant characteristics describing each species, species' habitat or ecological community;
   b. a map of the location of species, species' habitat, or ecological community in proximity to the ROW;
   c. measures that will be employed to avoid impact on the species, species' habitat, or ecological community;
   d. a quantification of the unavoidable impact (in hectares and/or individual specimens);
   e. where impacts are unavoidable and a disturbance limit is not specified for the listed species or ecological community under condition 11, propose offsets to compensate for the impact on the population of the species, species' habitat, or the ecological community;
   f. current legal status (under the EPBC Act);
   g. known distribution.

For listed species, each plan must also include:
   a. known species' populations and their relationships within the region;
   b. biology and reproduction;
   c. preferred habitat and microhabitat including associations with geology, soils, landscape features and associations with other native fauna and/or flora or ecological communities;
   d. anticipated threats to MNES from pipeline construction, operation and decommissioning;
   e. management practices and methods to minimise impacts, such as:

i. site rehabilitation timeframes, standards and methods;
ii. use of sequential clearing to direct fauna away from impact zones;
iii. re-establishment of native vegetation in linear infrastructure corridors;
iv. handling practices for flora specimens;
v. translocation and/or propagation practices and monitoring for translocation/propagation success;
vi. monitoring methods including for rehabilitation success and recovery;

f. reference to relevant conservation advice, recovery plans, or other policies, practices, standards or guidelines relevant to MNES published or approved from time to time by the Department.

Note: Management plans should include sufficient detail to inform pipeline construction, management and decommissioning to minimise adverse impacts on MNES throughout the life of the project.

9. Each plan required under condition 8 must be submitted for the approval of the Minister. Commencement in the location covered by the management plan must not occur without approval. Each approved plan must be implemented.

10. If, during construction a listed threatened species or migratory species or their habitat, or a listed ecological community is encountered and is not specified in the table at condition 11 or 12, the proponent must submit a separate management plan for each species or ecological community in accordance with condition 8 within 20 business days of encountering that MNES. Work must not continue at the construction site where the MNES is encountered until the relevant management plan has been approved. Each approved plan must be implemented.

Disturbance limits

11. (a) The following maximum disturbance limits apply to any disturbances authorised for unavoidable impacts on listed threatened communities and potential habitat for listed threatened species or migratory species as a result of the construction, operation and decommissioning of the pipeline (and all associated activities).

Table 1: EPBC Listed threatened ecological communities		
Ecological community	**EPBC status**	**Disturbance limit (ha)**
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	13
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nadewar Bioregions	Endangered	0.37
Species	**EPBC status**	**Disturbance limit**
Cycas megacarpa (Large-fruited Zamia)	Endangered	130 individuals
Cadellia pentasylis (Ooline)	Vulnerable	10 individuals
Xeromys myoides (False-water Rat)	Vulnerable	15.2

(b) The proponent must prepare a reconciliation statement of impacts against the agreed limit of disturbance, as defined above in condition 11 (a). It must be updated by the proponent every 12 months from commencement until construction is complete.

12. The proponent must prepare a management plan for each species in the table below. Each plan must be prepared in accordance with the requirements of condition 8.

Table 2: Species management plans required before commencement	
Listed flora species	**EPBC Act Status**
Philotheca sporadica	Vulnerable
Cadellia pentasylis (Ooline)	Vulnerable
Cupaniopsis shirleyana (Wedge-leaf Tuckeroo	Vulnerable
Bothriochloa biloba (Lobed Blue-grass)	Vulnerable
Polianthum minutiflorum (Small-flowered polianthion)	Vulnerable
Eucalyptus virens (Shiny-leaved Ironbark)	Vulnerable
Quassia bidwillii (Quassia)	Vulnerable
Tylophora linearis (Slender tylophora)	Endangered
Westringia parvifolia (Small-leaved westringia)	Vulnerable
Listed fauna species	**EPBC Act Status**
Paradelma orientalis (Brigalow Scaly-foot)	Vulnerable
Furina dunmalli (Dunmall's Snake)	Vulnerable
Egernia rugosa (Yakka Skink)	Vulnerable
Geophaps scripta scripta (Squatter pigeon – southern)	Vulnerable
Nyctophilus timoriensis (Eastern Long-eared Bat)	Vulnerable
Chalinolobus dwyeri (Large-eared Pied Bat)	Vulnerable
Xeromys myoides (Water Mouse)	Vulnerable
Delma torquate (Collared Delma)	Vulnerable
Denisonia maculate (Ornamental Snake)	Vulnerable

Note: The intent of the table above is to require preparation of management plans for those species that are likely to be encountered along the ROW, but where a disturbance limit has not been quantified. To the extent that the requirements of condition 8 are satisfied for each species, a single Species Management Plan may be prepared for this purpose.

13. Each management plan must be submitted for the approval of the Minister. Commencement must not occur without approval. Commencement in the location covered by the management plan must not occur without approval. Each approved plan must be implemented.

14. Disturbance of vegetation related to the construction and maintenance of the pipeline must be confined to the ROW. Any proposed siting of construction camps, vehicle access tracks and pipe lay-down areas outside the ROW during construction must be undertaken so as to minimise potential adverse impacts on MNES.

Offsets

Cycas megacarpa

15. To offset the unavoidable impacts to *Cycas megacarpa* the proponent must:
   a. within 12 months of the date of this approval, secure an area of at least 141 hectares as an offset for receiving no less than 780 translocated and propagated individuals;
   b. identify alternative recruitment methods if it is considered unlikely that translocation and propagation will be successful;
   c. notify the Department in writing of the acquisition or transfer of ownership of the area identified in condition 15(a) within one month of securing the land;
   d. if the proponent proposes any action within a proposed offset area, other than actions related to managing that area as an offset property, approval must be obtained, in writing from the Department. In seeking Departmental approval the proponent must provide a detailed assessment of the proposed action including a map identifying where the action is proposed to take place and an assessment of all associated adverse impacts on MNES. If the Department agrees to the action within the proposed offset site, the area identified for the action must be excised from the proposed offset and alternative offsets secured of equal or greater environmental value in relation to the impacted MNES;
   e. demonstrate that the measures for securing and managing the offset will ensure that the offset is protected in perpetuity.

Cycas megacarpa Management Plan

16. The proponent must prepare a *Cycas megacarpa* Management Plan in consultation with an expert approved by the Department in writing.

17. The *Cycas megacarpa* Management Plan must include:
   a. measures to ensure all *Cycas megacarpa* within the ROW are avoided using, for example suitable trenchless technique(s) as necessary or, if avoidance is not possible, individual plants must be removed and kept offsite and replanted in the same location, or alternatively translocated. Where it can be demonstrated that removal and translocation of individuals is unlikely to succeed, translocation may be substituted by establishing propagated individuals;
   b. measures to propagate and plant *Cycas megacarpa* individuals removed or impacted by construction activities to maintain a population of no less than 780 individuals within the offset site required by Condition 15(a);
   c. a detailed methodology for translocation, propagation, and planting, including a map of the location of the offset site;
   d. details of funding required to secure, maintain and enhance the values of the offset site in perpetuity;
   e. details of a suitably qualified person to undertake translocation, propagation and planting;

f. details of the erosion and sediment control measures to be implemented in the ROW in the Callide and Calliope Ranges;

g. measures to rehabilitate the ROW in the Callide and Calliope Ranges;

h. measures for the control and management of weeds, fire, feral animals, access and grazing in translocation sites;

i. measures for the management, maintenance and protection of the population of *Cycas megacarpa* individuals in the offset site for a period of five years following final planting;

j. details of monitoring practices to assess the success of proposed management regimes of the offset;

k. performance measures, reporting requirements, trigger levels for corrective actions and identification of those actions to be taken to ensure performance measures are met; and

18. The *Cycas megacarpa* Management Plan must be submitted for the approval of the Minister. Commencement in the location covered by the management plan must not occur without approval. The approved plan must be implemented.

Migratory species

19. If a bundled pipeline crossing of the Narrows is not pursued then to offset the unavoidable impacts on listed migratory birds within the ROW at the Kangaroo Island wetlands west of the Narrows, the proponent must contribute at least $250,000 to the Gladstone Port Corporation's migratory bird research study required by conditions for the Gladstone Western Basin Dredging and Disposal Project (EPBC 2009/4904).

The Narrows crossing

20. The proponent must prepare an Environmental Management Plan for the crossing of the Narrows. This must include:

   a. if the crossing is undertaken concurrently with the construction of one or more additional gas transmission pipelines (a 'bundled crossing'):
      i. the roles and responsibilities of each party involved in the bundled crossing;
      ii. details of the final pipeline route, engineering design and construction methodology, including details of the total number of gas transmission pipes including any pipelines for water supply and/or sewerage;
      iii. potential impacts from the construction of the pipeline on listed threatened species, ecological communities, migratory species and World and National Heritage-listed values of the Great Barrier Reef;
      iv. mitigation measures to reduce impacts on listed threatened species, ecological communities, migratory species and World and National Heritage-listed values of the Great Barrier Reef;
      v. proposed offset measures to compensate for unavoidable impacts on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage-listed Great Barrier Reef;
      vi. measures for the management of acid sulfate soils (both potential and actual);
      vii. measures for ongoing maintenance and decommissioning of the pipelines, or

If the proponent does not proceed in a bundled crossing:

b. a construction method which, in the opinion of the Minister, will result in minimal surface disturbance to the Kangaroo Island Wetlands and minimal disturbance to the area of the estuary of the Narrows (preferably achieved by horizontal directional drilling or tunnelling);
   i. details of the final pipeline route, design and construction methodology, including details of inclusion of pipes for water supply and sewerage;
   ii. potential impacts from the construction of the pipeline on listed threatened species, ecological communities, migratory species and World and National Heritage-listed values of the Great Barrier Reef;
   iii. mitigation measures to reduce impacts to listed threatened species, ecological communities, migratory species and World and National Heritage-listed values of the Great Barrier Reef;
   iv. proposed offsets to compensate for the unavoidable impacts of the action on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage-listed Great Barrier Reef;
   v. measures for the management of acid sulfate soils;
   vi. measures for ongoing maintenance and decommissioning of the pipeline.

   Note: 20(b) does not prescribe a particular construction method.

21. The Environmental Management Plan must be submitted for the approval of the Minister. The activity which is the subject of the Environmental Management Plan must not start without approval. The approved plan must be implemented.

22. If the pipeline construction involves dredging to be undertaken by the proponent under the approval to which these conditions are attached, the proponent must prepare a Dredge Management Plan.

23. The Dredge Management Plan required under these conditions must include:
    a. details of dredging methods, planned commencement, duration and frequency of dredging;
    b. identification of areas of potentially impacted seagrass habitat and their environmental tolerances;
    c. site specific water quality objectives for the designated habitats as a guideline for habitat protection and that are in accordance with the National Water Quality Management Strategy including the Australian and New Zealand Guidelines for Fresh and Marine Water Quality, the Australian Guidelines for Water Quality Monitoring and Reporting, the Great Barrier Reef Water Quality Guidelines and the Queensland Water Quality Guidelines;
    d. measures to refine the plume modelling data presented in the proponent's Environmental Impact Statement;
    e. mitigation measures and controls for the dredging and spoil disposal activities;
    f. triggers for initiating adaptive management and potential remediation measures;
    g. monitoring of:
       i. potential impacts of dredging on seagrass including but not limited to turbidity and light attenuation;
       ii. the triggers established under condition 23(f); and
       iii. the long term impacts of the action;
    h. options, linked to the triggers established under condition 23(f), for adaptively managing the action – including options for varying the timing and location of dredging and spoil disposal activities;
    i. details for monitoring of dredging activities, including timing and variables measured such as turbidity and light attenuation in a format as directed by the

Department to allow validation of other modelling of dredging impacts relating to the Port of Gladstone;

j. measures to minimise the impact on listed migratory birds from noise associated with construction activities;
k. measures to prevent and respond to the introduction of marine pest species;
l. measures to protect dugongs and listed turtles including the use of turtle excluder devices;
m. details of dredge spoil placement;
n. provisions to sample and analyse dredge spoil composition.

24. The Dredge Management Plan must be submitted for the approval of the Minister. The activity subject to the Dredge Management Plan must not occur without approval. The approved plan must be implemented.

Location of pipeline (Callide range)

25. East of the Callide Range, the proponent must locate the pipeline within the Callide Infrastructure Corridor State Development Area as indicated in the map at Attachment 1.

Water crossings

26. Where reasonably possible horizontal directional drilling must be used for major waterway crossings, including:
    a. those within the Dawson and Calliope River catchments and any water crossing within the known distribution of the Fitzroy River Turtle (*Rheodytes leukops*) and Murray Cod (*Maccullochella peelii*). Pipeline construction across waterways must not take place during the nesting and breeding season of the Fitzroy River Turtle;
    b. Humpie and Targinie Creeks before marshlands near Kangaroo Island and The Narrows.

27. Trenchless techniques are not required in dry creek beds within the known distribution of the Fitzroy River Turtle (*Rheodytes leukops*) and Murray Cod (*Maccullochella peelii peelii*) where the distance to the nearest water is sufficient to buffer any potential impacts resulting from the crossing technique.

28. The proponent must prepare an Aquatic Values Management Plan. This plan must include:
    a. a detailed assessment of aquatic values, including animal breeding locations for listed threatened and migratory species within the ROW;
    b. measures to minimise impacts on listed riparian, aquatic and water dependent flora and fauna;
    c. measures to minimise erosion and sediment impacts to waterways;
    d. measures to maintain water quality and water flow requirements, including treatment and disposal methods for hydrostatic test water;
    e. site-specific mitigation measures for any potential impacts from construction and operation of the pipeline on listed threatened species, including but not limited to the Fitzroy River Turtle (including use of shallow turbid pools);
    f. details of an MNES survey of the site where the pipeline will cross Cockatoo Creek. To avoid impacts to the *Eriocaulon carsonii* (Salt Pipewort), the requirements for the Aquatic Values Management Plan (a) to (e) above should be presented separately for Cockatoo Creek.

29. The Aquatic Values Management Plan must be approved in writing by the Minister. Activities the subject of the plan must not start without approval. The Plan must be implemented.

Impacts on EPBC-listed species resulting from activities associated with the pipeline crossing at Cockatoo Creek

30. If an EPBC-listed species is identified during the survey required in condition 28(f), the Proponent must develop and implement a management plan in accordance with the requirements of condition 8.

Notification of commencement

31. Within 20 business days of commencement, the proponent must advise the Department in writing of the actual date of commencement.

32. If, at any time after five years from the date of this approval, the Minister notifies the proponent in writing that the Minister is not satisfied that there has been commencement of the action, the action must not commence without the written agreement of the Minister.

Request for variation of plans by proponent

33. If the proponent wants to act other than in accordance with a plan approved by the Minister under these conditions, the proponent must submit a revised plan for the Minister's approval.

34. If the Minister approves the revised plan, then that plan must be implemented instead of the plan originally approved.

35. Until the Minister has approved the revised plan, the proponent must continue to implement the original plan.

Revisions to plans by the Minister

36. If the Minister believes that it is necessary or desirable for the better protection of a relevant controlling provision for the action, the Minister may request the proponent to make, within a period specified by the Minister, revisions to a plan approved under these conditions.

37. If the Minister makes a request for revision to a plan, the proponent must:
    a. comply with that request; and
    b. submit the revised plan to the Minister for approval within the period specified in the request.

38. The proponent must implement the revised plan on approval of the Minister.

39. Until the Minister has approved the revised plan, the proponent must continue to implement the original plan.

Minimum timeframes for consideration of plans

40. For any plan required to be approved by the Minister under these conditions, the proponent must ensure the Minister is provided at least 20 business days for review and consideration of the plan, unless otherwise agreed in writing between the proponent and the Minister.

Compliance with State environmental and other authorities

41. The proponent must comply with all environmental authorisations issued by the State, including conditions of an environmental authority issued under the EP Act.

Provision of State plans

42. If a condition of a State approval requires the proponent to provide a plan then the proponent must also provide the plan to the Department or Minister on request, within the period specified in the request.

Timeframes

43. If these conditions require the proponent to provide something by a specified time, a longer period may be specified in writing by the Minister.

Auditing

44. On the request of and within a period specified by the Department, the proponent must ensure that:

    a. an independent audit of compliance with these conditions is conducted; and
    b. an audit report, which addresses the audit criteria to the satisfaction of the Department, is published on the Internet and submitted to the Department.

45. Before the audit begins, the following must be approved by the Department:

    a. the independent auditor; and
    b. the audit criteria.

46. The audit report must include:

    a. the components of the project being audited;
    b. the conditions that were activated during the period covered by the audit;
    c. a compliance/non-compliance table;
    d. a description of the evidence to support audit findings of compliance or non-compliance;
    e. recommendations on any non-compliance or other matter to improve compliance;
    f. a response by the proponent to the recommendations in the report (or, if the proponent does not respond within 20 business days of a request to do so by the auditor, a statement by the auditor to that effect);
    g. certification by the independent auditor of the findings of the audit report.

47. The financial cost of the audit will be borne by the proponent.

48. The proponent must:

    a. implement any recommendations in the audit report, as directed in writing by the Department after consultation with the proponent;
    b. investigate any non-compliance identified in the audit report; and
    c. if non-compliance is identified in the audit report - take action as soon as practicable to ensure compliance with these conditions.

49. If the audit report identifies any non-compliance with the conditions, within 20 business days after the audit report is submitted to the Department the proponent must provide written advice to the Minister setting out the:

    a. actions taken by the proponent to ensure compliance with these conditions; and