6.5 Surface Water

6.5.1 Introduction

This section identifies the environmental values of surface waters in the vicinity of the proposed CSG fields, the potential impacts on these values from development of the CSG fields, and the proposed mitigation measures to be used to minimise these impacts. Further detail on the baseline assessment is provided in Appendix O1.

6.5.2 Methodology

An assessment of the surface water resources within the proposed CSG fields was undertaken, to identify with environmental values as defined by the *Environmental Protection (Water) Policy 1997* (EPP (Water)). Water demand and usage, including anticipated flows of water to and from the project areas is discussed in the CSG field water report provided in Appendix O1.

A baseline water quality assessment was conducted and is further discussed in Appendix O1. Relevant water quality objectives for the CSG fields were identified from Queensland Water Quality Guidelines 2006 (QWQG) and compared with median values of various physico-chemical parameters, metals, nutrients and organic indicators. The baseline surface water quality of the three catchments (the Condamine-Balonne Catchment, Upper Dawson Catchment, and Comet-Brown Catchment) were evaluated using data from Department of Natural Resources and Mines (DNRW), supplemented by targeted and spatially dense samples taken during this assessment.

Major planned activities for the CSG field development through the different stages of construction, commissioning, operation and decommissioning have been assessed. This section discusses the scope of the surface water assessment undertaken, provides an overview of the surface water management regulatory framework, a description of the existing environmental values, potential impacts of the project and proposed management measures to be adopted to minimise those impacts identified. This impact assessment was undertaken using a qualitative risk assessment approach.

Potential impacts and mitigation measures of associated water from the operational activities of the GLNG Project have been assessed in detail within Section 6.7 and Appendix Q.

A detailed description of the existing surface water environment including physical integrity and fluvial processes, and potential impacts of the project is provided in Appendix O1.

6.5.3 Regulatory Framework

Key legislation governing the management of surface water identified with regards to the proposed CSG fields of the GLNG Project includes:

- *Water Act 2000, (Qld);*
- *Water Supply (Safety and Reliability) Act 2008, (Qld);*
- *Environment Protection Act 1994, (Qld);*
- *Environmental Protection (Water) Policy 1997, (Qld)*[1]*;*

[1] Note that at the time of technical report preparation (December 2008) the EPP Water policy was still in force. However, on 1 January 2009 the Environmental Protection Act 1994 Environmental Protection (Water) Amendment Policy (No.1) 2008 came into effect. The Amendment allowed for the identification of additional environmental values, with respect to water. The shallow groundwater resources have been evaluated according to the updated criteria

- *Petroleum and Gas (Production and Safety) Act 2004, (Qld);*
- *Petroleum Act 1923, (Qld); and*
- *Water Resource (Fitzroy Basin) Plan 1999.*

6.5.3.1 Water Act 2000

The *Water Act 2000* (Water Act) provides a framework for the sustainable management of water and related resources. It regulates the taking, use and allocation of water through (among other things) water resource plans and resource operations plans. Relevantly, it sets out permitting and licensing requirements for taking or interfering with water and other resources.

Where water used for, or during, surface water activities is not associated water under the *Petroleum and Gas (Production and Safety) Act 200*4 (P&G (PSA) Act), or is not water necessarily produced as a result of the carrying out authorised activities under the *Petroleum Act 1923* (Qld) (Petroleum Act), a water licence, which regulates the taking or interfering with water from a watercourse or overland flowwater, will be required for those activities.

6.5.3.2 Water Supply (Safety and Reliability) Act 2008

The *Water Supply (Safety and Reliability) Act 2008* (Qld) (WS (S&R) Act) aims to provide for the safety and reliability of water supply in Queensland. It provides for water service provider registration and sets out service provider obligations. It also determines what dams are referrable dams for which a failure impact assessment will be required. A failure impact assessment must be accepted by the DNRW before the construction of any referrable dam occurs.

A further ramification of the WS (S&R) Act is that if the petroleum tenure holder is granted a water licence, it may not charge for the on-supply of water unless it is also registered as a water service provider. Development approval under the IP Act is also required in respect of certain WS (S&R) Act activities for the construction of a referrable dam.

6.5.3.3 Environment Protection Act 1994

The *Environmental Protection Act 1994* (Qld) (EP Act) aims to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (being ecologically sustainable development).

6.5.3.4 Environmental Protection (Water) Policy 1997

The *Environmental Protection (Water) Policy 1997* (Qld) (EPP (Water)) aims to achieve the object of the EP Act in relation to Queensland waters by providing a framework for identifying environmental values, stating water quality guidelines and objectives to enhance or protect the environmental values, making consistent and equitable decisions about Queensland waters that promote their efficient use and best practice environmental management and providing for community consultation and education. Legislative amendments to the EPP Water that took effect on 1 January 2009 were considered during preparation of this EIS.

6.5.3.5 Petroleum and Gas (Production and Safety) Act 2004

The P&G (PSA) Act allows the holder of a petroleum tenure to take, interfere with and use an unlimited amount of underground water (referred to as 'associated water') that arises during the course of, or results from, activities that are authorised activities under the terms of the petroleum tenure.

6.5.3.6 Petroleum Act 1923

The Petroleum Act regulates petroleum and natural gas in Queensland in relation to certain petroleum tenements granted prior to 2004. The Petroleum Act deals with authorities to prospect and leases, and provides for the ownership and pipelines and equipment.

6.5.3.7 Water Resource (Fitzroy Basin) Plan 1999

The Water Resource (Fitzroy Basin) Plan 1999 (Fitzroy Basin WRP) provides a framework for sustainably managing water, and the taking of water within the plan area. The Plan also provides a framework for establishing water allocations and the regulation of the taking of overland flow water.

The Fitzroy Basin Resource Operations Plan 2006 (Fitzroy Basin ROP) provides guidance on the allocation and management of water to implement the objectives set out in the Fitzroy Basin WRP.

6.5.4 Existing Environmental Values

The existing environmental values include the biological integrity of the aquatic ecosystem and recreational, drinking water supply, agricultural and/or industrial uses.

6.5.4.1 Study Area

The surface water study area includes the catchments within the CSG fields. In order to provide an assessment of surface water environments it is necessary to consider catchments as a whole. This section therefore considers the following three catchments; the Condamine-Balonne catchment, Upper Dawson catchment, and Comet- catchment, which combined make up the Condamine-Culgoa Catchment as shown on Figure 6.5.1. An overview of each catchment is provided below.

6.5.4.2 Catchment Overview

Condamine-Balonne

The Roma CSG field area is situated within the Condamine-Balonne catchment which is part of the Condamine-Culgoa catchment (refer to Figure 6.5.2). Roma is the main township in the catchment, situated on Bungil Creek. The catchment contains extensive, meandering streams that are largely ephemeral or intermittent. The topography is primarily flat with wide alluvial floodplains. Streams have long periods of low to zero flows, forming a series of disconnected waterholes.

Major streams within the study area include Bungil Creek, Wallumbilla Creek and Yuleba Creek. The catchment's tributaries predominantly drain in a south westerly-direction to the Balonne River. Flows from the Balonne River proceed into the Murray Darling Basin and hence are subject to inter-governmental agreements and actions such as the Basin Salinity Management Strategy.

Upper Dawson River/ Dawson River

The Fairview CSG field area lies within the Upper Dawson River catchment that extends upstream and westwards from Taroom, encompassing the townships of Injune and Wandoan (refer to Figure 6.5.3) within the larger Fitzroy Basin. The catchment contains extensive but largely ephemeral or intermittent stream networks. Major streams in the area include the Dawson River, Hutton Creek, Baffle Creek, Juandah Creek, Eurombah Creek, Commissioner Creek and Broken Creek. The Dawson River is spring fed along a reach from the outflow of Hutton Creek to Yebna Crossing.

In the downstream reaches of the Hutton Creek, grazing, forestry and cropping are widespread. A number of water storages and weirs are located on the Dawson River from Taroom downstream and are used for irrigation and recreational purposes supporting regional industry and urban communities.

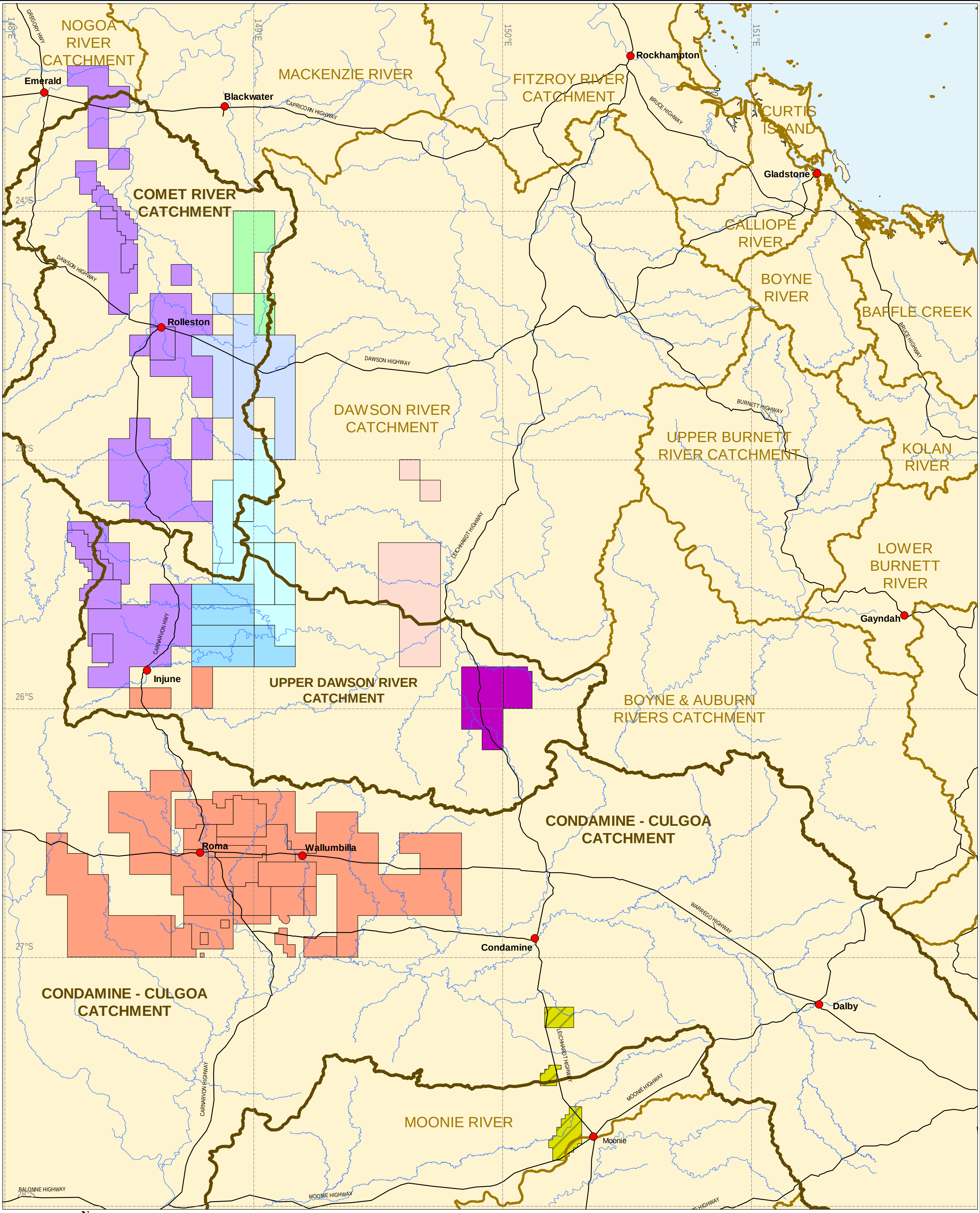
Comet River

The Arcadia Valley, Denison, Comet and Mahalo CSG field areas lay within the Comet catchment area (refer to Figure 6.5.4), extending from the Carnarvon Ranges north to Emerald. Catchment land uses are dominated by grazing and cropping. The Comet catchment is part of the larger Fitzroy Basin, which comprises almost 10% of the agriculturally productive land in Queensland. The Fitzroy River, discharges into the marine environment at the southern end of the Great Barrier Reef, near the major urban centre of Rockhampton.

Catchment Environmental Values

Within the CSG fields there are a significant number of major watercourses and various minor tributaries (refer to Figures 6.5.2 to 6.5.4).

Specific environmental values for the watercourses within the CSG fields are not defined within the EPP (Water), and there are no detailed local plans relating to environmental values for the catchments. However, since similar land uses exist within each catchment it is expected that the same environmental values will apply to all streams within a catchment. These are summarised in Table 6.5.1.



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Roma CSG Field	Denison CSG Field	Scotia CSG Field	Catchment Boundary
Fairview CSG Field	Comet Ridge CSG Field	Eastern Surat CSG Field	Major Roads
Arcadia Valley CSG Field	Mahalo CSG Field	Roma Other CSG Field	Major Drainage

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Client

URS

Project

GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title

SURFACE WATER CATCHMENT AREAS AND CSG FIELDS

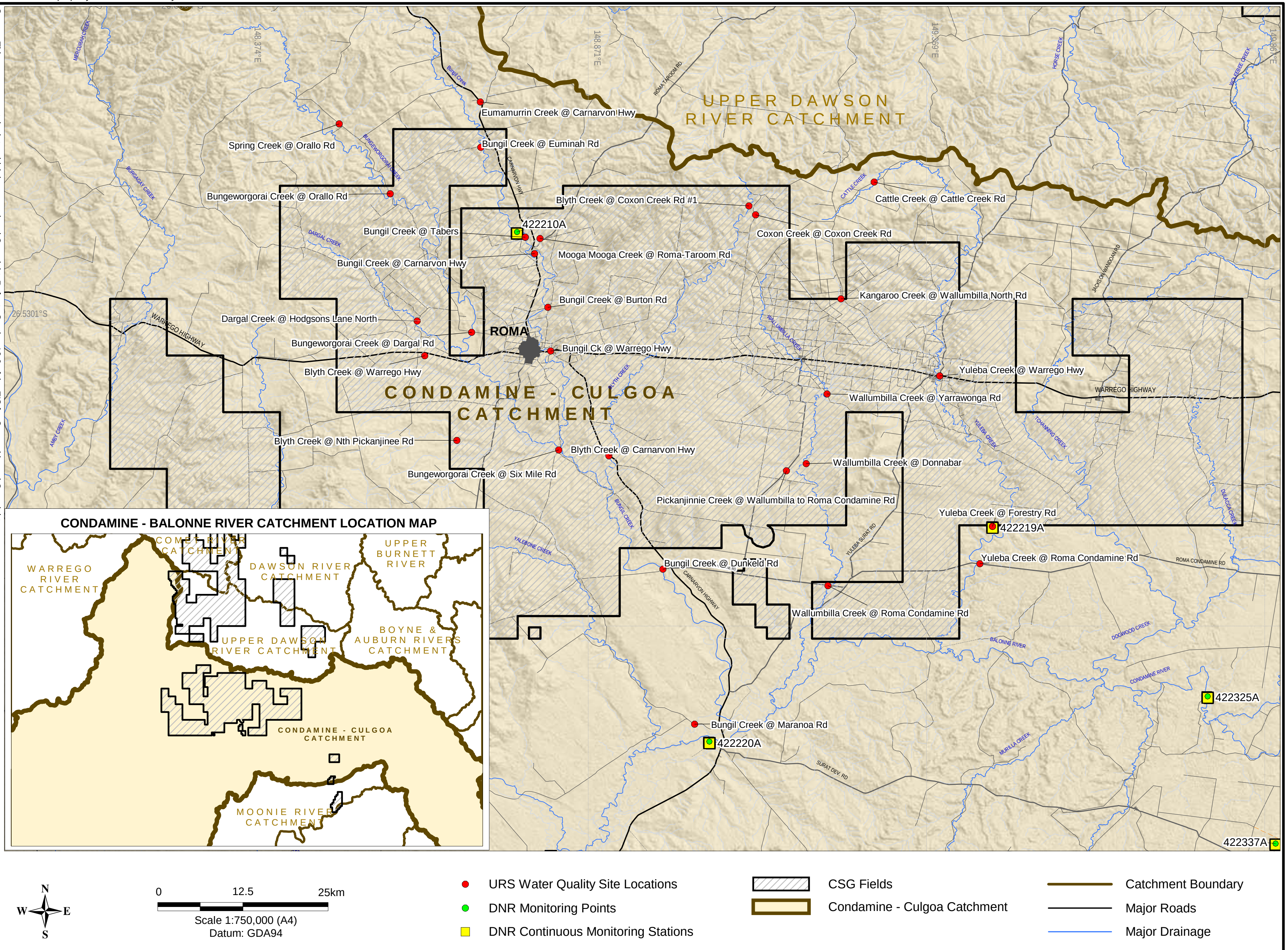
Drawn: CA	Approved: JB	Date: 03-03-2009	Figure: **6.5.1**
Job No: **4327 0896**	File No: 42626220-g-905.wor		Rev:B A4

Table 6.5.1 Catchment Environmental Values

Environmental Values	Condamine-Balonne Catchment	Upper Dawson Catchment	Comet-Brown Catchment
Protection of high ecological value aquatic habitat	X	X	X
Protection of slightly to moderately disturbed aquatic habitat	✓	✓	✓
Protection of highly disturbed aquatic habitat	X	X	X
Suitability for primary contact recreation (e.g. swimming)	✓	✓	✓
Suitability for secondary recreation (e.g. boating)	✓	X	✓
Suitability for visual (no contact) recreation	✓	✓	✓
Suitability for drinking water supplies	✓	X	✓
Suitability for crop irrigation	✓	✓	✓
Suitability for stock watering	✓	✓	✓
Suitability for farm use	✓	✓	✓
Suitability for aquaculture (e.g. red claw, barramundi)	X	X	X
Suitability for human consumers of aquatic food	X	X	X
Suitability for industrial use (including manufacturing plants, power generation)	✓	✓	✓
Protection of cultural and spiritual values	✓	✓	✓

✓ Denotes that the environmental value is applicable to the watercourses within the catchment.

X Denotes that the environmental value is not applicable to the watercourses within the catchment.



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Client

Project

GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title

CONDAMINE - CULGOA RIVER CATCHMENT WATER QUALITY SITES AND DNR MONITORING SITES

Drawn: CA	Approved: JB
Date: 29-01-2009	
Job No: 4262 6220	File No: 42626220-g-907.wor
Figure: 6.5.2	Rev: A
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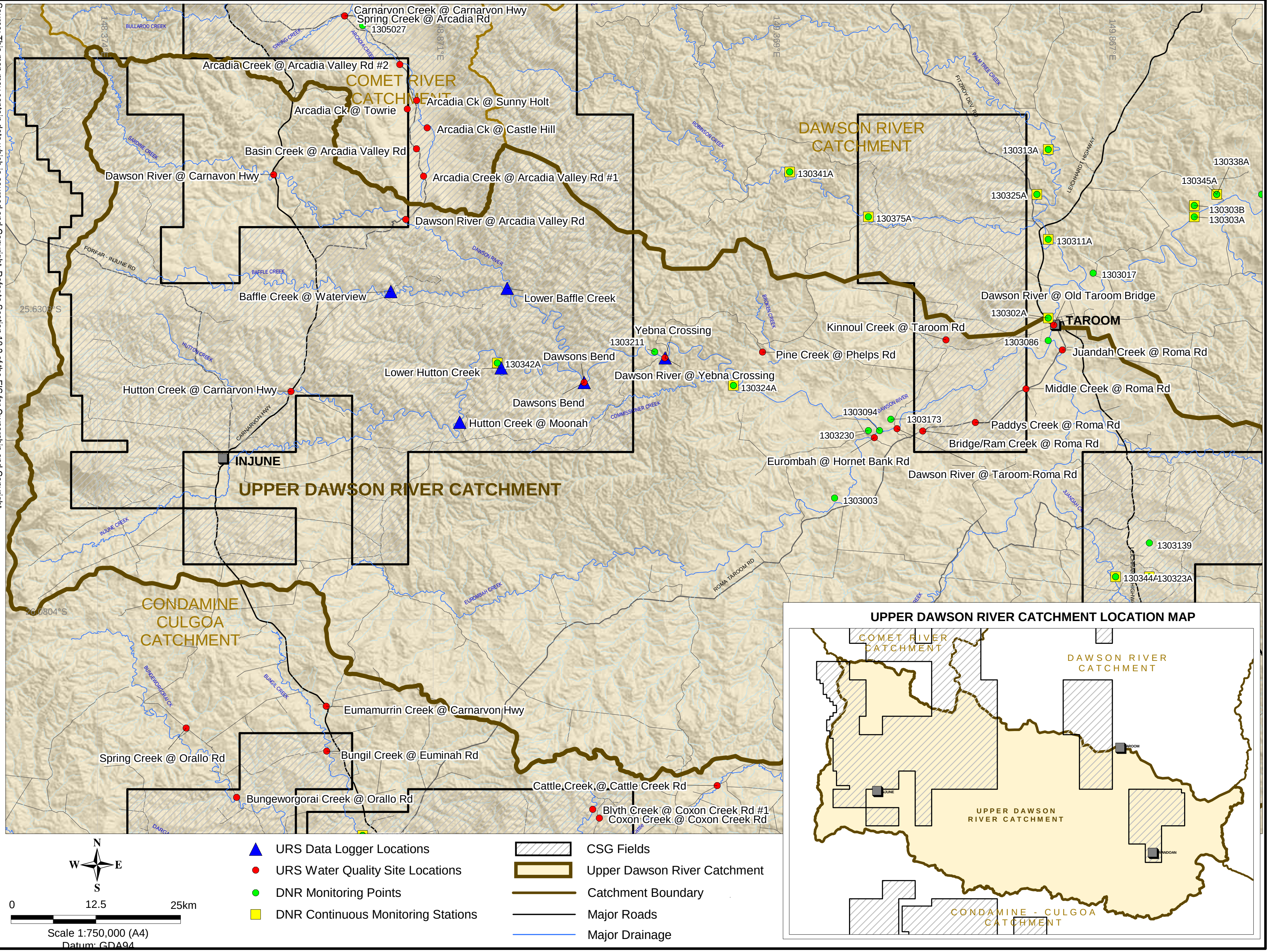

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Client: URS | LNG

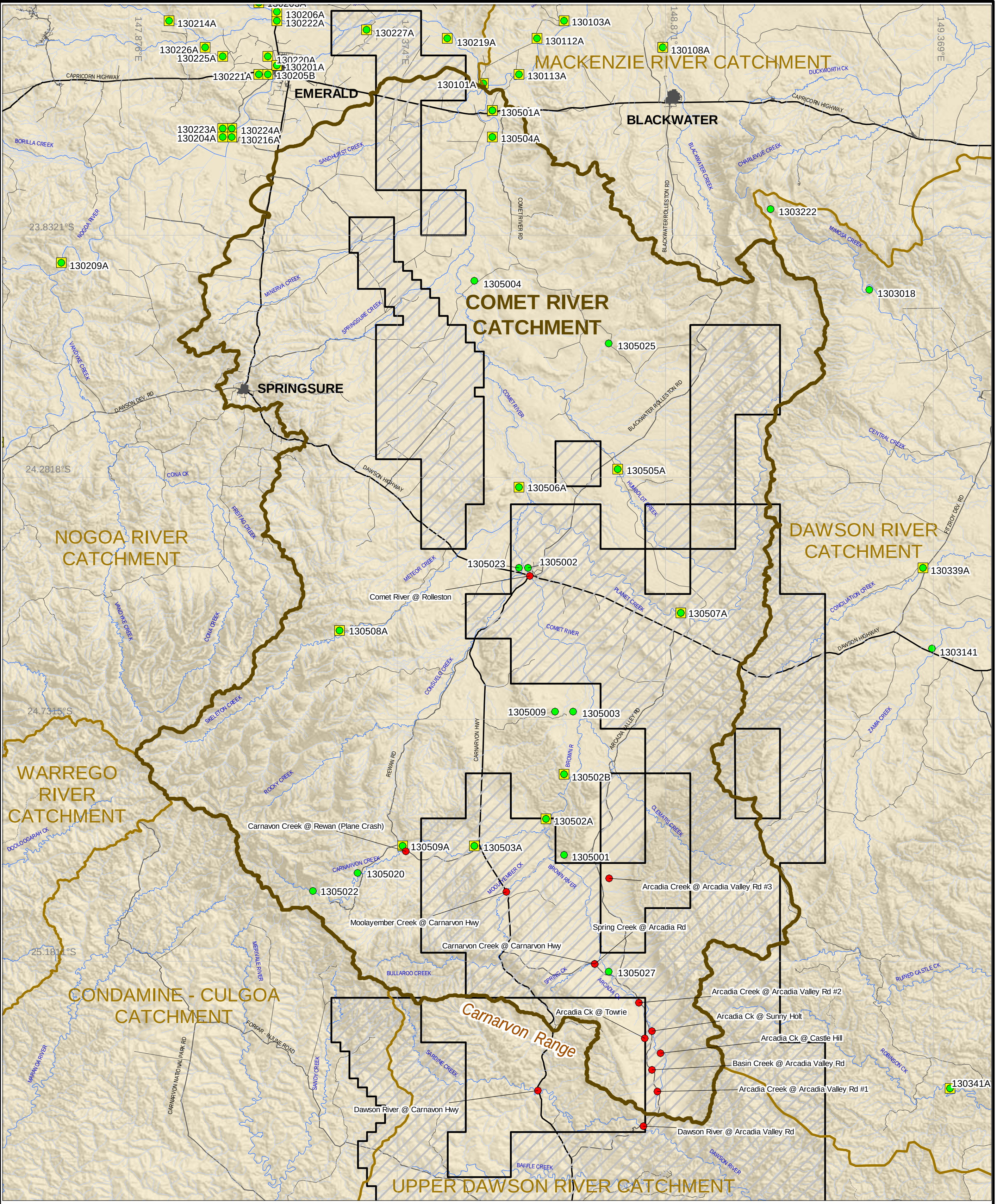
Project: GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title: UPPER DAWSON RIVER CATCHMENT
WATER QUALITY SITES AND
DNR MONITORING SITES

Drawn: CA | Approved: JB | Date: 29-01-2009

Job No: 4262 6220 | File No: 42626220-g-908.wor

Figure: 6.5.3 | Rev: A | A4



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- CSG Fields
- URS Water Quality Site Locations
- DNR Monitoring Points
- DNR Continuous Monitoring Stations
- Comet River Catchment
- Catchment Boundary
- Major Roads
- Major Drainage

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Client	Project	Title
LNG / URS	GLADSTONE LNG PROJECT ENVIRONMENTAL IMPACT STATEMENT	**COMET RIVER CATCHMENT WATER QUALITY SITES AND DNR MONITORING SITES**
	Drawn: CA · Approved: JB · Date: 29-01-2009	Figure: **6.5.4** · Rev:A
	Job No: **4262 6220** · File No: 42626220-g-909.wor	A4

Condamine-Balonne

Protection of aquatic ecosystems is applicable to all stream lengths within the CSG fields. In accordance with EPP (Water) the waterways of the Condamine-Balonne River catchment are considered predominantly to be of slightly to moderately disturbed ecosystems, as “systems that have undergone some changes, with aquatic biological diversity affected to some degree but the natural communities are still largely intact and functioning” (EPA, 2005).

Weirs and dams along the Balonne River are used for primary and secondary recreation purposes such as swimming and fishing. It is possible that water holes along the Bungil Creek are also utilised for local recreational purposes. The use of the waterways for ‘visual recreation’ purposes must also be considered, particularly in the less disturbed regions of the upper Bungil Creek.

The towns of Roma and Mitchell draw drinking water from the artesian groundwater basin. However Surat takes drinking water from the Balonne River, as do towns situated further downstream. On this basis the environmental value of drinking water must be protected at and downstream of Surat, but is not considered relevant to upstream Bungil Creek, Wallumbilla Creek and Yuleba Creek.

The Roma area is extensively used for cattle grazing, and across the catchment there is evidence of stock access to streams. It is likely that water is taken from the waterways for stock and farming purposes, evident by observation of a dam on the Bungil Creek downstream of Roma.

The Roma CSG field area falls within the Condamine Balonne catchment area. Water allocations in the Tributaries water management area including from Bungil Creek, Bungeworgorai Creek and Yuleba Creek includes agriculture, irrigation and industrial water use (DNRW, 2006).

Upper Dawson River

In accordance with EPP (Water), the waterways of the Upper Dawson River catchment are considered predominantly to consist of “slightly to moderately disturbed ecosystems” based on the State of the River Report for the region (Telfer, 2005). These are “systems that have undergone some changes, with aquatic biological diversity affected to some degree but the natural communities are still largely intact and functioning”.

Water allocations under the Dawson Valley Water Supply Scheme are primarily for the purposes of ‘agriculture’ or ‘any’ (DNRM, 2006). Significant allocations are made along the Dawson River from approximately 20 km downstream of Taroom to the Fitzroy River junction, though some licences are used upstream, particularly on Juandah Creek. Taroom is approximately 90 km downstream from the Fairview CSG field. Allocations are for stock watering, irrigation and industrial water use. Between the Hutton Creek Junction and Fairview it is evident from river health surveys (Envirotest, 2003 to 2006, Simmonds and Bristow, 2007 & 2008) that stock access waterways in this area from time to time. However, stock access to the Dawson River is generally limited due to steep banks.

Fishing is a widespread recreational activity along the Dawson River including upstream of Yebna Crossing only 12 km downstream of Fairview (Mr. Radel pers. comm.). Other recreational activities such as swimming are possible, but realistically only along the Dawson River downstream of Yebna Station. Access along the Dawson River is restricted due to steep banks and limited road crossings. Swimming is probably occasional and intermittent. At Taroom, treated groundwater supplies are used to maintain the local swimming pool. Without specific evidence of swimming, primary contact recreation has not been identified as an environmental value.

Along the Dawson River downstream of Taroom, the Glebe Weir is utilised for primary recreation (such as swimming) and secondary recreation purposes (such as canoeing and fishing) (Taroom Shire Council pers. comm.). It is possible that other waterholes upstream and downstream along the Dawson River are also used for local recreational purposes. The aesthetics of the waterways are of relevance with parts of the region considered to be of “inherent natural beauty” (Telfer, 1995).

The towns of Taroom and Injune draw drinking water from an artesian groundwater supply. Water from the Dawson River is used in the urban setting for irrigation of schools and sports fields only. It is understood that residential properties within the catchment but outside of the townships utilise rainwater or borewater for drinking purposes (Taroom Shire Council pers. comm.).

Comet River Catchment

Along the Comet River a number of dams and the Comet Weir provide water primarily for irrigation purposes. Water allocations from the Nogoa-McKenzie Supply Scheme downstream of the Comet River are predominantly for ‘agricultural’ or ‘other’ purposes (Fitzroy Basin Resource Operations Plan, April 2006).

The town of Rolleston utilises water from the Comet River for drinking purposes. Water is harvested approximately once per year based on rainfall events, stored in ring tanks and treated. Groundwater is also used to supplement the drinking water supply (Bauhinia Shire Council pers. comm.).

Regions of the catchment, particularly in the western portion, have been identified as ‘scenic rural settings’, with the potential for activities such as swimming and fishing to be realised (Henderson, 2002).

Based on the above identified uses of the rivers and tributaries, all environmental values are considered applicable in the Comet River catchment area.

6.5.4.3 Hydrology

All three catchments contain extensive but largely ephemeral stream networks with summer rainfall (October to April) dominant and periods of low to zero flow during winter when the streams become a series of isolated waterholes. The Dawson River downstream of Dawson’s Bend is the exception as it is perennial, maintained by significant spring flows arising from the river bed and adjacent to the stream.

Velocities of associated water flows are typically less than 0.1 m/s except in the case of the Dawson River at Utopia where 0.19 m/s was estimated (Table 6.5.2). Compared with the estimated velocity for inception of erosion (0.3 – 0.5 m/s) all of these velocities are small.

Table 6.5.2 Estimated Velocities and Depths

Catchment	Site Name	Site No	Discharge (ML/day)	Gauge Height (m)	Area (m2)	Velocity (m/s)	Mannings Velocity (m/s)
Upper Dawson	Hutton at Fairview	130342A	52.5	0.45	40.29	0.015	0.031
	Dawson at Utopia	130324A	52.5	0.9	3.63	0.167	0.0005
Condamine - Balonne	Bungil at Tabors	444210A	20	0.71	2.94	0.078	0.0006
	Yuleba at Forest	422219A	6	1.2	8.94	0.008	0.002
Comet-Brown	Brown at Lake Brown	130502B	8.22	0.58	15.73	0.006	0.008

Data in Table 6.5.2 was compared to average velocities under flooding conditions. The highest gauge data was obtained from the NRW WaterShed site to calculate the velocities (Table 6.5.3) under flood conditions.

Table 6.5.3 Estimated Velocities and Depths under Flood Conditions

Catchment	Site Name	Site No	Discharge (ML/day)	Gauge Height (m)	Area (m2)	Flood flow velocities (m/s)
Upper Dawson	Hutton at Fairview	130342A	45,606	9.70	79.9	2.98
	Dawson at Utopia	130324A	87,696	12.82	553.2	0.86
Condamine - Balonne	Bungil at Tabors	444210A	72,817	7.87	470.7	1.79
	Yuleba at Forest	422219A	29,516	9.92	1182.0	0.62
Comet-Brown	Brown at Lake Brown	130502B	31,505	7.53	114.5	3.25

The flood flow velocities shown in Table 6.5.3 are well above the estimated velocity for inception of erosion (0.3 - 0.5 m/s). Compared to the discharge under flood conditions, additional discharges of associated water are minimal. It is also noted that most of these streams are ephemeral and the flood behaviour is rapid and large. The small proportion of the stream channel occupied by associated water discharges is unlikely to significantly reduce flood carrying capacity and hence unlikely to alter the frequency of flood events and associated erosion.

6.5.4.4 Soils and Geology

Soil types are largely influenced by the underlying geology and whether they occur in an erosive environment or a depositional environment. Soil types in the area are typically weathered sandstone, mudstone and sandy-clay.

Streams in the CSG field study area catchments are typically heavily incised due to the large episodic channel forming flows that occur during the wet season. For further information refer to Section 6.3.

6.5.4.5 Existing Water Quality

The QWQG specify guideline values for a range of indicators for the Central Coast region, which encompasses the Upper Dawson and Comet catchments. The Condamine-Balonne catchment falls within the Murray Darling region. There is considered to be insufficient data available in the Murray-Darling region for appropriate reference values to be derived, therefore, the QWQG default to the Australian Water Quality Guidelines published by ANZECC & ARMCANZ (2000) for all parameters.

Water quality information has been compiled and collected for the study area. Data sources included DNRW spot and continuous water quality data, QMDC community monitoring program, data collected by other consultants, and data collected during this EIS study (spot and continuous data). Water quality parameters collected during the EIS are provided in Table 6.5.4. Generally, the data available prior to the sampling undertaken during the EIS were limited in spatial coverage and appear to have been subject to variable quality control arrangements.

Table 6.5.4 Water Quality Parameters

Sampling Site	Water Quality Parameter
Condamine-Balonne	
Bungil Ck at Tabers[1]	EC, DO, pH, Turbidity, Temperature, TSS, TN, TP, calcium, chloride, fluoride, sodium, sulphate, boron, copper, iron
Yuleba Creek at Forestry[2]	Temperature, boron, TP, calcium, chloride, fluoride, magnesium, potassium, sodium, sulphate, alkalinity
Upper Dawson River	
Upper Baffle Creek[1]	Temp, EC, TDS
Lower Baffle Creek[2]	Temp, EC, TDS
Dawson R d/s Baffle Ck[2]	Temp, EC, TDS
Dawson R at Yebna Crossing[2]	Temp, EC, TDS
Dawson R at Utopia Downs[2]	Temp, pH, DO, EC, TDS, TSS, Na, K, Mg, Ca, HCO_3, Cl, F, SO_4, TN, TP, NH_4, NO_3, B, Cu
Dawson R at Taroom[2]	Temp, EC, TDS
Comet Catchment	
Comet River at Comet Weir*	EC, DO, pH, Turbidity, Temp
Comet River d/s Rolleston	EC, DO, pH, Turbidity, Temp
Meteor Creek	Temp
Planet Creek	Temp
Brown Creek	EC, Temp
Carnarvon Creek at Ingelara	EC, pH, Temp

Note:
[1] upstream of associated water discharges
[2] downstream of associated water discharges

A full description of the water quality data is provided in Appendix O1. This data suggests that:

- The majority of waters sampled fall in the 6.5 - 8.5 pH range, which is consistent with the protection of all environmental values. However, some pH readings around 9.0 were observed. These readings are slightly higher than recommended for recreation and drinking water supply, but are still consistent with the protection of irrigation use.
- All systems are subject to significant dissolved oxygen (DO) sags, which correspond with the high levels of chemical and biological oxygen demand measured. The observed DO levels are well below those recommended for recreation, drinking water supply or the maintenance of aquatic ecosystems.
- All catchments are subjected to a wide range of electrical conductivity (EC - a surrogate for salinity) over time and space. However, most streams typically have EC consistent with the recommended trigger level (340 μS/cm).
- Sodium is normally found in the range 30 - 40 mg/L which is well below the trigger values for irrigation, recreation or drinking water supply. There is no trigger value for the protection of aquatic ecosystems.
- Chloride has a wider range in the Condamine - Balonne system (1 - 40 mg/L) compared with the Upper Dawson and Comet-Brown catchments (10 - 20 mg/L). All chloride concentrations are below the recommended trigger values for irrigation, recreation and raw water drinking water supply. There are no trigger values for stock watering or the protection of aquatic ecosystems.
- Fluoride concentrations are usually below the recommended trigger levels for stock, irrigation and drinking water supply. There are no trigger values for the protection of aquatic ecosystems or for recreation.

- Boron concentrations are usually below the recommended trigger levels for the protection of all environmental values (aquatic ecosystems, stock, irrigation, recreation and drinking water supply).
- Surface waters across all catchments are nutrient enriched (eutrophic) with concentrations of nitrogen, phosphorus, and ammonia above recommended trigger levels for the protection of aquatic ecosystems.
- Turbidity and suspended solids concentration are orders of magnitude above the recommended trigger values for the protection of aquatic ecosystems.
- At least 25 % of all samples have copper concentrations higher than the relevant trigger value for the protection of aquatic ecosystems, but substantially lower than the trigger values for stock watering, irrigation, recreation and the taking of raw water for drinking water supply.
- Iron concentrations are often well above the recommended trigger levels for irrigation, recreation and the taking of raw water for drinking water supply.
- Zinc concentrations regularly exceed the trigger level for the protection of aquatic ecosystems across all catchments. The observed maximum concentration is below the trigger levels for stock watering, irrigation, recreational use and the taking of raw water for water supply.
- Lead concentrations are above the trigger level for the protection of aquatic ecosystems in approximately 50 % of samples. However, the maximum recorded lead concentration is well below the relevant trigger levels for stock watering, irrigation, recreational use and the taking of raw water for water supply.

6.5.5 Potential Impacts and Mitigation Measures

The potential impacts associated with construction, commissioning, operations and decommissioning activities associated with the CSG fields have been identified. Mitigation and management measures have been developed to reduce them to a level that does not significantly impact upon the surrounding environmental values. These impacts and mitigation measures are summarised in Table 6.5.5. Impacts and mitigation measures for associated water are in Section 6.7.

Using the protocols developed under this EIS for Phase 2 (post EIS) processes, consideration will be given to site specific surface water management, as part of the site specific development of the CSG fields.

The appropriate management/mitigation measures are included in the relevant surface water EMP for the CSG fields (refer to Section 11).

The implementation of a water quality monitoring program to assess impacts and effectiveness of mitigation measures to water quality is proposed. The installation of automatic monitoring stations and telemetry downstream of works within watercourses will be considered. Additionally, the testing of grab water samples will be conducted on a regular or “as need” basis (for instance after storms) to ensure that the peaks are established.

6.5.5.1 Cumulative Impacts

Section 1 identifies other CSG development projects planned for the surrounding region. Some of these projects are up to 100 km from the GLNG Project CSG field areas and some may be within the GLNG Project future development (FD) area. There is limited information available as to the planned development of those projects or the quantity and timing of the development of the wells or associated infrastructure; however, a qualitative assessment can be made of the possible cumulative impacts.

Santos will develop the CSG fields in accordance with the EIS. There will be no other development by other petroleum producers in the tenements described in the CSG fields. Infrastructure impacts will not exceed those stated in the project description.

It is however, possible that other companies may develop CSG facilities within the CSG fields FD area as part of their planned CSG development projects in addition to the existing CSG domestic supply facilities.

This will mean that there will be more CSG development in the FD area than the Santos project. As an area is developed, the number of wells will increase, but the spacing of wells will not intensify.

Cumulative impacts of these activities will potentially occur from operational activities, such as vehicular traffic and infrastructure development. This may be especially exacerbated at creek crossings, impacting upon surface water environmental values. Increases in the volume of associated water managed at the surface will also increase the risk of impacts to surface waters from uncontrolled discharges.

It is expected that the other CSG field development projects would include some or all of the proposed mitigation measures in relation to surface water impacts described in this section. By utilising these mitigation measures, it is anticipated that there will be a minimal cumulative impact on the surrounding environment.

Table 6.5.5 provides a summary of potential surface water impacts and mitigation measures for the CSG fields.

Table 6.5.5 Potential Surface Water Impacts and Mitigation Measures

Aspect	Potential Impact	Mitigation Measures	Objective
Construction			
Erosion and Sediment Mobilisation.	Sediment from earth moving and stockpiling may enter surface water runoff or be blown by wind and discharge to watercourses.	• Undertake monitoring and maintenance programs as required. • Develop, implement and maintain a stormwater management plan following site impact assessment process. This may include: – Erosion control and energy dissipation, – Stormwater controls and upstream treatment, – Stabilisation techniques; – Appropriate scheduling of construction activities during wet season; – Crossings (pipelines and bridges) to be as close as possible right angles to direction of flow; – Stockpiling of topsoil located away from watercourses; – Vehicle wash bays to be located away from watercourses; – Minimise vegetation disturbance; and – Routine inspection. • Identify and avoid other environmentally sensitive areas (e.g. highly erodible soils etc). • Develop and implement a water quality monitoring program during the planning phase, including telemetry and event based grab water samples, to further refine mitigation measures.	Minimise erosion and sediment release.
	Seismic survey causing ground disturbance, resulting in erosion issues.	• Use methods that will result in minimal impact to the environment (e.g. Vibroseis method).	
Pollution.	Oily waste water (from miscellaneous plant and equipment wash water);	• All fuel, oil and chemical storage facilities to be bunded. • All industrial waste storage tanks to be bunded.	Ensure contaminants do not enter watercourses.

Aspect	Potential Impact	Mitigation Measures	Objective
	Contaminated runoff from chemical storage areas; Potentially contaminated drainage from fuel oil storage areas; Oil-filled transformer yard areas and general washdown water. Diesel and other petroleum-based fuels and lubricants used by excavation and construction machinery. Environmental and public health and safety issue.	• Bunds to be inspected regularly for evidence of leakage. • Spills to be reported and immediately contained. • Contaminated soil to be removed and remediated. • Contaminated water (e.g. stormwater in bund) to be treated. • All vehicles, plant and equipment to be checked regularly for integrity of fuel tanks. • Monitoring and maintenance programs to be undertaken as required. • Spill cleanup kits (AS1940 and AS3780) to be located in convenient locations and in all vehicles on site. • Refuelling to occur in bunded areas away from watercourses (> 50 m).	
Drill mud spillage and seepage	Mud may enter watercourses and increase turbidity and sediment loads.	• Develop, implement and maintain a drilling procedure. • Ensure as far as practicable that mud is contained and disposed of as per a waste management plan should a spill occur, (see Appendix K).	Ensure drill mud does not enter watercourses.
Improper disposal of all operational wastes.	Litter and other operational waste can be washed into watercourses during rain events and impact receiving waters.	• Develop, implement and maintain waste management plan (Appendix K).	Ensure control of litter and construction wastes appropriately.
Works adjacent to/within drainage lines/watercourses.	Vehicle access crossings can alter flow characteristics. Pipeline installation across watercourses can alter flow characteristics.	• Divert watercourse either by low flow diversion or coffer dam with pumping. • Implement suitable stormwater management infrastructure and control measures before construction activities that may affect existing drainage channels commence. • Design vehicle crossings adequately for all likely flow conditions, perhaps incorporating under road drainage.	Ensure works adjacent to/within drainage lines and watercourses do not alter flow characteristics.
Flooding.	Possibility of out-of-bank/flash flood rainfall event during construction, causing erosion	• Schedule construction activities appropriately during wet season to reduce flooding risk.	Manage risk of out-of-bank/flash flooding.

Aspect	Potential Impact	Mitigation Measures	Objective
	and damage to erosion and sediment control infrastructure.	• Install stormwater management facilities e.g. drainage diversions and bunding. • Facilitate emergency response procedures and flood forecasting.	
Lack of water supply.	Inadequate dust suppression, soil compaction and washdown.	• Develop, implement and maintain an environmental management plan to include water supply management.	Ensure an adequate amount of water is available during the construction phase.
Spillage from containment dams (for a detailed review of impacts relating to containment dams, refer to Section 6.7, Table 6.7 and Appendix Q).	Uncontrolled release of associated water contained in dams contaminating surface water, shallow groundwater and soils.	• Install compacted clay liners or HDPE liners to restrict infiltration. • Locate dams above the 1 in 100 year flood level and away from sensitive watercourses.	Minimise chance of associated water entering watercourses and infiltrating into the ground.
Commissioning.			
Lack of water supply.	Insufficient water to undertake hydrostatic testing.	• Develop an Environmental Management Plan (EMP).	To ensure an adequate amount of water is available for hydrostatic testing in the commissioning phase.
Use of local water sources.	Decreasing environmental flows.	• Develop and implement an EMP, including licenses required to extract water.	Ensure the use of local water does not decrease environmental flows.
Disposal of water.	Improper disposal of water used in hydrostatic testing - impact surrounding environment and receiving waters (quantity and quality).	• Develop and implement water management procedures.	Ensure water is disposed of in the proper manner.

Aspect	Potential Impact	Mitigation Measures	Objective
Operation.			
Erosion and Sediment Mobilisation.	Permanent structures and minor earth disturbance can result in localised erosion and sediment mobilisation leading to deleterious effects on water quality and aquatic habitats.	• Develop a stormwater management plan to include: – Localised erosion control and energy dissipation measures; – Stabilisation techniques, i.e. revegetation; • Routine inspection and maintenance of existing erosion and sediment control measures.	Ensure sediment does not enter watercourses.
	Erosion resulting from rainfall runoff from roofed buildings (offices, compressors, kitchens, accommodation).	• Capture runoff captured by guttering then pipe systems that discharge to designated seepage areas. • Reduce water velocities at discharge points with rock and concrete pads etc to minimise erosion.	Ensure sediment does not enter watercourses.
	Runoff at unsealed sites and lay down areas where traffic areas are unsealed and flat.	• Design surface runoff flows to flow to adjacent grass areas at low velocities.	Ensure runoff from unsealed sites does not enter watercourses.
Incomplete rehabilitation.	Erosion and movement of sediment. Turbid and sediment laden runoff into watercourses.	• Develop, implement and maintain a Rehabilitation Plan.	Ensure sediment does not enter watercourses.
Pollution.	Diesel and other petroleum-based fuels and lubricants used by operational vehicles and machinery entering watercourses.	• Refer to the construction section above.	Ensure contaminants do not enter watercourses.
Improper disposal of all operational wastes.	Litter and other operational waste can be washed into watercourses during rain events and impact receiving waters.	• Refer to the construction section above.	Ensure litter and construction wastes are disposed of appropriately.
Discharge of associated water to watercourses (for a detailed	Alteration of the flow regime by introducing additional flows, potentially changing long term stream morphology and	• Employ beneficial reuse options such as irrigation, re-injection, stock watering and evaporation should wherever practicable. • Treat water to background levels prior to discharge to surface waters.	Minimise environmental impacts on the surface water environment.

Aspect	Potential Impact	Mitigation Measures	Objective
review of impacts relating to containment dams, refer to Section 6.7, Table 6.7 and Appendix Q).	sediment and erosion patterns; Alteration of riparian vegetation and aquatic species through increased/altered environmental flows and differences in water quality; Localised erosion and scour at the point of discharge, if suitable controls are not put in place.	• Limit discharge to grade to flow periods only or at downstream locations where sufficient baseflow exists. • Establish water quality and river health monitoring program to detect environmental change outside of agreed limits (physical, chemical and biological change). • Introduce inspection and water quality sampling at the location of discharge and up to two kilometres downstream. • Implement erosion controls at the point of discharge.	
Flooding.	Possibility of out-of-bank/flash flood rainfall event causing failure of erosion and sediment control infrastructure.	• Monitor and maintain erosion and sediment control features. • Develop and implement emergency response procedures and flood forecasting.	Manage the risk of out-of-bank/flash flooding.
Decommissioning			
Ground disturbance during above ground infrastructure removal.	Erosion and mobilisation of sediment, potential adverse impact to water quality.	• Implement and maintain a decommissioning EMP. • Apply sediment and erosion control measures prior to earth moving activities commencing.	Ensure sediment does not enter watercourses.
Use of local water sources.	Decreasing environmental flows.	• Develop and implement an EMP and water supply strategy, including licenses required to extract water.	Ensure the use of local water does not decrease environmental flows.
Pipeline failure.	Discharge of water to environment.	• Develop, implement and maintain an appropriate purging procedure.	Minimise impact of pipeline failure on environment.
Incomplete rehabilitation.	Erosion and movement of sediment, potential adverse impact to water quality.	• Develop a Decommissioning Management Strategy (including replanting of riparian and other erosion sensitive zones) during phase 2 planning approach.	Ensure sediment does not enter watercourses.

6.5.6 Summary of Findings

In summary, the baseline assessment has indicated that the existing water quality of surface streams across the CSG field study area catchments is variable, with surface waters frequently not meeting the water quality guidelines specified for the protection of aquatic ecosystems. The results suggest a considerable influence of regional land clearing and stock access on water quality (particularly nutrients).

Potential impacts from CSG field development result from a number of activities, including gas well development, road and pipeline construction and minor infrastructure development such as workforce accommodation facilities and laydown areas.

The investigation considers that the impacts associated with the development of the CSG fields for the GLNG Project could be appropriately managed by implementing a range of mitigation measures including various construction techniques, operational procedures and planning tools.