EMGA | MitchellMcLennan

Response to Submissions

Modification to DA 183-8-2004i

Prepared for AGL Upstream Investments Pty Ltd | 17 February 2012

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Response to Submissions

Final

Report RP2 | Prepared for AGL Upstream Investments Pty Ltd | 17 February 2012

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1 Introduction

1.1 Background

The Camden Gas Project (CGP) is a major coal seam methane gas project within the Southern Coalfields of the Sydney Basin, owned and operated by AGL Energy Limited (AGL). The CGP currently comprises over 142 wells, low pressure gas gathering lines (GGL), access roads, the Rosalind Park Gas Plant and a high pressure gas sales pipeline.

Development consent 183-8-2004-i was granted for the Harness Racing Drilling Program of the CGP in 2004 by the NSW Minister Assisting the Minister for Infrastructure and Planning (Planning Administration) under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This consent granted drilling and connection of 15 coal seam methane wells to the previously approved Rosalind Park Gas Plant and for the production of coal seam methane from these wells.

An Environmental Assessment (EA) report was prepared in October 2011 to assess an application for a modification to this development consent. The proponent of the modification is AGL Upstream Investments Pty Ltd, a subsidiary of AGL. The proposed modification is for the addition of a production well, MP25 (the well), associated GGL for connection to Rosalind Park Gas Plant for distribution of gas, and associated minor works associated with construction access.

The proposed location of the new well is on the existing site layout/pad location for gas well MP16 and is approximately 400 m west of another gas well (MP17) (see Figure 1.1).

Figure 1.2 shows the local context of the site, including the other existing gas wells approved with the development consent.

The modification EA was lodged for adequacy review with the Department of Planning and Infrastructure (DP&I) in late September 2011. Following receipt of comments from the DP&I in early October 2011, the EA was amended to include further information on the description of the compounds for MP16 and MP25, access from Menangle Road and additional details on the plans within the document.

The final EA was lodged with DP&I on 18 October 2011 under section 75W of the EP&A Act. As the proposed activities utilise the existing drill pad and are located within previously disturbed areas and agreements were in place with the landowner, the proponent understands that DP&I determined not to publicly exhibit the EA because there is no mandatory requirements to do so having regard to the circumstances and nature of the proposed modification. Subsequently, the EA was distributed by DP&I to relevant state government agencies and Council for comment. These agencies and Council have provided correspondence to DP&I raising matters regarding the proposed modification.

Subsequent to receipt of comments from agencies and Council, the proponent undertook a design review of the proposed activities. This design review identified opportunities for some efficiencies regarding the proposed modification which are addressed in this report. These include:

- revision of the construction site layout, which is discussed in Section 5, to account for proximity to the Nepean River and ecological values of the adjacent land; and
- addition of 'twinned' GGL between MP16 and MP13/30, which is discussed in Chapter 6, within an existing GGL route along an access track.

1.2 Purpose and structure of this report

This response to submissions report has been prepared in accordance with section 75H(6) of the EP&A Act and considers the matters raised in the agency and Council submissions received. Chapter 2 provides a summary of the matters raised by the agencies and Council. The matters raised predominantly relate to groundwater and surface water impacts and these are addressed in Chapter 3 and in Chapter 4, respectively. Other matters, inclusive of an ecological assessment, are then addressed in Chapter 5.

Chapter 6 of this report provides an environmental assessment of the addition of the 'twinned' section of GGL between the existing wells of MP16 and MP13/30. It should be noted that the well surface location of MP13/30 (refer to Figure 1.1) contains two production wells, known as MP13 and MP30 approved under DA 183-8-2004i. This report will refer to the well surface location as MP13/30.

Integrated Design Solutions | 030562 RS, Camden Gas Project: MP25 modification to DA 183-8-2004i Rev A - 18 Jan 2012

Aerial Imagery : NearMap May 2010

EMM

Existing wells and proposed well within DA183-8-2004i

Response to submissions, Camden Gas Project: MP25 modification to DA 183-8-2004i

Figure 1.1

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Aerial Imagery : @ Microsoft BingMap

Integrated Design Solutions | 030562 RS, Camden Gas Project: MP25 modification to DA 183-8-2004i Rev A - 18 Jan 2012

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Local context

Response to submissions, Camden Gas Project: MP25 modification to DA 183-8-2004i

Figure 1.2

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2 Matters raised

2.1 Overview

The EA was distributed by DP&I to the following agencies and landowners (totalling nine recipients of the documentation):

- NSW Office of Water (NOW);
- Division of Resources and Energy (DRE) (within the Department of Trade and Investment, Regional Infrastructure and Services (DTIRIS));
- NSW Office of Environment and Heritage (OEH);
- NSW Roads and Maritime Services (RMS);
- Sydney Catchment Authority (SCA);
- NSW Heritage Office (part of OEH);
- Council; and
- NSW Harness Racing Club Ltd.

A total of six submissions were received. The state government agencies which provided submissions on the EA comprised RMS, SCA, DRE, NOW, and OEH. Council also provided submissions on the EA.

RMS had no objections to the proposal. SCA had no comments on the proposal.

The matters raised by the agencies and Council are summarised below, with a reference to the section of this report in which they are addressed.

It is also important to note that during the preparation of this response to submissions report that both OEH and NOW were consulted regarding groundwater matters, and the items raised within their submissions. Both of these agencies had positive responses in regards to the additional information to be provided within this report.

Table 2.1 Summary of matters raised by agencies and Council

Body	Aspect	Matter raised	Where addressed in this report
NOW	Groundwater	Provide information on the existing groundwater in the vicinity of the well	Section 3.1
		Bore construction to be undertaken by a driller holding a water drillers licence	Section 3.6.1
		Provide discussion on the expected extracted volumes and whether this is within the existing entitlements held by AGL	Section 3.6.2

Table 2.1 Summary of matters raised by agencies and Council

Body	Aspect	Matter raised	Where addressed in this report
		Discuss the need for an aquifer interference approval prior to the commencement of drilling	Section 3.6.3
OEH	Justification	Provide justification why MP16 cannot satisfy demand for energy supply and security	Section 5.3
	Consolidation of consents	OEH requested that the proponent consider consolidation of the development consents for the CGP	Section 5.8
	Groundwater	Design and construction information and measures to ensure integrity	Section 3.3.3
		Management controls to prevent pollution of groundwater resources	Section 3.4
		Details of hydraulic fracturing	Section 3.4.1
		Describe the regional groundwater system	Section 3.1
		Identify and characterise potentially affected groundwater resources and values that require protection (ie GDEs, bores, etc)	Section 3.3.2
		Describe transmissivity, flow rate, hydraulic conductivity and directions of flow of groundwater resources	Section 3.1
		Describe any barriers and connections between target formations and groundwater resources	Section 3.1.7
		Quantify and characterise any proposed extraction of groundwater	Section 3.2
		Assess impact of extraction or interference on existing groundwater resources	Section 3.3
		Mass balance estimating concentrations and absolute masses of chemicals that will be reacted, returned to surface or left in the hole	Section 3.4.2
		Risk assessment of chemicals used and any associated impacts as a result of drilling and gas extraction	Section 3.4.2 and 3.4.3
		Details of groundwater monitoring programs	Section 3.5
		Details of contingency measures	Section 3.4
	Environment Protection Licence (EPL)	Explain how existing EPL No 12003 has been taken into account in relation to the development	Section 5.4
	Consultation	Provide details on community consultation	Section 5.2
	Cumulative impacts	Provide details on potential cumulative impacts on the surrounding environment	Section 5.7
Council	Groundwater	Existing baseline data on groundwater resources is inadequate	Section 3.1.1
		The current extent of groundwater monitoring is inadequate	Section 3.5
		AGL should hold discussions with NOW regarding the need for an aquifer interference approval prior to the commencement of drilling	Section 3.6.3
		Provide detail on previous groundwater studies and investigations currently being undertaken by the proponent	Section 3 and Appendices A and B
		Provide more detail on impacts on groundwater sources	Section 3.3

Table 2.1 Summary of matters raised by agencies and Council

Body	Aspect	Matter raised	Where addressed in this report
		associated with coal seam gas extraction activities	
	Water resources	A moratorium should be placed on any new wells until conclusive evidence emerges that coal seam gas mining does not damage groundwater or surface water resources	n/a
	Surface water	Provide detail on distance between the site and the highest bank of the Nepean River, to determine whether the activity should be controlled under the NSW *Water Management Act 2000*	Section 4.2
		Use of lined pits contravenes NSW government prohibition on use of evaporation ponds as part of coal seam gas projects and is contrary to advice provided by AGL representatives at meetings of the Camden Gas Community Consultative Committee; the construction of the pits could result in salinity impacts to the Nepean River and surrounds	Section 4.5
		Provide more detail on potential impacts to downstream users	Section 3.3.2 and 4
		Assess implications of stockpiling of fill within the floodplain	Section 4.3
	Consistency with modification requirements under the EP&A Act	The proposal cannot be modified under section 96 of the EP&A Act	Section 5.5
	Ecological assessment	Provide more detail on potential impacts on the overall ecological health of the Nepean River within a catchment context, particularly impacts associated with sediment loss, salinity, stormwater flow, flooding and groundwater contamination	Section 5.6
		Provide more detail on mitigation measures	Section 5.6
		Provide a detailed flora and fauna assessment including targeted surveys, assessment of impacts on terrestrial, aquatic and riparian ecology, and with reference to the OEH threatened species assessment guidelines	Section 5.6 and Appendices D and E
	Public consultation	The level of consultation with the Camden Gas Community Consultative Committee during preparation of the EA was inadequate	Section 5.2
DTIRIS		Final rehabilitation	Section 5.1
		Conceptual final landform plan	Section 5.1

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3 Groundwater

3.1 Existing environment

3.1.1 Baseline information and context

The proponent is currently working closely with Environment Protection Authority (EPA) (part of OEH) and NOW to further develop the management and monitoring regimes for groundwater and surface water within the CGP area.

This includes a recent amendment of the CGP Environment Protection Licence (EPL) No 12003 to include pollution studies and pollution reduction programs (PRPs). These PRPs include requirements for the development of a Groundwater Management Plan (GMP) (refer to Section 3.5) and the undertaking of additional groundwater modelling and technical investigations into groundwater attributes and risks associated with hydraulic fracturing. The GMP is also being prepared as a condition of bore licence for the CGP area. These studies will enhance baseline data resources for future applications within the CGP. The sections below provide a description of the existing environment based on recent studies, data collation and ongoing monitoring results within the CGP.

3.1.2 Geology

The whole of the CGP is located within the Southern Coalfield of the Sydney Geological Basin. The Sydney Basin is sedimentary in origin and the deposition of sediments occurred from the early Carboniferous (290 million years ago) through to the latter part of the Triassic (200 million years ago). The Sydney Basin on-laps (or overlaps) the Lachlan Fold Belt to the west and south, with basin depth increasing to the north and east.

The geological strata of the southern Sydney Basin (from youngest to oldest) can be summarised as:

- unconsolidated alluvial deposits along the major rivers (Tertiary and Quaternary in age);
- fractured volcanic intrusive and flows (and associate dyke swarms and occasional sills) (Jurassic and Tertiary in age);
- sedimentary rocks (including substantial coal measures at depth) (Permian and Triassic age); and
- fractured basement rocks (Palaeozoic age).

In the vicinity of proposed MP25 well surface location, alluvial sediments (sand, gravel, silt and clay) overlie the Wianamatta Shales and Hawkesbury Sandstone close to the Nepean River. At this location these alluvial sediments are approximately 20 m thick. As it is not specifically recorded in the MP16 and MP17 geological logs, it can be inferred that the underlying Wianamatta (Ashfield) Shale is relatively thin (or may not even exist) at the base of the alluvium.

The Triassic Hawkesbury Sandstone has a thickness of approximately 150 m in this area, and is generally medium to coarse grained quartz sandstone, with interbedded siltstone, finer grained sandstone and shale lenses. Underlying the Hawkesbury Sandstone are Triassic and Permian sandstones and claystones. The Permian coal measures are the Illawarra coal measures, located about 570 m below ground level (bgl) and approximately 200 m thick, according to well logs from nearby wells. It is proposed that MP25 target the Bulli seam within the Illawarra coal measures for the extraction of coal seam gas.

3.1.3 Regional groundwater system

Table 3.1 below lists some hydrogeological properties for the local stratigraphic units for the Sydney Basin (PB 2011a). A schematic model for the stratigraphy of the CGP area is provided in Appendix C of this report (PB 2011b).

Table 3.1 Hydrogeological properties for stratigraphic units (SCA (2005) and PB (2011a))

Stratigraphic unit	Approx. depth to top of unit (m)	Approx. Thickness (m)	Hydrogeological unit	Hydraulic conductivity (m/day)	Transmissivity (m^2/day)
Alluvial deposits	0	20	Unconfined aquifer	1 – 10	-
Wianamatta Group	20	<20	Unconfined/perched aquifer	0.01 – 0.1	4<1 (Ashfield Shale)
Hawkesbury Sandstone (including the Newport and Garie Formations)	30	150	Unconfined/semi-confined aquifer	10^{-3} – 70	1 – 5
Bald Hill Claystone	180	40	Aquitard	10^{-5} – 10^{-4}	-
Bulgo Sandstone	220	280	Minor confined aquifer	10^{-4} – 10^{-1}	0.1 – 0.5
Stanwell Park Claystone	500	5	Aquitard	10^{5} – 10^{-4}	-
Scarborough Sandstone	505	55	Minor confined aquifer	-	0.1 – 0.5
Wombarra Claystone	560	10	Aquitard	10^{-5} – 10^{-4}	-
Illawarra Coal Seams	570	200	Confined 'aquifer' (typically water bearing zones rather than aquifers)	10^{-3} – 10^{-2}	0.005 – 0.105

Thin Tertiary and Quaternary alluvial deposits occur in valleys, creeks and river beds across the region. The alluvial deposits are generally shallow, discontinuous and relatively permeable. They typically have transmissivities (ie the rate at which groundwater flows horizontally through an aquifer) in excess of 20 m^2/day. Alluvial aquifers are responsive to rainfall and stream flow and are a localised beneficial aquifer across the region. The Wianamatta Group shales are characterised by saline groundwater due to marine deposition, and are not considered beneficial aquifers. The Ashfield Shale (within the Wianamatta Group) has a transmissivity of < 1 m^2/day.

The Hawkesbury Sandstone is a dual porosity aquifer system that occurs across the whole of the Sydney Basin. It is the major aquifer across this region. Groundwater flow is variable throughout the sandstone, and is generally dominated by secondary porosity and fracture flow associated with structures such as faults and fracture zones. The primary porosity of the rock matrix is low, and a bore that does not intercept major fractures or fissures is likely to yield less than 2 litres per second (L/s) in this area. Transmissivity for the Hawkesbury Sandstone is typically 1 to 5 m^2/day. Water quality within the upper sections of the Hawkesbury Sandstone is often poorer than the lower sections due to leakage from the overlying shale formations.

The sandstone formations within the Narrabeen Group below the Bald Hill Claystone (predominantly the Bulgo Sandstone and the Scarborough Sandstone) are considered minor aquifers. These formations are generally considered to be much lower yielding and of poorer water quality then the overlying Hawkesbury Sandstone. Transmissivities of thin sandstone aquifers within the Bulgo Sandstone of the Narrabeen Group are low and expected to be around 0.1 to 0.5 m^2/day.

Coal seams, such as those present in the Illawarra coal measures, generally form minor water bearing zones. Groundwater associated with coal seams is generally poor in quality, with moderate to high salinities. Negligible yields and poor water quality characterise these coal measures so it is not considered to be a beneficial aquifer.

The permeability (ie the ability of a porous material to allow fluids to pass through it) of the coal seams within the Illawarra coal measures is quite low. The Bulli seam has a permeability range of between 1 to 10 millidarcies (approximately equivalent to a hydraulic conductivity of 0.001 to 0.01 m/day), with an average of 5 millidarcies (0.005 m/day), the Balgownie seam has a permeability range of about 1 to 3 millidarcies, and the Wongawilli seam has a permeability of less than 1 millidarcy. These permeabilities convert to transmissivities of between 0.005 and 0.05 m^2/day, which is considered to be very low.

The groundwater resource in the regional area is characterised by low yields from the Hawkesbury Sandstone, Bulgo Sandstone, and alluvium, with generally variable water quality. It is predicted that any future groundwater exploitation (ie for beneficial use) will be from the shallower sandstone aquifers on a relatively minor scale and that nearby (and future) urban developments will be serviced by reticulated water supplies.

The following aquifer systems are identified in the vicinity of the proposed MP25 well surface location:

- shallow alluvial aquifer system;
- Hawkesbury Sandstone (including Newport and Garie Formations) aquifer system;
- Narrabeen Group aquifer system (minor); and
- Illawarra coal measures (water bearing zones rather than aquifers).

On a local basis, it is considered that these aquifer systems have similar groundwater characteristics to those described above.

3.1.4 Water levels

Water table levels in the alluvial aquifers tend to be less than 6 m bgl. In the Hawkesbury Sandstone, water levels depend on topography and consequently at low sites (such as at the proposed MP25 well surface location) the water level is expected to be around 15 m bgl. Deeper water levels are expected in the Bulgo Sandstone aquifers but there is no available local data.

As stated previously, coal seams at depth are water bearing zones rather than aquifers and in its natural state are saturated. In order to initiate and maintain gas flow from coal, this water must continuously drain from the coal seam. Dependent upon conditions, initial produced water can be significant but the rate will decrease quickly over a 6 to 12 month period to as little as zero flow in some cases. It should be noted that produced water is formation water brought to the surface, which is water that occurs naturally within the pores of rock.

To maximise gas production from coal seam gas wells, the water level in the well must be kept below the lowest producing coal seam. Because coal seams are usually relatively shallow, low pressure formations, it aids gas production to pump water from coal seam gas wells continuously or intermittently to minimise and maintain the lowest bottom-hole pressure and allow gas to flow into the well. In summary, the producing seams are generally flowing at very low pressure and the operational water levels are just above or within the perforated interval (for a vertical well) and the open horizontal section (for a surface to in-seam (SIS) well). As stated in the original EA, the proposed MP25 is to be drilled as a SIS well.

There are currently no dedicated water level monitoring bores across the existing CGP area. However, the proponent is in discussions with NOW and OEH and it is planned to implement a groundwater level monitoring network in the Hawkesbury Sandstone aquifers commencing in 2012/13 as part of the GMP. It should be noted that water levels are rarely monitored in gas production wells because of the nature of the internal tubing, pumping equipment, and required American Petroleum Institute (API) standard wellhead configuration designed to ensure minimal effects on water levels.

Through regular consultation processes between the proponent and the owners of private water bores located in the south of the CGP (within the Razorback well field), it has been reported that there has been no observable change in water levels within their water bores (which are targeting water from the shallower aquifers) since the commencement of gas production in 2002. Similarly, an AGL-owned water bore used for agricultural purposes within the vicinity of the Loganbrae and Kay Park wells (ie within 5 km of the proposed MP25 well surface location) constructed in 2002, has not had any change in water levels.

3.1.5 Water quality

The groundwater quality in aquifer systems underlying the CGP area is highly variable, with salinities ranging from fresh (below 500 µS/cm) to slightly salty (up to 10,000 µS/cm), with the most saline groundwater generally occurring in the deeper Permian coal seams. While it is typical for groundwater quality to decline with depth reflecting increasing residence time of the groundwater, the available data does not show a clear systematic depth-quality relationship in this area (most probably due to the marine origin of the Wianamatta Shales and residual connate salts at shallow depth).

In particular there is a wide range in reported salinity in the Hawkesbury Sandstone aquifer and it tends to be more brackish than encountered in other areas of the southern Sydney Basin. Overall, the quality of the water within the coal seams is considered poor and is generally salty (up to 23,700 µS/cm), and averaging slightly salty with values around 9,000 µS/cm. It should be noted that beneficial aquifers in the area produce water with a range of salinity from fresh to slightly saline. Water produced from the Hawkesbury Sandstone shows a range of salinity levels mostly between 700 µS/cm and 8,000 µS/cm (PB, 2011a, and SCA, 2005, and Appendix A). The higher salinity waters within the Hawkesbury Sandstone tend to be associated with saline seepages from the overlying shale.

The nearby MP17 gas well is part of the dedicated water quality monitoring network already in place for the CGP. Formation water within the coal seams has a salinity of around 6,000 to 7,000 µS/cm at this location. Results from recent analyses of the produced water are shown in Appendix B. Further information relating to the groundwater monitoring within the CGP is provided in Section 3.5.

3.1.6 Conceptual groundwater model flow systems and connectivity

A study of the conceptual model for groundwater flow within the CGP area (PB 2011a) shows that on a regional scale, recharge of groundwater is from a number of sources, with these being rainfall infiltration in rock outcrop areas, through-flow from the major recharge areas to the south, and minor infiltration of river water in some areas, and also by minor inter-aquifer leakage.

Within the local area there is rainfall and river recharge to the alluvial sediments associated with the Nepean River, with very limited rainfall recharge to the Wianamatta Groups shales with most rainfall generating stormwater runoff. There is some minor leakage through the Wianamatta Group down into the Hawkesbury Sandstone aquifer, however most recharge to the sandstone aquifers is expected to occur via lateral groundwater through-flow from up-gradient and up-dip areas located to the south.

Flow occurs within the individual aquifers and there does not appear to be any interaction between the Hawkesbury Sandstone aquifers and the deeper water bearing zones in the Narrabeen Group and the Illawarra Coal Measures, which are the subject of the proposed gas extraction for MP25.

On a regional scale groundwater levels and flows will be largely controlled by the basin geometry, topography and major hydraulic boundaries. In the southern Sydney Basin, groundwater flow is predominantly towards the north or north-east (ie down-dip), eventually discharging via the Georges and Hawkesbury River systems, and ultimately also off shore to the east.

3.1.7 Confining layers and barriers

All aquifer systems are separated by low permeability aquitards. The following claystones (and shales) act as confining layers and essentially separate/isolate the aquifers mentioned in Section 3.1.3 and Table 3.1:

- Ashfield Shale and Mittagong Formation (located above the Hawkesbury Sandstone and below the Bringelly Shale and alluvium) – in this area these formations separate the alluvial aquifers from the deeper sandstone aquifers.
- Bald Hill Claystone (located below the Hawkesbury Sandstone and above Bulgo Sandstone of the Narrabeen Group) – in this area, this formation separates the Hawkesbury Sandstone from any sandstone aquifers in the Bulgo Sandstone.
- Stanwell Park Claystone (located below the Bulgo Sandstone and above the Scarborough Sandstone, both of the Narrabeen Group).
- Wombarra Claystone (located below the Scarborough Sandstone and above the Coal Cliff Sandstone, both of the Narrabeen Group).

There are no specific test pumping data that demonstrate the degree of vertical connection between the Illawarra coal measures and overlying aquifer zones within the Narrabeen Group, Hawkesbury Sandstone and thin alluvial deposits. However, inferences can be drawn from studies nearby in the southern Sydney Basin, including impacts from longwall coal mining (see review by Merrick, 2009) and nearby groundwater resource investigations (eg KBR 2008; PB 2008; SCA 2005). Based on these previous studies it is concluded that the presence of extensive and thick claystone formations in the stratigraphic sequence that overlies the Permian coal measures in the area protect shallower aquifers in the Triassic sandstones.

3.2 Characterisation of produced water

OEH requested further information regarding the characterisation of any extracted groundwater. As stated previously, when MP25 is commissioned, the initial volume of formation water likely to be produced from the coal measures will decrease over time. The initial produced water volumes from MP25 are expected to be significantly less than 0.25 megalitres (ML) per year. Over time, these initial volumes are expected to progressively diminish to similar volumes currently experienced at nearby wells, MP16 (located on the same pad) and MP17 (located approximately 400 m to the east).

These low volumes of produced water reported during the commissioning of MP16 and MP17 and the latest two calendar years (ie 2010 and 2011) of production are shown in Table 3.2. This formation water will be extracted from storage within the coal seams of the Illawarra coal measures, which is naturally hydraulically separated from the shallow beneficial aquifers in the Hawkesbury Sandstone and surficial alluvial aquifers (refer to Table 3.1 and Sections 3.1.1, 3.1.2, 3.1.5 and 3.1.6). The extraction of this deep formation water will have no impact on shallow groundwater resources. Whilst no pumping tests can be performed during the commissioning of MP25 due to the cased and inclined nature of the SIS well, produced volumes will be monitored during the initial construction and ongoing operation of the well.

Further assurance is given by the successful dewatering of existing wells throughout the CGP area. The volume of produced water from each existing well is monitored and recorded on an internal database. This database shows a decreasing trend in produced water over time for each well (for example, as shown in Table 3.2, MP16 has produced negligible amounts of water in the last two years), which demonstrates the isolation of the targeted water bearing zone from other water bearing zones and aquifers in the vicinity.

Table 3.2 Volume of water produced MP16 and MP17 and CGP wellfield during the last two calendar years

Site	Volume of water produced per year (ML)			
	First year (2003)	**Second year (2004)**	**2010**	**2011**
MP16	0.441	0.081	0	0
MP17	0.449	0.073	0.008	0.004
Total CGP Wellfield			**2.873**	**2.742**

3.3 Discussion of potential impacts to existing groundwater resources

3.3.1 Beneficial aquifers

Within OEH's submission, further discussion regarding potential impacts of extraction or interference on the existing groundwater resources was requested. It can be expected that the extraction of coal seam gas and associated groundwater in the deeper Illawarra coal measures will lead to the depressurisation of the coal seam water bearing zones at depth for the duration of the gas extraction operations. Of key relevance to understanding the potential impacts to shallow groundwater resources, and surface water, is the degree to which the Illawarra coal measures are in vertical connection with overlying aquifer zones within the Narrabeen Group, Hawkesbury Sandstone and thin alluvial deposits. As discussed in Section 3.1.7, inferences as to the degree of this connection can be drawn from previous studies elsewhere in the southern Sydney Basin. Based on these studies it is considered that the presence of very low and thick permeability layers in the stratigraphic sequence that overlies the Permian coal measures in the area is likely to impede the vertical flow of groundwater to and from the subject coal measures. Therefore it is likely that overlying aquifer zones are hydraulically isolated, experiencing negligible drawdown impact related to depressurisation of the coal measures.

The only beneficial aquifers (used for water supply) across the CGP area are the shallow alluvial aquifers (where present) and the porous and fractured rock aquifers within the Hawkesbury Sandstone. Groundwater in these aquifers is used for stock, domestic, recreation and minor irrigation uses and is not used as a drinking water source. Most bores in the CGP area are test bores that appear never to have been converted to water supply bores.

It should be noted that the coal seams are not beneficial aquifers and are not being used as a water supply source. Even though they are depressurised and dewatered over a large area, and MP25 will contribute to this depressurisation in this area, there is no connectivity and hence there are no impacts on beneficial shallow aquifers and surface water within this area.

3.3.2 Groundwater resources and values

Within OEH's submission, further information on the characterisation of potentially affected groundwater resources and values that require protection, such as groundwater dependent ecosystems (GDEs) and bores, was requested.

There is one GDE (Riverflat Eucalypt Forest on Coastal Floodplains endangered ecological community (EEC); refer to Section 5.6 and Appendix D) growing adjacent to the existing MP16 compound and drill pad that is likely to be dependent on river baseflow from shallow aquifers in the region beneath and alongside the stream bed of the Nepean River, where there is mixing of shallow groundwater and surface water. However, as discussed in Section 3.3.1, no interaction between shallow aquifers in the riparian zone and the deep coal seams is anticipated.

Additionally, there would be no dependent ecosystems associated with the formation water of the deep coal seams as this groundwater is isolated from all other aquifers and water bearing zones and has no surface expression. Further information on the GDE is provided in Section 5.6.3 and Appendix D of this report.

Licensed private water bores within a 2 km radius of the proposed MP25 have been listed and mapped, along with their characteristics (refer to Figure 3.1 and Appendix A). A review of these bores indicated that most are test bores that appear never to have been converted to water supply bores. As stated in the previous section, there is no connectivity between the coal seams and the beneficial shallow aquifers, therefore no impacts to the supply of water from these bores is expected to result from the construction and operation of MP25.

3.3.3 Well integrity

Further information on the design and construction of the proposed well to ensure its integrity was requested by OEH. The well will target the Bulli seam, similar to MP16, for the extraction of coal seam gas.

With the construction and completion of this new gas well, it is important to ensure that there is no unnatural aquifer connectivity created in the vicinity of this location near the Nepean River. To ensure that the different groundwater systems remain isolated, the following is a brief outline of the well specifications for MP25:

- conductor casing will be installed a couple of metres deeper than the base of the alluvium (approximately 18 m bgl), which is likely to be around 20 - 25 m bgl;
- surface casing will be installed and pressure cemented, to isolate the upper aquifers, to at least the base of the Hawkesbury Sandstone and most likely the top of the Bald Hill Claystone which acts as part of the protective barrier between the Hawkesbury Sandstone and the Narrabeen Group, which is likely to be around 150 m bgl; and
- production casing will be installed to the bottom of the build section where it intersects the Bulli seam, likely to be around 570 m bgl.

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Aerial Imagery : NearMap May 2010

EMM

Private bores located within approximate 2km radius of proposed MP25 well

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Figure 3.1

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The well will be constructed in accordance with the API standard, the requirements of DTIRIS for coal seam gas wells, and where relevant, the Minimum Construction Requirements for Water Bores in Australia (Land and Biodiversity Committee, 2003).

3.4 Management controls to be implemented

This section provides further information on management controls to prevent potential pollution of groundwater resources. The protection measures detailed below will be in place during construction and operation to protect the environment and consumptive users, including from unforeseen or unpredicted consequences. Regular groundwater monitoring will continue to be conducted (see Section 3.5). It is also noted that stormwater controls and the use of lined pits (see Sections 4.1 and 4.5) will prevent pollution of surface water resources which could lead to pollution of groundwater resources during construction.

3.4.1 No hydraulic fracturing/fracture stimulation

The proposed MP25 well is a SIS well and hence there is no requirement for hydraulic fracturing/fracture stimulation. Accordingly, no hydraulic fracturing will occur.

3.4.2 No petroleum-based drilling fluids or additives

The proposed MP25 well would be drilled utilising either a formation or fresh water based fluid containing one or a combination of constituents that may include: potassium chloride, bentonite clay, polyanionic cellulose, partially hydrolysed polyacrylamide, xanthium gum, acrylic polymer, anionic surfactants and sodium carbonate. These compounds are routinely used in the drilling industry including the construction of water bores. No petroleum based fluids or additives will be used in the drilling of the proposed well.

Any water based drilling fluids would be contained in a series of above ground tanks located on the construction pad. Any drilling fluids containing excessive amounts of polymer or other additives would be removed from the site and disposed of at an appropriately licensed facility. Any water left in the tanks at the completion of drilling would also be disposed of at an appropriate facility. No drilling fluid circulation water would be discharged avoiding any potential for this water to enter the Nepean River or alluvial aquifer. All returns may be stored in appropriately constructed and lined pits to avoid any seepage or contamination to soils and surface water courses.

Within OEH's submission, further information on a risk assessment of chemicals used and any associated impacts as a result of drilling and gas extraction was requested. During the project design phase, the following matters were considered in an evaluation of potential risks resulting from the proposed activities:

- the known geology and hydrogeology of the area;
- that no petroleum-based fluids or additives will be used in the drilling of or gas extraction from the proposed well;
- the constituents of the proposed drilling fluid are in common use throughout the drilling industry;
- the measures in place for containment, storage and disposal of the drilling fluids; and
- the control measures and design specifications required by DTIRIS for the construction of the well.

The conclusion of this evaluation was that appropriate control measures are in place and these would be implemented during the proposed activities to minimise identified risks.

3.4.3 Use of biodegradable muds during drilling

It is important to protect the shallow beneficial aquifers in the alluvium and Hawkesbury Sandstone; within the well, these zones would be fully cased and cemented off (refer to Section 3.3.3). Biodegradable muds and formation waters (where possible, otherwise high quality fresh water sources) are used for well construction, with the well drilled over-balanced (ie at a higher pressure than in the target formation) to ensure that there is no ingress of natural groundwater into the wellbore.

The in-seam section of the well is open against the deeper coal measures containing (saline) groundwater and there is potential for some fluid loss into the coal measures. As previously discussed, this groundwater is too low in yield and too high in salinity to be considered a beneficial aquifer, and it is not connected to any aquifers in adjacent strata due to presence of extensive and thick claystone formations.

Groundwater contained in the upper alluvial and shallow fractured rock aquifers (ie the only beneficial groundwater sources in the Camden area) will not be impacted by drilling as these zones are cased and cemented off in accordance with the requirements of DTIRIS during the construction of the well. The well would be cased using pressure rated steel casing beyond the uppermost beneficial use aquifers to ensure there is no contamination or drainage of the groundwater resources. Relevant activities with the construction of the well will also be undertaken in accordance with the Minimum Construction Requirements for Water Bores in Australia (Land and Biodiversity Committee, 2003), where appropriate (ie where the stronger and more appropriate API standard does not apply). The vertical section of the hole would be logged using a cement bond log, which would demonstrate the quality of the cement within the beneficial water zones.

Once drilling is completed, all drilling fluids removed from the well will to be taken off-site for disposal at an appropriately licensed facility to prevent pollution of aquifers and water bearing zones. At the completion of drilling there will be no muds, chemicals, or fluids left in the hole. The well is developed by pumping produced (coal seam) formation water from the well.

3.5 Groundwater monitoring

The nearby existing MP17 well (approximately 400 m east of the proposed MP25 well) is part of the dedicated CGP water quality monitoring network which provides information on a suite of analytes (refer to Appendix B). This monitoring location is considered to be representative of the proposed MP25 well.

A GMP for the whole CGP has been designed and provides a framework for assessing any changes in the different groundwater systems beneath the CGP area, particularly to the shallow beneficial aquifers. It is currently being finalised through discussions with NOW and OEH, and implementation has commenced, with it likely to be fully operational by early 2014.

In relation to the proposed MP25 well, upon completion the water quality will be sampled and produced water volumes monitored. If the well produces more than 50 kilolitres (KL) per year, a flow meter will be installed and volumes monitored monthly. As ongoing water quality monitoring is occurring at the nearby MP17 well, no additional quality monitoring is expected to be required at this site.

3.6 Approvals and licences

3.6.1 Bore construction to be undertaken by a driller holding a water drillers licence

Within NOW's submission, the agency requested that construction of MP25 is to be undertaken by a driller holding a water drillers licence. The proponent acknowledges that all drilling rigs and drillers

associated with the construction of MP25 will comply with all appropriate statutory and licence requirements required to drill and construct a well at this location.

3.6.2 Extracted water volumes and existing entitlements

Within NOW's submission, the agency requested that discussion be provided on the expected extracted water volumes and whether these are within the existing entitlements held by the proponent.

The proponent holds industrial production bore licences under the NSW *Water Act 1912*, and a wellfield allocation of 30 ML per year, for its existing CGP and associated dewatering activities. The proposed MP25 well is to be constructed on the same drill pad as the existing MP16 well (licence 10BL603962). The bore licence (10BL604888) for the construction of MP25 was granted by NOW in mid 2011 under the NSW *Water Act 1912*. The proponent has been liaising with NOW and understands that all these licences are transitioning to a Water Access Licence and works approvals under the NSW *Water Management Act 2000*.

As shown in Table 3.2, the initial produced formation water volumes from well MP25 are expected to be significantly less than 0.25 ML per year, and it is expected that these volumes will be accommodated within the existing allocation of 30 ML per annum. Shown in Table 3.2 is the total volume of produced water for the entire CGP wellfield during the last two calendar years (2010 and 2011), which is 2.9 and 2.7 ML, respectively. An additional (predicted maximum) 0.25 ML per annum from the proposed well would not exceed the existing allocation of 30 ML per annum. Therefore, no additional allocation is required due to the proposed modification.

3.6.3 Aquifer interference approval

A draft aquifer interference policy is currently in development by NOW as a component of the NSW Government's Strategic Regional Land Use Policy (NOW website 20 January 2012). Whilst there is no current requirement for an aquifer interference approval prior to drilling, the proponent will discuss the need for aquifer interference approval with NOW prior to the commencement of drilling of MP25.

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4 Surface water

4.1 Introduction

This chapter provides further information relating to surface water matters raised in submissions by the state government agencies and Council. Specifically, this section relates to approvals under the *Water Management Act 2000*, flooding, stormwater control and management of surface waters during construction.

4.2 Requirement for controlled activity approval

The Council submission requests clarification on the distance of the proposed MP25 from the highest bank of the Nepean River, to determine whether the activity should be controlled under the *Water Management Act 2000*. As stated in Section 3.4.2 of the EA, a controlled activity approval is required if works are undertaken within 40m of waterfront land (ie in this case, the highest bank of the Nepean River) under section 91 of the *Water Management Act 2000.*

As stated in the EA, the proposed MP25 is situated more than 40 m from the highest bank of the Nepean River, however the construction layout area was partially within 40 m. Subsequent to comments received on the proposal, a design review was undertaken with respect to the construction site layout. As a result, the construction site layout has been revised and will be established approximately 40 m east of the highest bank of the Nepean River, therefore no activities will be undertaken within 40 m of the highest bank.

However it is noted that as the proposed activity will be undertaken in accordance with a petroleum title in force under the NSW *Petroleum (Onshore) Act* 1991, these activities are exempt under clause 39 of the NSW Water Management (General) Regulation 2011 and a controlled activity approval is not required. It should be noted that NOW, in its submission dated 18 November 2011, confirmed that a controlled activity approval is not required.

4.3 Implications of stockpiling fill within the floodplain

Within Council's submission, further information relating to the potential flooding implications associated with the intended stockpiling of fill within the floodplain were requested. Section 5.2 of the EA provides information relating to the implementation of measures to prevent impacts to water quality from stockpiling of fill:

- minimisation of stockpiling, in terms of height and volume;
- locating stockpiles on higher ground (where possible) to avoid impact from less intense flooding;
- vegetating soil stockpiles where material is to remain on site for a long period of time;
- immediate disposal of any contaminated soil generated during construction, subject to daily monitoring; and
- prompt spreading of soil stockpiles during site rehabilitation, following drilling and completion activities.

The *Camden Gas Project – Environmental Management System (Soil and Water Management Sub Plan)* provides that in the event of likely significant movement of material from the stockpile due to rainfall or wind, additional containment measures for the stockpile shall be implemented as directed by the Field Environment and Safety Officer. Within flood-prone areas such as that of MP25, these additional containment measures and construction techniques would be implemented to minimise potential flooding impacts on the stockpiling of soil and vegetative materials.

4.4 Stormwater control

During the construction (ie drilling) of the proposed MP25 well, drainage and erosion control measures will be implemented to prevent potential off-site surface water impacts by directing water flow around the drill pad ensuring water from adjacent undisturbed areas does not flow into the pad area. These erosion and sediment control measures would be utilised to minimise the potential for sediment to move/migrate to nearby drainage lines and watercourses (ie Nepean River). Specific control measures may include silt fences, hay bales or diversion drains.

In conjunction with the management of surface water on site, appropriate waste management will be implemented to minimise the potential for surface water interaction with oil, grease or other fluids. Drilling fluids will be contained in on-site above ground tanks to ensure no impact to surface water. Other measures will include ensuring fuel and lubricants are stored in appropriate bunded locations and drilling fluids are appropriately contained, managed and disposed offsite. All works will be undertaken in accordance with the *Camden Gas Project – Environmental Management System (Soil and Water Management Sub Plan)*.

4.5 Use of lined pits

The Council submission incorrectly states that lined pits which are prohibited by the NSW Government, will be used as evaporation ponds.

Lined pits do not constitute evaporation ponds and therefore the NSW Government prohibition does not apply. As stated in Section 2 of the EA, these lined pits will be used to contain the drilling-produced cuttings and any drilling fluids returned to surface during drilling. The pits will be lined with polyethylene (a geotechnical liner), bunded on the upslope and downslope and one other side. Drill cuttings, including coal fines, will be managed by regular inspection of levels in pits to ensure that the pit does not exceed approximately 80% of its holding capacity. Once drilling activities have been concluded, these pits will be emptied and transported off-site to a licensed facility. The implementation of the environment protection measures outlined in the *Camden Gas Project – Environmental Management System (Soil and Water Management Sub Plan)* will ensure that the use of lined pits does not result in salinity impacts on the Nepean River and surrounds.

Once all drilling activity has ceased and these pits have been emptied of cuttings or residual fluids the pits are then fully rehabilitated. At no stage or time during the proposed activities are these pits used for evaporative purposes.

5 Other matters

This chapter provides a response to other matters raised in agency and Council submissions.

5.1 Rehabilitation and conceptual final landform

The submission from DRE requests the proponent outline steps involved in plugging and abandoning the well and provide information relating to the conceptual final landform plan for MP25. The steps involved in plugging and abandoning the well are outlined below and a conceptual final landform plan is provided as Figure 5.1.

The well will be plugged and abandoned in accordance with requirements stated in the Onshore Petroleum Exploration and Production Safety Requirements (which the NSW Petroleum (Onshore) Regulation 2007 has adopted as a code of practice):

- infrastructure and equipment will be removed from the well surface;
- the steel pipe/casing will be removed from the coal seam and the location of the well will be logged;
- the well will be cemented back to surface with a cement bentonite mixture in relevant cement plug sizes (typically 150 to 200 m). The casing will be cut a minimum of 1 m bgl and a steel fixed to the well with the name of the well, the company name and the date of plug and abandonment clearly visible.
- excavated areas and trenches, eg the GGL if this is required, will be filled in;
- topsoil will be pushed back across the disturbed area;
- the disturbed area (including existing access tracks) will be lightly ripped, re-contoured and revegetated by broadcast of seed; and
- the disturbed area will be temporarily fenced and will be subject to ongoing maintenance and monitoring until it is determined that rehabilitation has been successful. rehabilitation success will be assessed using the following completion criteria:
    - species cover and abundance;
    - presence of weeds;
    - presence of rock and soil inversion; and
    - presence of erosion.

It should be noted that four wattles will be relocated prior to construction of MP25 and these will be monitored during relocation and initial rehabilitation for the site. These wattles will be included in the final landform and considered in the rehabilitation of the site following plugging and abandoning MP25.

The submission from DRE also stated that the Petroleum Operations Plan (POP) for the project must be amended to reflect the modification prior to the commencement of the construction. The proponent confirms that the POP will be amended accordingly.

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Aerial Imagery : NearMap May 2010. Source: AGL Drawing nº76442.15.D67 13/01/12

EMM

Conceptual final landform

Response to submissions, Camden Gas Project: MP25 modification to DA 183-8-2004i

Figure 5.1

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5.2 Consultation

Further details relating to the consultation undertaken by the proponent with the community and relevant government agencies was requested within the OEH submission.

Consultation activities undertaken regarding the proposed modification were referenced within Section 4 of the EA. In addition to these activities, further consultation was undertaken; namely:

- Harness Racing NSW – Further consultation conducted in regards to construction pad changes, and permission for twinned GGL between MP16 and MP13/30 (refer to Chapter 6). Designs confirmed as a result of this further consultation;
- the modification application has been uploaded to the Camden Gas Project web site, within the project news section. An explanation of the proposal, and the link to the application documents is available;
- the proponent's Responses to Submissions report was discussed at the February CCC meeting, which includes representatives of Council. The content of the submissions from the various government agencies and Council were discussed as well as the responses drafted for each item;

Future consultation activities prior to the commencement of works will also be undertaken by the proponent. A program for construction work is to be agreed with Harness Racing NSW, to accommodate the racing schedule at the Menangle Park Paceway. Additionally, a letter box drop to residents in the local area will be issued two weeks prior to construction commencement, which will include information regarding the construction commencement date, and duration of the construction period.

As stated in Section 1 of this report, as the proposed activities utilise the existing drill pad and are located within previously disturbed areas and agreements were in place with the landowner, the proponent understands that the DP&I determined not to publicly exhibit the EA because there is no mandatory requirement to do so having regard to the circumstances and the minor nature of the proposed modification.

The proponent has also been advised by DP&I that the proposed modification will be determined by the PAC. During this determination process, it is understood that the documentation (ie the EA, submissions received and this Response to Submissions report) will be available to the public prior to determination of the application.

5.3 Justification

Within OEH's submission, further information regarding the justification of the proposed MP25 well was requested. In particular, OEH wanted more information as to why the existing well MP16 cannot accommodate the demand for natural gas and energy security referred to in the EA.

As stated in the EA, demand for natural gas is expected to increase from 90 petajoules (PJ) in 2007 to 230 PJ in 2015. MP16 has a yield of 0.7 PJ. This is insufficient to respond to the demand for natural gas and energy security. The expected additional gas production generated from the proposed MP25 is 1.1 PJ. Together, these two wells are anticipated to have an average yield of 1.8 PJ, which would address some of the demand for natural gas and energy security.

The proposed MP25 well will be a SIS well. This drilling technique is in itself a form of reservoir stimulation which increases the drainage area without the need for hydraulic fracture stimulation. The well will be

drilled vertically from the surface, then will gradually angle to intersect the coal seam, nearly parallel with the seam dip angle. Following intersection of the coal seam, the well will be cased and cemented and a smaller hole will be drilled for up to 2,500 m through the coal seam.

The existing MP16 is a vertically drilled well. Utilising the SIS drilling technique for the proposed MP25 well enables the extraction of gas from coal seam more than 2,500 m away from the surface location, thereby increasing the total potential gas extraction than would otherwise be extracted from the vertically drilled existing MP16 well.

Furthermore, the SIS drilling technique allows more flexibility in the location of gas production wells, particularly with the option of co-locating wells in existing disturbed areas, such as the drill pad for MP16.

5.4 Environment Protection Licence

Within the their submission, OEH wanted to confirm how EPL No 12003 has been taken into account in relation to the proposed development and will be complied with.

On 22 December 2011, EPL 12003 was varied by the OEH to include conditions on, among other things, implementation of a Leak Detection and Repair Program, and submission to the OEH of a spatial layer that details all of coal seam gas infrastructure and gas and water gathering lines associated with the Rosalind Park Gas Plant and a Groundwater Assessment Report and GMP.

If the application for modification is approved, the proponent will ensure compliance with EPL 12003, including in relation to the scale within which the prescribed activity may be carried out (ie, the expected additional gas production from the proposed MP25 to the CGP will not exceed 500,000 tonnes).

Furthermore, Condition A2.2 and Condition A2.3 include the gas gathering reticulation system associated with the licensed Rosalind Park Gas Plant. The gas gathering reticulation system includes all gas wells, trunk lines and any associated effluent storages, temporary works areas and infrastructure associated with the gas gathering systems, gas wells and trunk lines. It is considered that the proposed MP25 and its associated GGL will be licensed under EPL 12003 should the modification be approved.

5.5 Consistency with modification requirements under EP&A Act

Council considered that a new application with a comprehensive environmental assessment was required. Council's submission contends that the proponent cannot modify the development consent under section 96 of the EP&A Act because the proposed development is not likely to have minimal environmental impact and is not substantially the same as the development subject of the development consent.

The proponent does not consider that a new application is required for the proposed MP25 well and associated infrastructure. The proposed development is appropriately subject of an application for the modification of the development consent under section 75W of the EP&A Act, and not section 96 of the EP&A Act as suggested by Council.

As stated in the EA, the development subject of the development consent was declared by the Minister to be state significant development on 13 June 2003 under (the now repealed) section 76A(7) of the EP&A Act. The development consent was granted in 2004 by the Minister under Part 4 of the EP&A Act. The development consent allows the connection of 15 coal seam methane wells to the Stage 2 CGP and the construction of a dam at the MT1 gas well site.

The proposal assessed in the EA seeks to modify the development consent. The proposal involves the construction of a new production well (MP25), associated GGL spur, and upgraded and additional tracks

for construction access and twinned GGL between MP16 and MP13/30 (refer to Chapter 6). The wells covered by the existing development consent and the proposed new MP25 well are within the area covered by the concept plan approval for the CGP. The Minister's approval for the modification of the development consent is being sought because the proposal is inconsistent with the development consent. Relevantly, section 75W of the EP&A Act provides:

> The proponent may request the Minister to modify the Minister's approval for a project. The Minister's approval for a modification is not required if the project as modified will be consistent with the existing approval under this Part.

The Council's submission incorrectly stated that the proposed modification should be assessed under section 96 of the EP&A Act.

Section 96 of the EP&A Act does not apply to the proposed modification because the proponent is seeking to modify a development consent granted by the Minister under Part 4 of the EP&A Act relating to state significant development. Relevantly, clause 8J(8) of the NSW Environmental Planning and Assessment Regulation 2000 provides that:

> (c) a development consent granted by the Minister under Part 4 of the Act (relating to State significant development) before 1 August 2005 or under clause 89 of Schedule 6 of the Act...

As Council correctly pointed out, Part 3A of the EP&A Act was recently repealed by the NSW *Environmental Planning and Assessment Amendment Act (Part 3A Repeal) Act 2011* (Part 3A Repeal Act). However, transitional provisions were introduced (Schedule 6A of the EP&A Act) enabling 'transitional Part 3A projects' to continue to be subject to Part 3A of the EP&A Act (as in force immediately before the repeal and as modified by the Part 3A Repeal Act). Transitional Part 3A projects include certain Part 4 projects that were subject to modification under Part 3A prior to the repeal.

Clause 12 of Schedule 6A (Transitional arrangements – repeal of Part 3A) of the EP&A Act states:

> 12. Section 75W of Part 3A continues to apply to modification of the development consents referred to in clause 8J(8) of the NSW Environmental Planning and Assessment Regulation 2000, and so applies whether an application for modification is made before or after the commencement of this clause.

Accordingly, the proponent lodged the proposed modification under section 75W of the EP&A Act rather than section 96 of the EP&A Act.

Council's submission also stated that the proposal will not have minimal environmental impact and is not substantially the same development as the development for which consent was originally granted. Accordingly, Council stated that the proposal is not consistent with section 96 of the EP&A Act.

As stated in the EA and discussed above, the proposed modification of the development consent correctly falls under section 75W of the EP&A Act, and not section 96 of the EP&A Act as suggested by Council. In any event, the environmental assessment of the proposal concluded that the proposal is unlikely to have any significant environmental impacts due to the low levels of ground disturbance proposed, the distance from sensitive receivers and the implementation of proven existing management measures under the CGP. In particular, the proposed facilities will be in close proximity to an existing well, MP16, in an area previously disturbed by the development of MP16 and sand quarrying activity. The area of disturbance will be limited to:

- two tracks of approximately 135 and 25 m long by 3 m wide;

- an approximately 145 m long by 30 to 50 m wide site compound, which encompasses the disturbance area for an existing well, MP16;
- an approximately 25 m long and 40 m wide topsoil stockpiling area to the north of the site compound;
- twinning of GGL between MP16 and MP13/30 within existing corridor of disturbance (further information is provided in Chapter 6); and
- widening by approximately 10 m of the approximately 30 m long shoulder at the intersection with an existing internal road.

5.6 Ecological assessment

5.6.1 Introduction

Within Council's submission, several matters related to ecology were raised. This section provides information relating to the ecological assessment and potential effects on the ecology of the site and its immediate surrounds due to the proposed modification. A threatened species and ecological communities habitat assessment has been prepared for the proposed modification and this is provided in Appendix D. Additionally, seven-part tests for species listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and assessments of significance for migratory species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) have been undertaken and are provided in Appendix E.

5.6.2 Nepean River

A detailed study of the ecological health of the Nepean River was not undertaken as part of the environmental assessment of the proposed modification. As detailed in the EA, adverse impacts to the ecological health of the Nepean River as a result of the proposed MP25 were assessed to be highly unlikely due to a number of reasons, inclusive of no direct disturbance activities and a lack of hydrogeological connectivity between the shallow aquifers of the Nepean River and the target formations of the proposed MP25.

Additionally, the EA states that run-off from the disturbed areas on-site will be prevented from reaching the Nepean River. During construction of the proposed well, management techniques detailed in the EA and the *Camden Gas Project – Environmental Management System (Soil and Water Management Sub Plan)* will be implemented to prevent run-off from entering the Nepean River, including the construction of diversion drains to divert surface water drainage away from disturbed areas, and containment of drilling fluids and soil stockpiles. Regular on-site monitoring will be undertaken during construction to ensure that these measures are implemented and maintained successfully and no impacts to the Nepean River are realised. It is considered that there is a low risk of failure of these management measures resulting in run-off from disturbed areas entering the nearby Nepean River, a detailed study of the ecological health of the Nepean River was not required as part of this modification.

5.6.3 Flora and fauna assessment

Subsequent to the lodgement of the EA and in response to requests regarding additional ecological information within Council's submission, the proponent has undertaken the following tasks:

- undertaken a recent site specific database search for threatened entities (both TSC and EPBC Act listed species and communities) to supplement the previous search undertaken as part of the approval for MP16;

- undertaken seven-part tests in accordance with section 5A of the EP&A Act. These are provided in Appendix E;

- undertaken assessments of significance in accordance with the EPBC Act for migratory species. These are provided in Appendix E; and

- undertaken a site survey targeting likely threatened species listed in the database search and a habitat assessment which have been undertaken in accordance with the revised OEH Threatened Species Assessment Guidelines.

Vegetation mapping including the *Native vegetation of the Cumberland Plain of Western Sydney* (NPWS 2002) was used to identify vegetation communities onsite.

A list of threatened entities with the potential to occur within or surrounding the proposed MP25 well was compiled by querying the following databases in January 2012:

- OEH Atlas of NSW Wildlife for species listed under the TSC Act; and

- the Commonwealth Protected Matters Search Tool for species listed under the EPBC Act.

A radius of 10 km was placed around the site to capture all records of threatened entities within this area.

A site inspection was carried out on Monday 23 January 2012 by Katie Whiting, a trained and experienced senior ecologist from EMM. During the site inspection, the following information was recorded:

- plant species;

- vegetation communities;

- fauna habitats; and

- opportunistic fauna observations.

An assessment of the likelihood that threatened entities (threatened species and communities) would occur in the proposed construction pad and the proposed twinned GGL between MP16 and MP13/30 was undertaken (Appendix D). The proposed activities are to occur adjacent to a listed EEC listed under the TSC Act, Riverflat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin, and South East Corner Bioregions. This EEC will be avoided during the proposed activities and as such will not be subject to any direct impacts. Indirect impacts such as weed invasion and sedimentation will be managed by appropriate measures detailed in the existing Camden Gas Project Environmental Management System.

The proposed construction pad has been identified as sub-optimal foraging habitat for listed threatened species (TSC Act) comprising the Black-necked Stork (*Ephippiorhynchus asiaticus*)and Spotted Harrier (*Circus assimilis*), and listed migratory species (EPBC Act) comprising the Great Egret (*Ardea alba*), Cattle Egret (*Ardea ibis*), Rainbow Bee-eater (*Merops ornatus*)and Latham's Snipe (*Gallinago hardwickii*). As the proposed construction pad is not within any breeding areas for this species, only constitutes sub-optimal

foraging habitat and this habitat is generally abundant in the surrounding area, the impacts to these threatened and migratory species are expected to be minimal.

Several weed species (two of which were noxious) were identified within the proposed work pad. These include Small and Broad-leaved Privet (*Ligustrum lucidum* and *L.sinense*). These and other weeds will continue to be managed according to the measures included in the existing Camden Gas Project Environmental Management System.

An introduced predator, the European Red Fox (*Vulpes vulpes*) was observed during the site inspection. As the area is heavily cleared and surrounding land-uses are agricultural, it is expected that this species is already established in the area, and the proposed MP25 well and associated infrastructure (inclusive of the twinned GGL between MP16 and MP13/30) will not increase the operation of this species whose predation is listed as a key threatening process under the EPBC Act.

One GDE was identified in vicinity to the proposed construction of MP25 and the twinned GGL between MP16 and MP13/30. The Riverflat Eucalypt Forest on Coastal Floodplains EEC growing adjacent to the existing MP16 compound and proposed MP25 drill pad is likely to be dependent on river baseflow from shallow aquifers in the region beneath and alongside the stream bed of the Nepean River, where there is mixing of shallow groundwater and surface water. However, as discussed in Section 3.3.1, no interaction between shallow aquifers in the riparian zone and the deep coal seams is anticipated. Therefore, the proposed drilling of MP25 and gas extraction activities are highly unlikely to have an impact on the river baseflow from shallow aquifers in the region beneath and alongside the stream bed of the Nepean River, where there is mixing of shallow groundwater and surface water, that the Riverflat Eucalypt Forest on Coastal Floodplains EEC is likely to be dependent upon. There are no GDEs associated with the formation water of the deep coal seams as this groundwater is isolated from all other aquifers and water bearing zones and has no surface expression.

No alteration to riparian or floodplain geomorphology is proposed. No impacts to aquatic ecosystems are predicted, subject to the implementation of measures to divert clean water run-off and prevent escape into the environment of drill water or sediment. These measures are contained in the EA and the *Camden Gas Project – Environmental Management System (Soil and Water Management Sub Plan)*.

The proposed extension to the existing MP16 drill pad is adjacent to an area of regenerating River Flat Eucalypt Forest to the south. This section of the site compound will be used as an access route to transport the drill rig to the proposed MP25. As part of a design review undertaken by the proponent in consideration of matters raised within submissions, the construction layout has been revised to prevent impacts to the EEC.

Additionally, para-webbing will be erected around the root zone of the one established River She-oak at this location prior to construction. The purpose of the para-webbing is to protect the tree and its roots from accidental damage during construction. The proposed construction pad will disturb a regeneration area for River She-oaks and the Riverflat Eucalypt Forest EEC adjacent to this protected River She-oak. To mitigate the minor effects of disturbance to this regeneration area, approximately five of River She-oaks will be planted in tubestock form following the completion of construction. During construction the regeneration area to the south of the drill pad will be designated as a 'no-go' or 'exclusion' zone with para-webbing preventing access. The revised construction layout area for the proposed MP25 is shown in Figure 5.2.

In summary, the threatened species habitat assessment, seven part tests and assessment of significance (provided in Appendix D and E) concluded that impacts to these species are not expected and that neither a Species Impact Statement nor an EPBC referral are required (as previously stated in the EA).

5.7 Cumulative impacts

Submissions raised the matter of cumulative impacts resulting from the construction and operation of an additional gas well (MP25) within the CGP. As demonstrated in Section 3 of this Response to Submissions report, the proposed extraction of coal seam gas and associated groundwater in the deeper Illawarra coal measures will lead to some further depressurisation of the coal seam water bearing zones at depth for the duration of the gas extraction operations (see Section 3.1.7). However, as there is no connectivity between the coal seam water bearing zone and beneficial aquifers present in the CGP area (see Sections 3.1.7 and 3.3.1) and with consideration given to the control measures in place and the design specifications required by DTIRIS, cumulative impacts to groundwater due to MP25 are not expected.

The EA included a noise assessment which assessed potential cumulative noise assessment. It concluded that the proposed drilling and operation of the proposed well (MP25) would not create cumulative noise impacts to identified sensitive receivers. Furthermore, no cumulative impacts to surface water, ecology, Aboriginal heritage and other environmental aspects are anticipated, provided that the environmental management and mitigation measures prescribed in the EA and this Response to Submissions report are implemented.

5.8 Consolidation of consents for CGP

Within their submission, OEH requested that the proponent consider the consolidation of the numerous different development consents within the CGP. The proponent commits to discussions with DP&I and OEH regarding the future consolidation of these development consents for the CGP.

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Aerial Imagery : BingMap. Source: AGL Drawing nº76442.15.D67 13/01/12

EMM

Revised construction layout of MP25

Response to submissions, Camden Gas Project: MP25 modification to DA 183-8-2004i

Figure 5.2

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6 Additional project component: Proposed twinning of gas gathering line

6.1 Introduction

Subsequent to the lodgement of the proposed modification EA for the construction and operation of MP25 and associated infrastructure and receipt of comments from government agencies and Council, a design review of the proposed modification was undertaken by the proponent. This design review of the proposed activities identified the requirement to further augment the associated infrastructure to support the gas gathering network. The proponent identified the need for additional GGL infrastructure, specifically to twin the existing GGL between MP16 and MP13/30, as shown in Figure 6.1.

This chapter of the Response to Submissions report provides an environmental assessment for the construction and operation of this additional component to the modification of the development consent.

6.2 Description of proposed route

An existing GGL is located between MP16 and MP13/30 which transports the extracted gas from these well surface locations to the Rosalind Park Gas Plant for distribution to the market for sale. The proponent proposes to install an additional GGL adjacent to the existing GGL between MP16 and MP13/30 which includes a connection spur from the proposed MP25 well.

This is a process known as 'twinning' and is required to maintain the distribution of gas from well surface locations to the Rosalind Park Gas Plant. The estimated length of the proposed twinned GGL is approximately 1,700 m and is located within the existing disturbance corridor width of 25 m.

To the west of the proposed twinned route lies the Riverflat Eucalypt Forest on Coastal Floodplains EEC. To the east of the southern section of the proposed twinned route is the training facility of the Paceway and the final void (now filled with water) of the previous sand mining activities is east of the proposed route in the vicinity of MP15. Further north along the proposed twinned route near MP13/30 is an area currently used and maintained by a gliders club.

The proposed twinned route does not cross any watercourses, drainage lines or waterbodies and will follow an existing access track, which formerly a wide haul road for trucks hauling extracted sand during the previous land use of sand mining.

6.3 Description of proposed activity

The twinned GGL will increase the capacity of the gas gathering system for the CGP to allow gas to be transported to the Rosalind Park Gas Plant.

The proposed GGL will be constructed within the existing disturbance area along the existing route, as shown in Figure 6.1. The expected area of disturbance for the proposed GGL would be approximately 5 m wide along the proposed route (within the designated corridor) and up to a depth of 1,200 mm (dependent upon localised conditions). Usually, dependent on terrain and weather conditions, construction of the gas gathering system moves at a rate of up to 400 m per day. Therefore, the construction of the proposed twinned GGL would be approximately five days, dependent upon terrain and weather conditions. The works would be undertaken within standard construction hours of 7am to 6pm (Monday to Friday) and 8am to 1pm (Saturdays) with no work undertaken on Sundays or public holidays.

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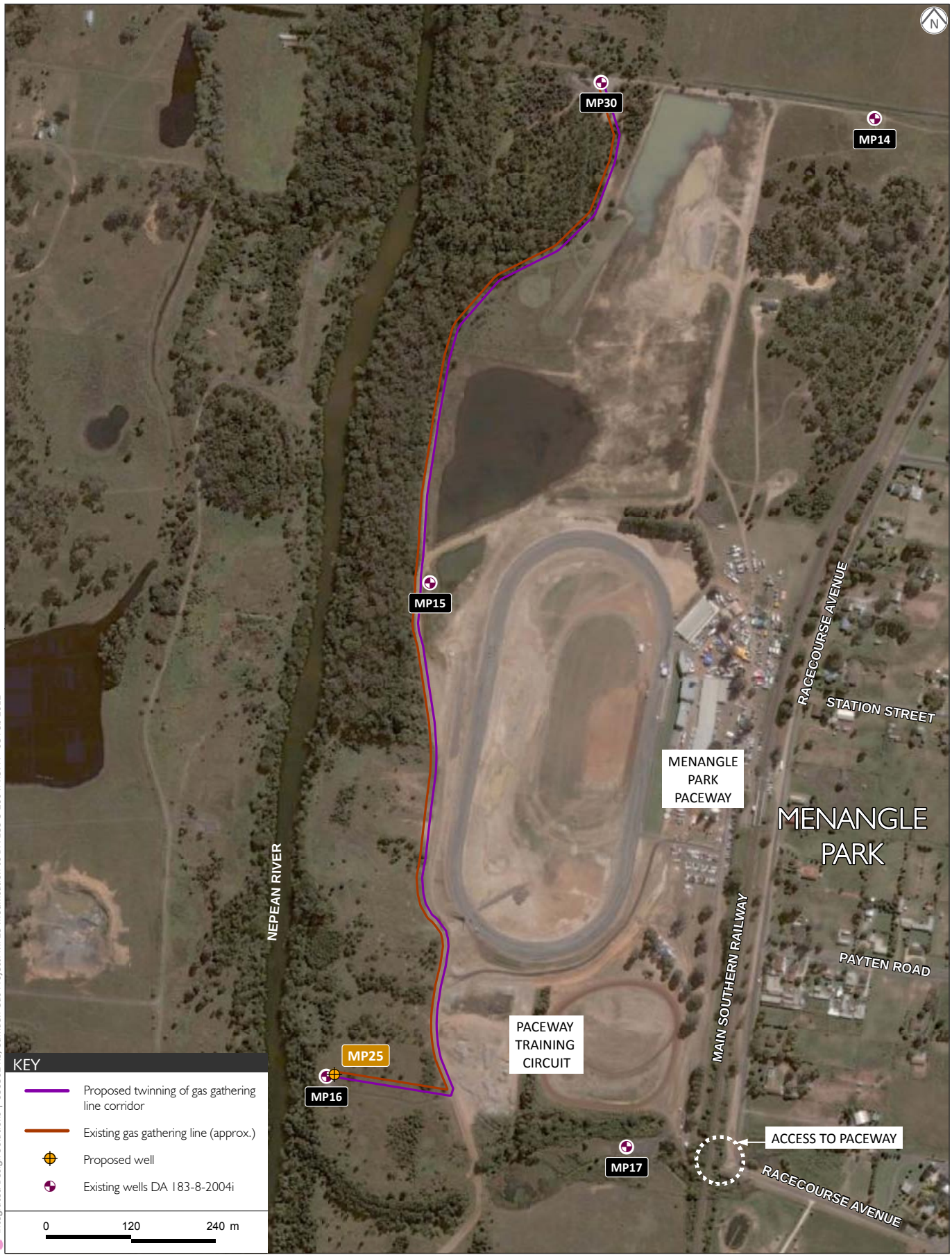

Integrated Design Solutions | 030562 RS, Camden Gas Project: MP25 modification to DA 183-8-2004i Rev A - 08 Feb 2012

Aerial Imagery : @ Microsoft BingMap

Proposed twinning of gas gathering line from MP16 to MP30

Response to submissions, Camden Gas Project: MP25 modification to DA 183-8-2004i

Figure 6.1

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Similar to the existing gas gathering system within the CGP the twinned GGL will be designed, constructed and operated in accordance with the requirements of *Australian Standard AS 4645.3 - 2008 Installation and Maintenance of Plastic Pipe Systems for Gas*. The gas gathering system will be buried to a minimum depth of 750 mm and up to 1,200 mm in some areas. The principal activities involved in the construction of the gas gathering system are as follows:

- survey of pipeline route;
- clear and grade 'Right of Way' pipeline route including stripping of any topsoil;
- stringing of pipe;
- welding of pipe joints;
- trenching and underboring where necessary;
- lowering-in of pipe strings (including trench preparation and padding);
- installation of tracer lines (for pipe tracing) as polyethylene (PE) pipe is non conductive;
- installation of gas marker tape above PE gas pipe;
- backfilling and compaction of trench;
- pressure testing of pipeline;
- rehabilitation of ground along pipeline route;
- installation of gas line signposts to mark and identify pipeline location; and
- register GGL on 'Dial before you dig'.

The GGL would be inspected annually by a specialist third party gas detection inspection service that performs a leakage survey of the below ground pipelines. The survey is conducted at 10 parts per million (ppm) sensitivity for gases and the 10 ppm sensitivity reflects the measurement capability of the equipment used to check for leaks. It does not arise from an Australian Standard or any requirement. It represents AGL best practice which has been adopted from the practices used by high pressure gas pipelines to inspect for gas leaks once a year (AGL only operates low pressure GGL at the CGP and consequently, this is a very high standard).

All work would be conducted in accordance with the CGP's Environmental Management System. An ancillary water transfer system (ie water pipes), if required, would be co-located in the trenches for the GGLs and installed simultaneously. The proposed twinning of the GGL will largely be managed through the implementation of measures and procedures outlined in the CGP Environmental Management System. Whilst the proposed modification is expected to have minimal environmental impact, an assessment of the proposed twinned GGL was undertaken with the outcomes and recommended mitigation measures outlined in the sections below.

At the end of the network's operational life, the preferred method of closure and rehabilitation for the gas gathering system would be to purge with air or water to remove remaining gas, seal and then leave in position to prevent any further disturbance. This method would be subject to consultation with the

landowner. Should removal of the GGL be required, the excavated trench would be backfilled and rehabilitated, including contouring and revegetation.

6.4 Impact assessment

6.4.1 Ecology

Approximately 1 ha of heavily disturbed, exotic grassland will be removed to facilitate the installation of the proposed twinned GGL within the 25 m wide corridor of the existing GGL. The proposed twinned GGL does not require the removal of native vegetation, and as such no direct impacts are expected. An EEC (Riverflat Eucalypt Forest on Coastal Floodplains) is present in the riparian corridor along the Nepean River, and is located approximately 10 m to the west of the proposed twinned GGL in the northern sections between MP15 and MP13/30 (refer to Figure 6.1). It should be noted that no works will be undertaken within the drip line of the trees on the western side of the access track, thereby protecting the root system of these trees.

An existing sedimentation fence installed along the edge of the vegetation will be maintained throughout the construction period to avoid indirect impacts to this EEC including sedimentation and soil nutrification. Additionally, this EEC is designated as a 'no-go zone' for construction activities.

6.4.2 Soils and water quality

The proposed twinning of the GGL between MP16 and MP13/30 involves trenching for the construction of the gas gathering systems. Ground disturbance activities may potentially impact upon the soils and water through an increase in erosion.

As described in Section 6.2 of this report, the proposed twinning of the GGL does not cross any watercourses and follows an existing access track and will be constructed adjacent to the existing GGL (refer to Figure 6.1). Construction activities for the proposed twinned GGL are expected to be undertaken over a period of five days, subject to terrain and weather conditions.

Section 5.1.3ii of the EA outlined specific management measures for the construction of the GGL spur from MP25 connecting to the gas distribution network to prevent or minimise potential soil and water impacts. These measures are:

- spoil from the trench will be temporarily stockpiled on the upslope side of the trench;
- silt fencing will be installed around the trench if working in close proximity to waterways;
- if the trench is not back filled on the day of the excavation, cut-off trains or silt fencing will be installed upslope of the spoil to divert surface water; and
- stormwater contained within the trench will not be released into any existing waterways. It can be discharged across vegetated areas where the groundwater is sufficient to act as a natural filter.

Additionally, the ecological assessment (refer to Section 6.4.1 of this report) identified that the existing sedimentation fence will be maintained along the edge of the EEC in the vicinity of the construction of the twinned GGL to avoid indirect impacts to the EEC. No stormwater will be discharged into the EEC.

Given the short duration of the proposed activities and implementation of the management measures outlined above, impacts to soil and water quality as a result of the proposed twinning of the GGL between MP16 and MP13/30 are not expected.

6.4.3 Noise

Previous noise assessments and monitoring undertaken by the proponent state that the typical sound power level for the equipment used for excavation of trenches and pipe laying can be between 100 dB(A) (HLA ENSR, 2007) and 115 dB(A) (Heggies, 2010). Usually, dependent of terrain, construction of the GGL moves at a rate of up to 400 m per day. Therefore, with respect to surrounding receivers, the noise is transient and short term, and will occur only once during construction of the proposed twinned GGL.

The closest identified receivers to the proposed twinned GGL are some 550 m to the east of Racecourse Avenue with several noise generating sources (the Paceway, the Main Southern Railway and Racecourse Avenue) between the receiver and the proposed activities.

Given the distance and the minor nature of the proposed twinned GGL, it is unlikely that the proposed activities will result in noise impacts to any surrounding receivers.

6.4.4 Aboriginal cultural heritage

As detailed in the EA, the original Statement of Environmental Effects (SEE) for the construction of the wells and infrastructure of DA 183-8-2004i contained a detailed Aboriginal cultural heritage assessment (NSW Archaeology, 2003) for the original GGL between MP16 and MP13/30.

The previous assessment found no evidence of Aboriginal cultural heritage items or artefacts with following conclusions specific to the proposed corridor of the twinned GGL (NSW Archaeology, 2003; p12):

> Gathering line between MP16 and MP17
>
> > This route extends from the west along a drainage line (and past a farm dam) into an area of previously sad mined terrace. Given its location within the drainage line and mined land, this route is assessed to be of low archaeological potential.
>
> Gathering line between MP16 and MP15
>
> > This route extends from the south along a formed track located on previously sand mined river terrace. Given the location within a formed track and mined land, this route is assessed to be of low archaeological potential.
>
> Gathering line between MP15 and MP13
>
> > This route extends from MP15 along an unformed track located on relatively undisturbed river terrace. Given the location of this route within an amorphous landform at 100m or more away from the river the route is assessed to be of low archaeological potential.

Given the conclusions of the previous assessments of the proposed corridor for the twinned GGL, it is considered highly unlikely that the proposed activities will impact upon Aboriginal cultural heritage in the locality. The management measures outlined in Table 5.5 of the EA, and in accordance with the CGP Environmental Management System, for the construction of MP25 are considered applicable for the construction of the proposed twinned GGL between MP16 and MP13/30. These measures would be implemented in the unlikely event that Aboriginal objects are identified during construction:

- All works within the immediate vicinity should cease until the potential Aboriginal object(s) can be assessed and recorded by a qualified archaeologist;
- The extent and significance of the Aboriginal object(s) will be determined;

- The Aboriginal object(s) will be recorded and collected, and later relocated to an appropriate location at the completion of works. Immediately after collection, construction may then continue; and

- Should any these Aboriginal object(s) be deemed culturally significant, then further investigation with a qualified archaeologist should be undertaken to determine the need for further archaeological investigation. If the Aboriginal object(s) are not regarded to be significant, these will be collected for analysis, and relocation.

6.4.5 Other environmental considerations

This section provides an assessment of other environmental considerations regarding the construction and operation of the proposed twinned GGL between MP16 and MP13/30. These are described in Table 6.1 below.

Table 6.1 Other environmental considerations

Environmental aspect	Existing environment and issue description	Impact assessment and management measures, if required.
Flooding	The proposed twinned GGL is located within the flood plain of the Nepean River. The pipeline is buried to a depth of up to 1,200 mm and will be located within the same corridor as the existing GGL between MP16 and MP13/30, along an existing access track. Due to the location of the proposed twinning, there is potential for construction activities to be impacted by flooding.	The measures outlined in Section 5.2.3 of the EA and within Section 4.3 of this Response to Submissions report are considered to address the potential implications of flooding with respect to the proposed twinning of the GGL between MP16 and MP13/30.
Air quality	Vehicle use of the access route, construction of the twinned GGL and stockpiled topsoil from trenching could generate short-term dust impacts.	Dust generation will be minimal provided the environmental management measures outlined in the *Camden Gas Project - Environmental Management System (Air Quality Management Sub Plan and Soil and Water Management Sub Plan)* are implemented. Air quality impacts due to the construction of the twinned GGL are expected to be negligible and managed with implementation of practices outlined in the Camden Gas Project Environmental Management System.
Traffic	Work vehicle access will be via the existing MP16, MP15 and MP13/30 access tracks within the Paceway.	These existing routes are located on private property and already used by AGL. The additional movements due to the construction of the twinned GGL will be minor and no impacts are expected to result from the proposed activity. As outlined in Table 5.5 of the EA, the *Camden Gas Project – Environmental Management System (Traffic Management Sub Plan)* will be implemented and manage traffic

Table 6.1 Other environmental considerations

Environmental aspect	Existing environment and issue description	Impact assessment and management measures, if required.
		associated with the proposed activities.
European and non-Aboriginal heritage	As outlined in Table 5.5 of the EA, there are some heritage items within the general area of the proposed twinning, inclusive of the 'Menangle Park Racecourse/Paceway' which is listed in the Campbelltown Local Environment Plan 2002.	The proposed twinned GGL does not directly impact upon the heritage items within the general area. The activities do not require access to or impact upon the infrastructure of the Paceway. Due to minor nature of the activities required for the proposed twinning of the GGL between MP16 and MP13/30, it is considered that no specific European and non-Aboriginal heritage management measures are required.
Visual amenity	As outlined in Table 5.5 of the EA, the closest receivers (with the exception of the landowner) to the proposed twinning are located approximately 400m to the west. Receivers to the east are over 600m and separated by the Paceway and Racecourse Avenue.	It is considered unlikely that the construction activities associated with the proposed twinned GGL will be visible to surrounding receiver to the west or to the east. Therefore, no specific visual amenity management measures are required.

6.5 Summary of mitigation

The environmental assessment of the proposed twinned GGL between MP16 and MP13/30 presented in the previous sections concluded that the environmental management measures recommended within the EA are sufficient to provide protection for the environment and surrounding receivers during the proposed activities. As described within this Response to Submissions report and the EA, the existing CGP Environmental Management System will be implemented and adhered to during the proposed activities.

In addition to the measures presented in the EA, the ecological assessment recommended the inclusion of additional measures in order to protect the EEC from potential runoff and resultant sedimentation and soil nutrification impacts. The measures to be implemented are:

- an existing sedimentation fence installed along the edge of the vegetation will be maintained throughout the construction period; and
- the EEC is designated as a 'no-go zone' for construction activities.

6.6 Cumulative impact with construction and operation of the proposed MP25

As demonstrated in the EA and in this Response to Submissions report, the activities proposed for the construction and operation of MP25 are not expected to result in adverse impacts to the local environment and surrounding receivers.

There is potential for aspects of the proposed construction activities of MP25 to coincide with the construction activities of sections of the proposed twinned GGL between MP16 and MP13/30. However, due to the relatively short duration of the proposed activities for the twinned GGL (ie approximately 400 m of line can be installed per day), the assessed minor nature of impacts and the considerable distance to surrounding receivers (ie approximately 500 m), it is considered highly unlikely that cumulative impacts would result should these activities occur simultaneously.

6.7 Conclusion

An assessment was undertaken of the potential impacts to the local environment and surrounding receivers from the construction of the proposed twinned GGL between MP16 and MP13/30. The existing management measures were analysed and, with the inclusion of additional ecological mitigation measures, were considered to provide protection to the environment and receivers during the construction activities.

The cumulative impacts of the proposed activities for the twinned GGL occurring simultaneously with aspects of the construction of MP25 were also considered. However, it was concluded that adverse cumulative impacts were highly unlikely and not expected to occur.

7 Conclusion

This report provides consideration of the submissions received from government agencies and Council. The information requested in the submissions primarily related to groundwater and potential matters resulting from the drilling of the well. During the preparation of this report, the proponent consulted with both NOW and OEH, the agencies responsible for the management of water resources, regarding the content of their submissions. Both NOW and OEH were consulted regarding groundwater matters, and the items raised within their submissions. Both of these agencies had positive responses in regards to the additional information to be provided within this report.

No submission received has raised a matter which would necessitate modification of the proposal presented in the original EA.

The proposed modification involves the drilling of an additional production well (MP25) adjacent to the existing MP16 well utilising the same drill pad for construction. Subsequent to the lodgement of the EA and in consideration of matters raised in the submissions from agencies and Council, minor adjustments were made to the construction site layout.

The proposal also includes the installation of associated infrastructure to enable the connection of the well to the gas gathering network for the distribution of gas to the Rosalind Park Gas Plant. Upon receipt of comments from government agencies and Council regarding the proposed modification, a design review also identified the need to augment the proposed gas infrastructure with the inclusion of the twinned GGL between MP16 and MP13/30. An assessment of these activities was presented in Chapter 6 and concluded that with the additional of minor site-specific measures, the management measures presented in the EA would provide protection for the environment and surrounding receivers.

Based on the responses to the submissions, it is considered that the key considerations presented in the EA remain valid. That is, it is unlikely that the proposed modification will have any significant environmental impact, due to the low levels of ground disturbance, the distance from sensitive receivers, and the implementation of existing management measures employed by CGP.

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Appendix A

Private water bores

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A.1 Private water bores

Shown in the table below are characteristics of private water bores listed on the NSW Natural Resource Atlas[1] within a 2 km radius of the proposed MP25 well site.

Table A.1 Private water bores

Registered bore number	Depth (m)	SWL1 (m)	Aquifer Interval (m)	Yield (L/s)	Salinity (mg/L TDS2)	Geology of the water bearing zone/aquifer	Intended use
GW024351	21.9	6	14.9 – 19.5	0.2	-	Clay, gravel (alluvium)	Test bore only
GW024353	24.3	4.5	4.6 – 22.6	0.4	-	Clay sand (alluvium)	Test bore only
GW024354	21.3	-	11.2 – 11.6; 12.8 - 19.2			Clay sand (alluvium)	Test bore only
GW026469	20.4	-	15.8 – 19.7	-	-	Loose sand in silt (alluvium)	Test hole only
GW026471	5.5	-	2.7 – 4.9	-	-	Silt (alluvium)	Test hole only
GW026473	19.2	-	11.5 – 18.2	-	-	Sand traces in silt (alluvium)	Test hole only
GW026545	8.5	-	2.1 – 3.9	0	-	Gravel traces in silt (alluvium)	Test hole only
GW026551	11	-	-	-	-	-	Test bore only
GW026557	28.3	-	15.8 – 28.2	-	-	Sandy silt (alluvium)	Test hole only
GW072329	5	-	-	-	-	-	Monitoring bore
GW109315	3	0.6	1.0 – 3.0	1	“good”	Sand (alluvium)	Monitoring bore
GW109700	4.8	1.84	4.0 – 4.6	-	3106	Sandy clay (alluvium)	Monitoring bore
GW110413	156	17	39 – 156	1.4	700	Sandstone	Industrial

Notes: 1. SWL = standing water level
2. TDS = total dissolved solids

[1] NSW Natural Resource Atlas accessed online 13th January, 2011, http://www.nratlas.nsw.gov.au

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Appendix B

Water quality data

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B.1 Water quality data

Shown in the table below is data collected from produced water extracted during routine well operation. Analysis was performed by ALS Laboratory Group, Sydney.

Table B.1 Water quality data

Analyte	Units	Limit of reporting	Results of analysis	
Site			**MP17**	**MP17**
Sample date			**25/08/2011**	**17/11/2011**
General Parameters				
pH	pH units	0.01	na	Na
Conductivity	µS/cm	1	6130	7160
Salinity	g/kg	0.01	3.33	3.93
Suspended Solids	mg/L	5	66	15
Total Dissolved Solids	mg/L	1	na	na
Calculated Total Dissolved Solids	mg/L	-	na	na
Laboratory Analytes				
Total Hardness as $CaCO_3$	mg/L	1	36	na
Hydroxide Alkalinity as $CaCO_3$	mg/L	1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1	145	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	3366	4280
Total Alkalinity as $CaCO_3$	mg/L	1	3500	4280
Sulfate as SO_4^{2-}	mg/L	1	<1	<1
Chloride	mg/L	1	93	113
Calcium	mg/L	1	11	21
Magnesium	mg/L	1	2	3
Sodium	mg/L	1	1540	1840
Potassium	mg/L	1	11	16
Silica	mg/L	0.1	9.5	29.1
Ions				
Fluoride	mg/L	0.1	0.7	na
Total Anions	meq/L	0.01	72.6	88.7
Total Cations	meq/L	0.01	68	81.7
Ionic Balance	%	0.01	3.32	4.15
Dissolved Metals				
Aluminium	mg/L	0.01	<0.01	<0.01
Arsenic	mg/L	0.001	<0.001	0.001
Beryllium	mg/L	0.001	<0.001	<0.001
Barium	mg/L	0.001	2.92	5.59
Cadmium	mg/L	0.0001	<0.0001	<0.0001

Table B.1 Water quality data

Analyte	Units	Limit of reporting	Results of analysis	
Chromium			<0.005	0.001
Cobalt	mg/L	0.001	<0.001	<0.001
Copper	mg/L	0.001	<0.001	0.002
Lead	mg/L	0.001	<0.001	<0.001
Manganese	mg/L	0.001	0.054	0.004
Mercury	mg/L	0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	0.005	0.008
Nickel	mg/L	0.001	0.007	0.005
Selenium	mg/L	0.01	<0.01	<0.01
Strontium	mg/L	0.001	0.7	1.18
Uranium	mg/L	0.001	<0.001	<0.001
Vanadium	mg/L	0.01	<0.01	<0.01
Zinc	mg/L	0.005	<0.005	0.009
Boron	mg/L	0.05	<0.05	0.07
Iron	mg/L	0.05	0.14	0.23
Bromine	mg/L	0.1	0.2	0.2
Iodine	mg/L	0.1	<0.1	<0.1
Nutrients				
Ammonia as N	mg/L	0.01	6.05	na
Nitrite as N	mg/L	0.01	<0.01	na
Nitrate as N	mg/L	0.01	0.01	na
Nitrite + Nitrate as N	mg/L	0.01	0.01	na
Total Phosphorous	mg/L	0.01	na	na
Reactive Phosphorous	mg/L	0.01	0.02	na
Total Organic Carbon	mg/L	1	na	na
Dissolved Gases				
Methane	µg/L	10	2210	na
Phenolic compounds				
Phenol	µg/L	1	<1.0	na
2-Chlorophenol	µg/L	1	<1.0	na
2-Methylphenol	µg/L	1	<1.0	na
3-&4-Methylphenol	µg/L	2	<2.0	na
2-Nitrophenol	µg/L	1	<1.0	na
2.4-Dimethylphenol	µg/L	1	<1.0	na
2.4-Dichlorophenol	µg/L	1	<1.0	na
2.6-Dichlorophenol	µg/L	1	<1.0	na
4-Chloro-3-Methylphenol	µg/L	1	<1.0	na
2.4.6-Trichlorophenol	µg/L	1	<1.0	na
2.4.5-Trichlorophenol	µg/L	1	<1.0	na
Pentachlorophenol	µg/L	2	<2.0	na
Polycyclic aromatic hydrocarbons				
Naphthalene	µg/L	1	<1.0	na
Acenaphthylene	µg/L	1	<1.0	na

Table B.1 Water quality data

Analyte	Units	Limit of reporting	Results of analysis	
Acenaphthene	µg/L	1	<1.0	na
Fluorene	µg/L	1	<1.0	na
Phenanthrene	µg/L	1	<1.0	na
Anthracene	µg/L	1	<1.0	na
Fluoranthene	µg/L	1	<1.0	na
Pyrene	µg/L	1	<1.0	na
Benz(a)anthracene	µg/L	1	<1.0	na
Chrysene	µg/L	1	<1.0	na
Benzo(b)fluoranthene	µg/L	1	<1.0	na
Benzo(k)fluoranthene	µg/L	1	<1.0	na
Benzo(a)pyrene	µg/L	0.5	<0.5	na
Indeno(1.2.3.cd) pyrene	µg/L	1	<1.0	na
Dibenz(a.h) anthracene	µg/L	1	<1.0	na
Benzo(g.h.i)perylene	µg/L	1	<1.0	na
Sum of polycyclic aromatic hydrocarbons	µg/L	0.5	<0.5	na
Phenolic compound surrogates				
Phenol-d6	%	0.5	21.7	na
2-Chlorophenol-D4	%	0.5	56.3	na
2.4.6-Tribromophenol	%	0.5	73.7	na
PAH surrogates				
2-Fluorobiphenyl	%	0.5	63.3	na
Anthracene-d10	%	0.5	83.3	na
4-Terphenyl-d14	%	0.5	68	na
Total petroleum hydrocarbons	µg/L	20		
C6-C9 Fraction	µg/L	50	<20	na
C10-C14 Fraction	µg/L	100	<50	na
C15-C28 Fraction	µg/L	50	490	na
C29-C36 Fraction	µg/L	50	500	na
C10-C36 Fraction (sum)			990	na
Total recoverable hydrocarbons				
C6 - C10 Fraction	µg/L	20	<20	na
C6 - C10 Fraction minus BTEX (F1)	µg/L	20	<20	na
>C10 - C16 Fraction	µg/L	100	<100	na
>C16 - C34 Fraction	µg/L	100	820	na
>C34 - C40 Fraction	µg/L	100	260	na
>C10 - C40 Fraction (sum)	µg/L	100	1080	na
BTEX surrogates				

Table B.1 Water quality data

Analyte	Units	Limit of reporting	Results of analysis	
1.2-Dichloroethane-D4	%	2	114	na
Toluene-D8	%	2	104	na
4-Bromofluorobenzene	%	2	97.6	na
Aromatic Hydrocarbons				
Benzene	µg/L	1	<1	na
Toluene	µg/L	2	<5	na
Ethyl Benzene	µg/L	2	<2	na
m&p-Xylenes	µg/L	2	<2	na
o-Xylenes	µg/L	2	<2	na

Notes: na = not analysed

Appendix C

Schematic stratigraphic model for the CGP area

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C.1 Schematic stratigraphic model for the CGP area

Shown in the illustration below is a schematic representation of the stratigraphy for the CGP area. Although the above ground section of the model references the Camden North area, the underground stratigraphy is representative for the entire CGP area and, therefore, also relevant for the proposed MP25 site.

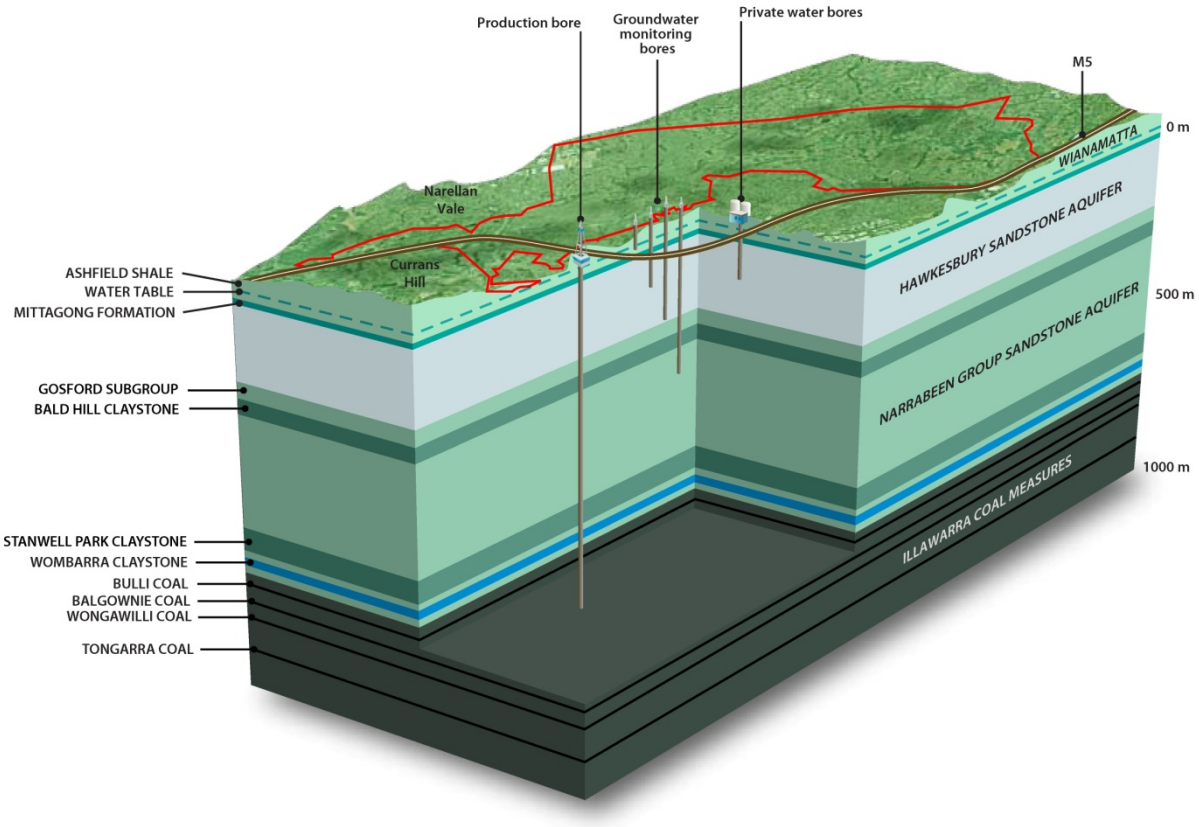

Figure C.1 Schematic stratigraphic model for the CGP area

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Appendix D

Threatened species and ecological communities habitat assessment

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D.1 Introduction

D.1.1 Project description summary

A new production well (MP25) is proposed adjacent to a previous production well (MP16). The new production well requires a level work pad area of 6,820 m^2, which is defined as the 'study area'. The proposed well requires that several shrubs (15 Wattles, nine of which are in the later stages of senescence) be removed to facilitate its use as a pad area to enable drilling of the production well. A spur access track to the north of the existing access track (Figure 2.1 of the EA) is also required. An alternate access to the pad is also proposed to the south of the existing track.

The proponent proposes to install an additional GGL adjacent to the existing pipe between MP16 and MP13/30 which includes a connection from the proposed MP25. The proposed twinned GGL will be constructed within the existing disturbance area along the existing GGL, as shown in Figure 6.1 in the Response to Submissions report. The expected area of disturbance for the proposed twinned GGL would be approximately 5 m wide along the proposed route (within the designated corridor) and up to a depth of 1,200 mm (dependent upon localised conditions).

A full description of proposed activities is provided in Section 2.1 and 6.2 of this report.

D.1.2 Site description

The proposed MP25 well is located on the floodplain of the Nepean River in Menangle Park, on land owned by Menangle Park Paceway (Figure 2.1 of the EA). The site has been subject to heavy disturbance. Historically, the site was a sand mine, which was rehabilitated when mining ceased. More recently, the site has been used as a horse training facility. A narrow corridor of dense vegetation (15 to 20 m) exists in the riparian zone along the Nepean River. The remainder of the site exists as open grassland dominated by exotic species. Further information on vegetation communities and plant species is provided in Section D.3.1.

D.1.3 Purpose

The purpose of this assessment is to:

- investigate the potential for threatened entities (species, populations and communities) listed under the *Threatened Species Conservation Act 1995* (TSC Act) or the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to occur at the site;
- determine any potential impacts to these threatened entities as a result of the proposed well;
- provide practical measures to minimise or mitigate potential impacts prior to, during and following the completion of construction.

D.2 Methodology

D.2.1 Desktop review

Vegetation mapping including the '*Native vegetation of the Cumberland Plain of Western Sydney*' (NPWS 2002) was used to identify vegetation communities onsite.

A list of threatened entities with the potential to occur within or surrounding the proposed MP25 was compiled by querying the following databases in January 2012:

- Office of Environment and Heritage (OEH) Atlas of NSW Wildlife for species listed under the TSC Act; and
- the Commonwealth Protected Matters Search Tool for species listed under the EPBC Act.

A radius of 10 km was placed around the site to capture all records of threatened entities within this area.

D.2.2 Site inspection

A site inspection was carried out on Monday 23 January 2012 by Katie Whiting, a trained and experienced senior ecologist from EMM. During the site inspection, the following information was recorded:

- plant species;
- vegetation communities;
- fauna habitats; and
- opportunistic fauna observations.

D.3 Results

D.3.1 Desktop review

D.3.1.1 Vegetation communities

NPWS (2002) classifies vegetation at the site to be 'Alluvial Woodland'. It occurs exclusively along, or in close proximity to minor watercourses draining soils derived from Wianamatta Shale. It is the most common community found on soils of recent alluvial deposition. Alluvial Woodland is also found on the floodplains of the major watercourse, the Hawkesbury-Nepean River, but grades into Riparian Forest on the terraces immediately adjacent to the river.

This vegetation community contains a number of tree species which may be dominant at different sites. The two most common species are Cabbage Gum (*Eucalyptus amplifolia*) and Forest Red Gum (*E. tereticornis*), with Rough-barked Apple (*Angophora floribunda*) occurring slightly less frequently.

Alluvial Woodland often includes a stratum of small trees, frequently including Parramatta Wattle (*Acacia parramattensis subsp. Parramattensis)*, and less frequently River She-oak (*Casuarina cunninghamiana*), and sometimes Flax-leaved Paperbark (*Melaleuca linariifolia*). A shrub stratum is usually evident, but is often sparse and invariably dominated by Blackthorn (*Bursaria spinosa*).

Alluvial Woodland often has a dense ground cover dominated by grasses such as Basket Grass (*Oplismenus aemulus*), Weeping Meadow Grass (*Microlaena stipoides var. stipoides*), Right-angled Grass (*Entolasia marginata*) and Hedgehog Grass (*Echinopogon ovatus*). Herb species are also common, including Forest Nightshade (*Solanum prinophyllum*), Whiteroot (*Pratia purpurascens*) and Native Wandering Jew (*Commelina cyanea*).

D.3.1.2 Threatened ecological communities

Thirteen threatened ecological communities have previously been recorded within the Cumberland sub-region of the Sydney Metropolitan Catchment Management Area (DEC 2005). These include:

- Agnes Banks Woodland in the Sydney Basin Bioregion;
- Blue Gum High Forest in the Sydney Basin Bioregion;
- Castlereagh Swamp Woodland Community;
- Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion;
- Cumberland Plain Woodland in the Sydney Basin Bioregion;
- Elderslie Banksia Scrub Forest;
- River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Shale Gravel Transition Forest in the Sydney Basin Bioregion;
- Shale/Sandstone Transition Forest;
- Southern Sydney Sheltered Forest on transitional sandstone soils in the Sydney Basin Bioregion;
- Swamp Oak Floodplain Forest of the NSW North Coast; Sydney Basin and South East Corner Bioregions;
- Sydney Turpentine-Ironbark Forest; and
- Western Sydney Dry Rainforest in the Sydney Basin Bioregion.

D.3.1.3 Threatened flora

Thirteen threatened flora species have previously been recorded within 10km of the proposed production well. These include:

- Austral Toadflax (*Thesium australe*);
- Bargo Geebung (*Persoonia bargoensis*);
- Brown Pomaderris (*Pomaderris brunnea*);
- Bynoe's Wattle (*Acacia bynoeana*);
- Camden White Gum (*Eucalyptus benthamii*);
- Deane's Paperbark (*Melaleuca deanei*);
- Hairy Geebung (*Persoonia hirsuta*);

- Matted Bush-pea (*Pultenaea pedunculata*);
- Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora);*
- Spiked Rice Flower (*Pimelea spicata);*
- Sydney Plains Greenhood (*Pterostylis saxicola*);
- White-flowered Wax Plant (*Cynanchum elegans*); and
- Woronora Beard Heath (*Leucopogon exolasius*).

D.3.1.4 Threatened fauna

Several threatened fauna species have previously been recorded within 10km of the proposed production well. These include:

- Invertebrates: Cumberland Plain Land Snail (*Meridolum corneovirens*);
- Birds: Black-necked Stork (*Ephippiorhynchus asiaticus*), Brown Treecreeper (*Climacteris picumnus victoriae*), Bush stone-curlew (*Burhinus grallarius*), Diamond Firetail (*Stagnopleura guttata*), Flame Robin (*Petroica phoenicea*), Freckled Duck (*Stictonetta naevosa*); Gang-gang Cockatoo (*Callocephalon fimbriatum*), Glossy Black Cockatoo (*Calyptorhynchus lathami*), Hooded Robin (*Melanodryas cucullata*), Little Eagle (*Hieraeetus morphnoides*), Little Lorikeet (*Glossopsitta pusilla*), Powerful Owl (*Ninox strenua*), Regent Honeyeater (*Anthochaera phrygia*), Scarlet Robin (*Petroica boodang*), Speckled Warbler (*Pyrrhoaelaeumus saggitatus),* Spotted Harrier (*Circus assimilis*), Swift Parrot (*Lathamus discolor*), Varied Sittella (*Daphoenositta chrysoptera*);
- Amphibians: Giant Burrowing Frog (*Heleioporus australasicus),* Red-crowned Toadlet (*Pseudophryne australis*);
- Reptiles: Broad-headed Snake (*Hoplocephalus bungaroides*), Rosenberg's Goanna (*Varanus rosenbergi*);
- Mammals: Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Eastern Freetail Bat (*Mormopterus norfolkensis*), Eastern Pygmy Possum (*Cercartetus nanus*), Greater Broadnosed Bat (*Scotoreanax rueppellii),* Grey-headed Flying-fox (*Pteropus poliocephalus*), Koala (*Phascolarctos cinereus*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Southern Myotis (*Myotis macropus*), Spotted-tailed Quoll (*Dasyurus maculatus*), Squirrel Glider (*Petaurus norfolcensis),* Yellow-bellied Glider (*Petaurus australis*), and Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*).

D.3.1.5 Migratory fauna

Several species listed as migratory have been recorded, or are predicted to occur by the '*Protected Matters Search Tool*' within 10km of the site. These include:

- Fork-tailed Swift (*Apus pacificus*);
- Great Egret (*Ardea alba*);
- Cattle Egret (*Ardea ibis*);
- White-bellied Sea Eagle (*Haliaeetus leucogaster*);
- White-throated Needletail (*Hirundapus caudacutus*);
- Rainbow Bee-eater (*Merops ornatus*);
- Black-faced Monarch (*Monarcha melanopsis*);
- Satin Flycatcher (*Myiagra cyanoleuca*); and
- Rufous Fantail (*Rhipidura cyanoleuca*).

D.3.2 Site inspection

D.3.2.1 Vegetation communities

Vegetation within the pad site for the proposed production well (MP25) is characterised by an open grassland structure to 1.5m in height. The grassland is predominantly exotic, and is dominated by African Lovegrass (*Eragrostis curvula*), Paspalum (*Paspalum dilatatum*), and Rhodes Grass (*Chloris gayana*). Other weed species present include Scotch Thistle (*Onopordum acanthium*), Small-leaved Privet (*Ligustrum sinense*), Purpletop (*Verbena bonariensis*), Fleabane (*Conyza bonariensis*), Bearded Oats (*Avena barbata*), Dandelion (*Taraxicum officinale*), Plantain (*Plantago lanceolata*), and Centaury (*Centaurium erythraea*). Small swards of the native species, Kangaroo Grass (*Themeda australis*) and Couch (*Cynodon dactylon*) are present within the disturbed grassland. Several Wattles (*Acacia decurrens, A. floribunda* and *A. longifolia* subsp. *longifolia*) are present within the disturbed grassland. A photograph of typical vegetation within the proposed pad site is shown in Figure D.1. Vegetation within the proposed twinned GGL is also highly disturbed, and comprises the same exotic species as the proposed pad site for the proposed MP25 well.

Figure D.1 Indicative photographs of proposed pad site

Vegetation adjacent to the pad site is consistent with the description of Alluvial Woodland (Section A.3.1.1). The canopy is dominated by Forest Red Gum (*E. tereticornis*) to 25 m in height. The shrub stratum is dominated by River She-oak (*Casuarina cunninghamiana*), however *Melaleuca decora* and the introduced Large-leaved Privet (*Ligustrum lucidum*) and juvenile Forest Red Gum are also present in this layer. The introduced Balloon Vine (*Cardiospermum grandiflorum*) is also invading the shrub and canopy strata. The ground cover is dominated by the introduced Wandering Jew (*Tradescantia fluminensis*).

Figure D.2 Indicative photographs of proposed twinned GGL route

D.3.2.2 Threatened ecological communities

No threatened ecological communities are present within the pad site. However, the Alluvial Woodland that is present along the Nepean River riparian corridor is consistent with an endangered ecological community (EEC), namely Riverflat Eucalypt Forest on Coastal Floodplains of NSW North Coast, Sydney Basin and South East Corner Bioregions. Vegetation communities on site are compared in Table D.1 with the '*Riverflat Eucalypt Forest Identification Guidelines'* (DECC n.d.).

Table D.1 Comparison of vegetation communities on site to Riverflat Eucalypt Forest EEC

Criteria	Proposed disturbance areas	Nepean River riparian corridor
Is the site south of Port Stephens in the NSW North Coast, Sydney Basin or South East Corner bioregions	Yes	Yes
Is the site on the coastal floodplain?	Yes	Yes
Is the site on silty, clay or sandy loam soil with a lack of deep humic layers and has little or no saline influence?	Yes	Yes
Is the site located on a river flat or terrace in an upper part of the coastal floodplain?	Yes	Yes
Does the site consist of an open forest or woodland with a mixture of Eucalypt or Angophora trees, particularly Forest Red Gum, Cabbage Gum or Broad-leaved Apple	No	Yes
Are there any characteristic shrub and/or groundlayer species present?	No	Yes
Are there relatively low numbers of She-oaks, Paperbarks or Swamp Mahogany trees?	Yes	Yes
Is the site Riverflat Eucalypt Forest?	No	Yes

Therefore, Riverflat Eucalypt Forest EEC is present adjacent to the site, but not located on the pad of the proposed construction pad for MP25 nor the route of the proposed GGL.

D.3.2.3 Threatened species

An assessment of the likelihood that the identified threatened species or ecological communities could occur at the proposed disturbance areas is provided below in Table D.2. Assessments of the significance of potential impact have been conducted for those threatened species and ecological communities and migratory species which could be impacted by the proposed activities (see Appendix E).

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
OEH Atlas of NSW Wildlife search results			
Brown Pomaderris (*Pomaderris brunnea*)	TSC Act – Vulnerable EPBC Act – Vulnerable	Found in moist woodland or forest on clay and alluvial soils of flood plains and creek lines around the Nepean, Hawkesbury and Colo Rivers, the Bargo area, the New England tablelands and far eastern Gippsland. Has been found in association with *Eucalyptus amplifolia*, *Angophora floribunda*, *Acacia parramattensis, Bursaria spinosa and Kunzea ambigua.*	Nil, associated species absent.
Bynoe's Wattle (*Acacia bynoeana*)	TSC Act – Endangered EPBC Act – Vulnerable	Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leafed Apple.	Nil, associated species absent.
Camden White Gum (*Eucalyptus benthamii*)	TSC Act – Vulnerable EPBC Act – Vulnerable	Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Occurs in open forest. Associated species at the Bents Basin site include *Eucalyptus elata, E. bauerina, E. amplifolia, E. deanei* and *Angophora subvelutina*. Understorey species include *Bursaria spinosa, Pteridium esculentum* and a wide variety of agricultural weeds. The Kedumba Valley site lists E. *crebra, E. deanei, E. punctata, Leptospermum flavescens, Acacia filicifolia* and *Pteridium esculentum* among its associated species.	Nil, associated species absent.
Deane's Paperbark (*Melaleuca deanei*)	TSC Act – Vulnerable EPBC Act – Vulnerable	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai/Berowra and Holsworthy/Wedderburn areas respectively. There are also more isolated occurrences at Springwood (in the Blue Mountains), Wollemi National Park, Yalwal (west of Nowra) and Central Coast (Hawkesbury River) areas. The species grows in heath on sandstone. Flowers appear in summer but seed production appears to be small and consequently the species exhibits a limited capacity to regenerate.	Nil, suitable habitat absent.
Hairy Geebung (*Persoonia*	TSC Act – Endangered	*Persoonia hirsuta* has a scattered distribution around Sydney. The species is distributed from Singleton in the north, along the east coast to Bargo in the south and the Blue Mountains to the	Nil, suitable habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
hirsuta)	EPBC Act Endangered	west. *Persoonia hirsuta* has a large area of occurrence, but occurs in small populations, increasing the species fragmentation in the landscape. The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations. It is probably killed by fire (as other Persoonia species are) but will regenerate from seed.	
Matted Bush-pea (*Pultenaea pedunculata)*	TSC Act – Endangered	The Matted Bush-pea occurs in a range of habitats. NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area. The ability of stems to creep and root from the nodes has made this species a very good coloniser of bare ground in many parts of its range. Flowers appear in spring.	Nil, suitable habitat absent.
Small-flower Grevillea (*Grevillea parviflora subsp. parviflora*)	TSC Act – Vulnerable EPBC Act – Vulnerable	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Found over a range of altitudes from flat, low-lying areas to upper slopes and ridge crests. Often occurs in open, slightly disturbed sites such as along tracks. Plants are capable of suckering from a rootstock and most populations demonstrate a degree of vegetative spread, particularly after disturbance such as fire. Flowering has been recorded between July to December as well as April-May. Flowers are insect-pollinated and seed dispersal is limited.	Nil, suitable habitat absent.
Spiked Rice Flower (*Pimelea spicata*)	TSC Act – Endangered EPBC Act Endangered	Once widespread on the Cumberland Plain, the Spiked Rice-flower occurs in two disjunct areas; the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas) and the Illawarra (Landsdowne to Shellharbour to northern Kiama). In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coast Banksia open woodland with a better developed shrub and grass understorey.	Nil, suitable habitat absent.
Sydney Plains Greenhood (*Pterostylis saxicola*)	TSC Act – Endangered EPBC Act Endangered	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Only one population occurs within a conservation reserve (Georges River National Park). Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines.	Nil, required habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
		The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils. All species of Pterostylis are deciduous and die back to fleshy, rounded underground tuberoids. The time of emergence and withering has not been recorded for this species, however flowering occurs from October to December and may vary due to climatic conditions. The above ground parts of the plant wither and die following seed dispersal and the plant persists as a tuberoid until the next year. Typically occurs as scattered individuals or in small groups.	
White-flowered Wax Plant (*Cynanchum elegans*)	TSC Act – Endangered EPBC Act – Endangered	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree Leptospermum laevigatum – Coastal Banksia Banksia integrifolia subsp. integrifolia coastal scrub; Forest Red Gum Eucalyptus tereticornis aligned open forest and woodland; Spotted Gum Eucalyptus maculata aligned open forest and woodland; and Bracelet Honeymyrtle Melaleuca armillaris scrub to open scrub. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific. The fruit can take up to six months to mature. Seed production is variable and unreliable. Seeds are wind dispersed. It is considered to be unlikely that a soil seed bank for this species exists. Plants are capable of suckering from rootstock in response to occasional slashing or grazing. The fire response of the species is unknown.	Nil, required habitat absent.
Woronora Beard Heath (*Leucopogon exolasius*)	TSC Act – Vulnerable EPBC Act – Vulnerable	Woronora Beard-heath is found along the upper Georges River area and in Heathcote National Park. The plant occurs in woodland on sandstone. Flowering occurs in August and September.	Nil, required habitat absent.
Cumberland Plain Land Snail (*Meridolum corneovirens*)	TSC Act – Endangered	Inhabits the Cumberland Plain Woodland endangered ecological community, which comprises a grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs or shelters in loose soil around grass clumps. Occasionally shelters under rubbish. Forages on fungus.	Nil, required habitat absent.
Black-necked stork (*Ephippiorhyncus asiaticus*)	TSC Act – Endangered	Shallow, permanent, freshwater terrestrial wetlands and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and	This species may occupy the site on an infrequent basis. Further assessment

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
		open savannah woodlands.	required.
Brown treecreeper (eastern subspecies (*Climacteris picumnus victoriae*)	TSC Act – Vulnerable	Inhabits eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range, and less commonly found on coastal plains and ranges. The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. This species is mainly found in woodlands dominated by rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more subspecies. This species is also found in mallee and River Red Gum Forest bordering wetlands. It is not usually found in woodlands with a dense shrub layer. Fallen timber is an important habitat component for foraging. Forages for invertebrates in trunks and branches of trees and fallen timber. Nests in hollows in standing dead or live trees and tree stumps.	Nil, required habitat absent.
Bush stone-curlew	TSC Act – Endangered	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch. Two eggs are laid in spring and early summer.	Nil, required habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
Diamond Firetail	TSC Act – Vulnerable	Birds roost in dense shrubs or in smaller nests built especially for roosting. Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum Eucalyptus pauciflora Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Usually encountered in flocks of between five to 40 birds, occasionally more. Groups separate into small colonies to breed, between August and January. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. Appears to be sedentary, though some populations move locally, especially those in the south. Has been recorded in some towns and near farm houses.	Nil. This species may occur along the riparian corridor, however this will not be directly impacted by the proposed activities.
Flame Robin	TSC Act – Vulnerable	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains).Often occurs in recently burnt areas; however, habitat becomes unsuitable as vegetation closes up following regeneration. In winter lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. In winter, occasionally seen in heathland or other shrublands in coastal areas. Birds forage from low perches, from which they sally or pounce onto small invertebrates which they take from the ground or off tree trunks, logs and other coarse woody debris. Flying insects are often taken in the air and sometimes gleans for invertebrates from foliage and bark. In their autumn and winter habitats, birds often sally from fence-posts or thistles and other prominent perches in open habitats.	Nil, required habitat absent.
Freckled Duck	TSC Act – Vulnerable	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. Generally rest in dense cover during the day, usually in deep water. Feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates. Nesting usually occurs between	Nil, required habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
		October and December but can take place at other times when conditions are favourable. Nests are usually located in dense vegetation at or near water level.	
Gang-gang Cockatoo	TSC Act – Vulnerable	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. May also occur in sub-alpine Snow Gum Eucalyptus pauciflora woodland and occasionally in temperate rainforests. Move to lower altitudes in winter, preferring more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas. Favours old growth attributes for nesting and roosting.	Nil, required habitat absent.
Glossy Black Cockatoo	TSC Act – Vulnerable	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (Allocasuarina littoralis), Forest She-oak (A. torulosa) or Drooping She-oak (A. verticillata) occur. In the Riverina area, again usually associated with woodlands containing Drooping She-oak but also recorded in open woodlands dominated by Belah (Casuarina cristata).Feeds almost exclusively on the seeds of several species of she-oak (Casuarina and Allocasuarina species), shredding the cones with the massive bill. Dependent on large hollow-bearing eucalypts for nest sites. One or two eggs are laid between March and August.	Nil. This species may forage along the riparian corridor, however this will not be directly impacted by the proposed activities.
Hooded Robin	TSC Act – Vulnerable	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season.	Nil, required habitat absent.
Little eagle (*Hieraaetus morphnoides*)	TSC Act – Vulnerable	Open eucalypt forest, woodland or open woodland or she-oak or acacia woodlands and riparian woodlands of interior NSW. Nests in tall living trees and preys on birds, reptiles, mammals, large insects and carrion.	Nil. This species may occur along the riparian corridor, however this will not be directly impacted by the proposed

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
			activities.
Little lorikeet (*Glossopsitta pusilla*)	TSC Act – Vulnerable	Forages primarily in the canopy of open eucalypt forests and woodland, also finding food in *Angophora* spp., *Melaleuca* spp. and other native species. Often uses riparian habitats. Feeds on nectar and pollen and native fruits, and occasionally in orchards or on isolated flowering trees in open country. Roosts in treetops, often distant from feeding areas. Typically nests in hollows in smooth-barked eucalypts or riparian trees, often *Allocasuarina* spp.	Nil. This species may occur along the riparian corridor, however this will not be directly impacted by the proposed activities.
Powerful owl (*Ninox strenua*)	TSC Act – Vulnerable	Inhabits woodland, open sclerophyll forest, tall open wet forest and rainforest. Breeds and hunts for medium-sized arboreal marsupials, birds and flying-foxes in open or closed sclerophyll forest or woodlands, occasionally hunting in open habitats. Roosts in dense vegetation comprising species such as eucalypts, *Syncarpia glomulifera*, *Allocasuarina littoralis*, *Acacia melanoxylon*, *Angophora floribunda*, and *Exocarpus cupressiformis*. Nests in hollow-bearing trees.	Nil. This species may occur along the riparian corridor, however this will not be directly impacted by the proposed activities.
Regent Honeyeater	EPBC Act – Endangered TSC Act – Critically Endangered	Mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. There are only three known key breeding regions remaining: north-east Victoria (Chiltern-Albury), and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Nil, required habitat absent.
Scarlet Robin	TSC Act - Vulnerable	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. The Scarlet Robin is primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with	Nil, required habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
		scattered trees.	
Speckled Warbler	TSC Act - Vulnerable	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees.	Nil, required habitat absent.
Spotted Harrier	TSC Act - Vulnerable	Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months.	This species could use the site infrequently. Further assessment is required.
Swift Parrot			
Varied sittella (*Daphoenositta chrysoptera*)	TSC Act - Vulnerable	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and acacia woodland. Nests in tree forks high in the living tree canopy. Feeds on arthropods found in rough or peeling bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.	Nil, suitable habitat absent.
Giant Burrowing Frog		Giant Burrowing Frogs usually live along clear, small slowly flowing water courses which traverse plateaus and broad upland gullies. They also live adjacent to stream head-waters where they prefer permanently moist soaks and pondages. Many breeding sites have been found to be associated with shallow temporary ponds receiving seepage and the ponded sections of slow flowing creeks that drain ridges and plateaus.	Nil, suitable habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
Red-crowned Toadlet	TSC Act – Vulnerable	Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Red-crowned Toadlets are usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites. Due to this tendency for discrete populations to concentrate at particular sites, a relatively small localised disturbance may have a significant impact on a local population if it occurs on a favoured breeding or refuge site. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Red-crowned Toadlets have not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5.	Nil, suitable habitat absent.
Broad-headed Snake	TSC Act – Endangered EPBC Act- Vulnerable	Nocturnal. Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer. Feeds mostly on geckos and small skinks; will also eat frogs and small mammals occasionally.	Nil, suitable habitat absent.
Rosenberg's Goanna	TSC Act – Vulnerable	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Individuals require large areas of habitat. Feeds on carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens.	Nil, suitable habitat absent.
Eastern bentwing-bat (*Miniopterus schreibersii oceanensis*)	TSC Act – Vulnerable	Occurs along the east and north-west coasts of Australia, hunting for flying insects in forested areas above the tree tops. Roosts in caves, derelict mines, stormwater tunnels, buildings, and other man-made structures.	Nil, suitable habitat absent.
Eastern false pipistrelle	TSC Act – Vulnerable	Occurs in moist habitats with trees taller than 20 m, and roosts in eucalypt hollows, loose bark on	Nil, suitable habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
(*Falsistrellus tasmaniensis*)		trees, and in buildings. Hunts flying insects above or just below the tree canopy.	
Eastern freetail-bat (*Mormopterus norfolkensis*)	TSC Act - Vulnerable	Inhabits dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roosts in tree hollows, under bark and in man-made structures. Probably insectivorous.	Nil. This species may forage along the adjacent riparian area, however this will not be directly impacted by the proposed activities.
Eastern Pygmy Possum	TSC Act – Vulnerable	Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation, (eg. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.	Nil, suitable habitat absent.
Greater Broadnosed Bat	TSC Act – Vulnerable	Uses a variety of habitats from woodland to moist and dry eucalypt forest and rainforest, most commonly using tall wet forest. Mainly found in gullies and river systems draining the Great Dividing Range, extending to the coast. Roosts in tree hollows and has been found roosting in buildings. Forages for flying insects in open woodland habitat and dry open forest.	Nil, suitable habitat absent.
Grey-headed flying-fox (*Pteropus poliocephalus*)	TSC Act – Vulnerable EPBC Act - Vulnerable	Inhabits subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps, urban gardens and cultivated fruit crops. Commonly roosts in dense canopy in gullies, close to water. Feeds on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia* spp., and fruits of rainforest trees and vines. Also forages in cultivated gardens and fruit crops.	Nil. This species may forage along the adjacent riparian area, however this will not be directly impacted by the proposed activities.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
Koala	TSC Act – Vulnerable	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Inactive for most of the day, feeding and moving mostly at night. Spend most of their time in trees, but will descend and traverse open ground to move between trees. Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.	Nil. This species may forage along the adjacent riparian area, however this will not be directly impacted by the proposed activities.
Large-eared pied bat (*Chalinolobus dwyeri*)	TSC Act – Vulnerable EPBC Act – Vulnerable	Occurs in low to mid elevation dry open forests and woodlands close to roosting habitat in caves, crevices in cliffs, old mine workings and disused nests of the fairy martin (*Hirundo ariel*). Found in well-timbered areas containing gullies and probably forages for small flying insects below the forest canopy.	Nil, suitable habitat absent.
Southern Myotis (*Myotis macropus*)	TSC Act – Vulnerable	Occurs along the coastal band from north-west Australia, the top end and south to western Victoria. Forages for insects and small fish over streams and pools. Roosts close to water in caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage.	Nil. This species may forage in the Nepean River however this will not be directly impacted by the activities.
Greater broad-nosed bat (*Scoteanax rueppellii*)	TSC Act – Vulnerable	The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.	Nil, suitable habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
EPBC Act Protected Matters Search Tool results – migratory species			
Fork-tailed swift (*Apus pacificus*)	EPBC Act - Migratory	The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. The sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines (Higgins 1999). They forage aerially, up to hundreds of metres above ground, but also less than 1 m above open areas or over water.	Nil, this species roosts and forages aerially.
Great egret/white egret (*Ardea alba*)	EPBC Act - Migratory	The Eastern Great Egret has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Kushlan & Hancock 2005; Marchant & Higgins 1990; Martínez-Vilalta & Motis 1992). The species usually frequents shallow waters. The Eastern Great Egret may retreat to permanent wetlands or coastal areas when other wetlands are dry (for example, during drought). This may occur annually in some regions with regular wet and dry seasons or erratically where the availability of wetland habitat is also erratic.	Suitable habitat is present at the site. Further assessment is required.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
Cattle egret (*Ardea ibis*)	EPBC Act - Migratory	The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation (Marchant & Higgins 1990; Morton et al. 1989). The Cattle Egret often forages away from water on low lying grasslands, improved pastures and croplands. It is commonly found in cattle fields and other farm areas that contain livestock. The Cattle Egret has also been observed foraging in rubbish tips. It is becoming more frequent in drier regions; consuming the ticks of livestock in the absence of other food sources. This inland spread is believed to be due to the construction of artificial waterways (Marchant & Higgins 1990).The Cattle Egret roosts in trees, or amongst ground vegetation in or near lakes and swamps. It has also been recorded roosting near human settlement and industrial areas in Murwillumbah, NSW (Marchant & Higgins 1990).	Suitable habitat is present at the site. Further assessment is required.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
White-bellied sea-eagle (*Haliaeetus leucogaster*)	EPBC Act - Migratory	The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). Birds have been recorded in (or flying over) a variety of terrestrial habitats (Marchant & Higgins 1993).The species is mostly recorded in coastal lowlands, but can occupy habitats up to 1400 m above sea level on the Northern Tablelands of NSW and up to 800 m above sea level in Tasmania and South Australia (Marchant & Higgins 1993).Birds have been recorded at or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs, saltmarsh and sewage ponds (Boekel 1976; Favaloro 1944; Gosper 1981; Marchant & Higgins 1993). They also occur at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves (Abbott 1982; Boekel 1976; Favaloro 1944; Gosper 1981; Smith 1985). Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, forest (including rainforest) and even urban areas (Bell 1984a; Czechura 1984a; Harris 1980; Johnson & Hooper 1973; Longmore 1978; Quinn 1969; Roberts & Ingram 1976; Smith 1984).	Nil. This species may forage occasionally in the adjacent riparian area, however this will not be directly impacted by the proposed activities.
White-throated needletail (*Hirundapus caudacutus*)	EPBC Act - Migratory	In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground (Coventry 1989; Tarburton 1993; Watson 1955). Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable (Cramp 1985), but there are, nevertheless, certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland (Higgins 1999). They also commonly occur over heathland (Cooper 1971; Learmonth 1951; McFarland 1988), but less often over treeless areas, such as grassland or swamps (Cooper 1971; Gosper 1981; Learmonth 1951). When flying above farmland, they are more often recorded above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks (Emison & Porter 1978; Friend 1982; Tarburton 1993). In coastal areas, they are sometimes seen flying over sandy beaches or mudflats (Cooper 1971; Crompton 1936; Davis 1965), and often around coastal cliffs and other areas with prominent updraughts, such as ridges and sand-dunes (Cooper 1971; Dawson et al. 1991; Loyn 1980; Mitchell et al. 1996; Schulz & Kristensen 1994). They are sometimes recorded above islands well out to sea (Brandis et al. 1992; Cooper 1971; Warham 1957).	Nil, this species roosts and forages aerially.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
Rainbow bee-eater (*Merops ornatus*)	EPBC Act - Migratory	The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (Badman 1979; Boekel 1976; Fry 1984; Roberts 1979; Storr 1984a, 1984b, 1985a). It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches (Higgins 1999). The Rainbow Bee-eater occurs in open woodlands and shrublands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands (Gibson 1986; Jones 1986; Leach 1988; Longmore 1978; McEvey & Middleton 1968; Saunders & Ingram 1995; Woinarski et al. 1988, 1989) and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Badman 1989; Gee et al. 1996; Gibson 1986; Gibson & Cole 1988; Henle 1989; Longmore 1978; Storr 1977; Woinarski et al. 1988).	Suitable habitat may be present. Further assessment is required.
Black-faced monarch (*Monarcha melanopsis*)	EPBC Act - Migratory	The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. The Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating.	Nil, suitable habitat is absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
Satin flycatcher (*Myiagra cyanoleuca*)	EPBC Act - Migratory	Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (Blakers et al. 1984; Emison et al. 1987; Officer 1969). Satin Flycatchers mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moister, taller forests than the Leaden Flycatcher, Myiagra rebecula, often occurring in gullies (Blakers et al. 1984; Emison et al. 1987; Officer 1969). They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest (Emison et al. 1987; Officer 1969). In south-eastern Australia, they occur at elevations of up to 1400 m above sea level, and in the ACT, they occur mainly between 800 m above sea level and the treeline (Emison et al. 1987; Taylor & COG 1992). Satin Flycatchers are mainly recorded in eucalypt forests, especially wet sclerophyll forest, often dominated by eucalypts such as Brown Barrel, Eucalypt fastigata, Mountain Gum, E. dalrympleana, Mountain Grey Gum, Narrow-leaved Peppermint, Messmate or Manna Gum, or occasionally Mountain Ash, E. regnans. Such forests usually have a tall shrubby understorey of tall acacias, for example Blackwood, Acacia melanoxylon.	Nil. This species may occasionally use the adjacent riparian corridor, however this will not be directly impacted by activities.
Rufous fantail (*Rhipidura rufifrons*)	EPBC Act - Migratory	The Rufous Fantail is found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas.	Nil, suitable habitat absent.

Table D.2 Threatened and migratory entities – likelihood of occurrence

Species/Community	Listing	Habitat (DEC 2005, DSEWPaC 2011, Birdlife Australia, n.d)	Likelihood of occurrence within the proposed disturbance areas
Latham's snipe/Japanese snipe (*Gallinago hardwickiil)*	EPBC Act - Migratory	In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2,000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983). Latham's Snipe occurs in temperate and tropical regions of Australia (Driscoll 1993). Its altitudinal range extends from sea-level (i.e. the coast) or possibly below. For example, there are records from near Lake Eyre (Higgins & Davies 1996) to approximately 2000 m above sea-level (Chapman 1969; Driscoll 1993).	This species may occasionally occur within the site. Further assessment is required.

D.3.2.4 Incidental fauna observations

A pair of Channel-billed Cuckoos (*Scythrops novaehollandiae*) was observed during the site inspection.

D.3.2.5 Introduced species

Two juvenile European Red Foxes (*Vulpes vulpes*) were observed near the site during the inspection. Several weed species were observed within the proposed pad site during the inspection, some of these being listed weeds under the NSW *Noxious Weeds Act 1993*. A description of the noxious weeds, and their control classes are shown in Table D.3.

Table D.3 Noxious weeds of Campbelltown LGA that occur in the pad site

Common name	Scientific name	Control Class
Small-leaved Privet	*Ligustrum sinense*	4 - The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its flowering and reproduction
Broad-leaved Privet	*Ligustrum lucidum*	4 - The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its flowering and reproduction

Several other weeds that are highly invasive (however not listed as noxious in the Campbelltown LGA) are also present in the pad site. These include African Lovegrass (*Eragrostis curvula*) and Rhodes Grass (*Chloris gayana*).

D.4 Impact assessment

The following section provides information on potential impacts to threatened entities as a result of construction of the proposed production well and GGL. In summary, the proposed construction pad requires the disturbance of approximately 1.6 ha of exotic grassland, and the removal of 15 Wattles; nine of which are in the later stages of senescence. The construction activities, which include site preparation, drilling, well-head construction and grading and trench construction, are expected to occur over a period of approximately 30 days. Following these activities, the disturbance area will be rehabilitated leaving the existing access track to MP16 and the proposed MP25 in place.

The following section also considers the proposed twinning of the existing GGL between MP16 and MP13/30. The proposed route will follow an existing track and the GGL will be placed within a trench adjacent to the existing GGL.

D.4.1 Threatened ecological communities

River-Flat Eucalypt Forest on Coastal Floodplains is listed as an EEC under the TSC Act. A corridor, 15-20m in width of this EEC is located along the Nepean River, approximately 30 m west of the proposed well. The proposed construction site compound will border the fence at the edge of the EEC. The proposed action does not involve any access to the fenced EEC. Some juvenile River She-oaks (*Casuarina cunninghamiana*) belonging to this EEC have seeded beyond the fence line of the regeneration area in an area south of the existing pad for MP16 and are within the proposed construction site compound as defined within the EA. However, as discussed within Section 5 of this Response to Submissions report, the construction pad has been redefined in order to protect these regenerating River She-Oaks from construction vehicles and stockpiling. During construction this area will be designated as a 'no-go' or 'exclusion' zone with para-webbing, preventing access.

The proposed activities are unlikely to have an adverse effect on the extent or composition of the EEC such that its local occurrence would be placed at risk of extinction. There is unlikely to be a significant impact on the EEC or its habitats as a result of this action.

Additionally, the existing sedimentation fence installed along the edge of the EEC vegetation will be maintained throughout the construction of the twinned GGL to avoid indirect impacts to the EEC, including sedimentation and soil nutrification. Further, no activities will be undertaken within the dripline of this vegetation and this EEC along the GGL route will also be designated as a 'no-go zone' for construction activities.

Therefore, a Species Impact Statement is not required.

D.4.2 Threatened flora

No threatened flora were recorded or considered likely to occur, therefore no impacts are expected.

D.4.3 Threatened fauna species

Black-necked Storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands.

The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. It occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.

The study area contains an area of disturbed grassland which may become inundated during heavy rains, providing potential foraging habitat for these two species. No wetlands occur within the study area that would constitute suitable habitat for the Black-necked Stork.

Although potential foraging habitat occurs within the study area, the removal of this habitat is not likely to have a significant impact on the local occurrence of these species. The viability of any local population is not considered to be put at risk as a result of the proposed activities, due to the ample foraging habitat in better condition outside the proposed impact area. Therefore, the proposed activities are not likely to have a significant impact on the Black-necked Stork and Spotted Harrier.

D.4.4 Migratory species

The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures.

The Great Egret has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs

The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water.

In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (eg swamps, flooded grasslands or heathlands, around bogs and other water bodies). (ref: http://www.environment.gov.au/cgi-bin/sprat/)

The study area constitutes sub-optimal foraging habitat for these species that use flooded grasslands adjacent to waterbodies after periods of heavy rain.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

The study area is not within the known breeding areas for these species. As such, any individuals present would be non-breeding and would be utilising the low quality foraging habitat present. These are not considered to be part of an ecologically significant proportion of the nearly 100,000 population within Australia and New Zealand.

The proposed activities are not likely to constitute a significant impact on the Cattle Egret, Great Egret, Rainbow Bee-eater or Latham's Snipe. No further assessment is required and a Referral to the Commonwealth Minister for the Environment is not required.

D.4.5 Key threatening processes

Clearing of native vegetation is listed as a 'Key threatening process' on Schedule 3 of the TSC Act. Native vegetation is made up of plant communities, comprising primarily indigenous species and includes canopy trees (where present), understorey, ground cover and below ground biomass (roots, bulbs and the seed bank). For the purposes of this determination native vegetation does not include marine vegetation within the meaning of the NSW *Fisheries Management Act* 1994.

Clearing, as defined by the determination, refers to the destruction of a sufficient proportion of one or more strata (layers) within a stand or stands of native vegetation. There are numerous impacts as a result of clearing native vegetation, including:

- destruction of habitat causing a loss of biological diversity, and may result in total extinction of species or loss of local genotypes;
- fragmentation of populations resulting in limited gene flow between small isolated populations, reduced potential to adapt to environmental change and loss or severe modification of the interactions between species;
- riparian zone degradation, such as bank erosion leading to sedimentation that affects aquatic communities;
- disturbed habitat which may permit the establishment and spread of exotic species which may displace native species; and
- loss of leaf litter, removing habitat for a wide variety of vertebrates and invertebrates.

There are numerous threatened species, populations and ecological communities adversely affected by the clearing of native vegetation.

(ref: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/threat_profile.aspx?id=20023)

The proposed production well will remove 15 Wattles, nine of which are in the later stages of senescence. As these trees are largely senescent, they do not provide significant habitat value to local fauna. It is far more likely that local fauna would use the densely vegetated corridor along the Nepean River. This habitat will not be directly affected by the proposed production well and will be protected during construction through fencing and appropriate sedimentation and erosion controls. Therefore, the proposed production well will not increase the operation of this key threatening process.

Predation by the European Red Fox (*Vulpes vulpes*) (Linnaeus, 1758) is listed as a key threatening process in Schedule 3 of the TSC Act. Foxes are an adaptable and elusive predator common in rural and urban areas throughout southern Australia. They do not appear to favour any particular habitat and the main determinants of their population size and distribution appear to be food supply, disturbance of natural habitats and refuge availability

(ref: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/threat_profile.aspx?id=20015).

Two juvenile European Red Foxes were observed in close vicinity to the study area during the site inspection. As this area has been heavily cleared and surrounding land-uses are agricultural, it is likely that this species is already established in the area. Therefore, the proposed production well will not increase the operation of this key threatening process.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is listed as a key threatening process on Schedule 3 of the TSC Act. Alteration to natural flow regimes refers to reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels. Three human processes have predominantly altered flows in streams, rivers and their floodplains, and wetlands in NSW, these are: building of dams, diversion of flows by structures or extraction, and alteration of flows on floodplains with levees and structures.

(ref: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/threat_profile.aspx?id=20002)

The Riverflat Eucalypt Forest endangered ecological community growing adjacent to the proposed site compound is likely to be dependent on river baseflow from shallow aquifers in the region beneath and alongside the stream bed of the Nepean River, where there is mixing of shallow groundwater and surface water. However, as discussed in Section 3.3.1, no interaction between shallow aquifers in the riparian zone and the deep coal seams is anticipated. Therefore, the proposed drilling and extraction activities are unlikely to have an impact on the river baseflow from shallow aquifers in the region beneath and alongside the stream bed of the Nepean River, where there is mixing of shallow groundwater and surface water, that the Riverflat Eucalypt Forest ecological community is likely to be dependent upon. There are no GDEs associated with the formation water of the deep coal seams as this groundwater is isolated from all other aquifers and water bearing zones and has no surface expression.

D.5 Conclusion

This assessment has investigated the potential for threatened entities listed under the TSC Act and EPBC Act to occur within the proposed construction pad and along the proposed twinned GGL route. It has assessed potential impacts to these threatened entities as a result of the proposed activities, and provided practical measures to minimise or mitigate identified potential impacts.

The proposed activities are to occur adjacent to a listed EEC, Riverflat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin, and South East Corner Bioregions. This EEC will be avoided during the proposed activities and as such will not be subject to any direct impacts. Indirect impacts such as weed invasion and sedimentation will be managed by appropriate measures detailed in the existing CGP Environmental Management System.

The proposed construction pad and proposed twinned GGL route has been identified as sub-optimal foraging habitat for listed threatened species (TSC Act) including the Black-necked Stork and Spotted Harrier, and listed migratory species (EPBC Act) including the Great Egret, Cattle Egret, Rainbow Bee-eater and Latham's Snipe. As the proposed construction pad and the proposed twinned GGL route is not within any breeding areas for this species, only constitutes sub-optimal foraging habitat and this habitat is generally abundant in the surrounding area, the impacts to these threatened and migratory species are expected to be minimal.

Several weed species (two of which were noxious) were identified within the proposed work pad. These include Small and Broad-leaved Privet. These and other weeds will be managed according to the measures included in the existing Camden Gas Project Environmental Management System.

An introduced predator, the European Red Fox was observed during the site inspection. As the area is heavily cleared and surrounding land-uses are agricultural, it is expected that this species is already established in the area, and the proposed production well and associated infrastructure will not increase the operation of this species whose predation is listed as a key threatening process under the EPBC Act.

D.6 Management and mitigation

A designated 'no-go' or 'exclusion' zone will be placed around the area of regenerating River Flat Eucalypt Forest south of the existing pad for MP16 and along the proposed twinned GGL route. The previously proposed alternative access track to the drill pad (as shown in Figure 2.1 of the EA) will be removed in order to protect this area from access by vehicles. Para-webbing will be erected in this area prior to construction. In addition, the existing sedimentation fence in the vicinity of the drill pad and along the proposed GGL route will be maintained to prevent runoff from entering the EEC while trenching is occurring. No carparking or stockpiling is to occur in these areas to avoid impacts to this EEC.

D.7 References and Bibliography

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Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC) (2011) Species Profile and Threat Database, (http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl) viewed 23.01.12

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Appendix E

Seven part tests

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E.1 SEVEN PART TESTS

E.1.1 River-flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

River-Flat Eucalypt Forest on Coastal Floodplains is listed as an endangered ecological community (EEC) under the NSW *Threatened Species Conservation Act* 1995 (TSC Act 1995). A corridor, 15-20m in width constituting this EEC is located along the Nepean River, approximately 30 m west of the proposed well and 10m west of the GGL. The proposed construction pad will border the fence at the eastern edge of the fenced EEC. The proposed activities do not involve any access to the fenced EEC. Some River She-oaks belonging to this EEC have seeded beyond the fenceline of the regeneration area in an area south of the existing pad for MP16 and will be within the proposed construction site compound as defined within the EA. However, as discussed within Section 5 of this Response to Submissions report, the construction pad has been redefined in order to protect these regenerating River She-oaks from construction vehicles and stockpiling. One established River She-oak will remain within the proposed construction site layout. Para-webbing will be erected around the root zone of this tree prior to construction to avoid accidental damage. During construction the regeneration area to the south of the drill pad will be designated as a 'no-go' or 'exclusion' zone with para-webbing preventing access. Additionally, an existing sedimentation fence west of the GGL will be maintained during the construction period to avoid indirect impacts such as sedimentation and soil nutrification to this EEC.

a) *in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

This section is not relevant to an EEC.

b) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

This section is not relevant to an EEC.

c) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

The proposal does not require any areas of EEC to be impacted directly. All proposed activities will be conducted outside the EEC; to the east of the fence along the Nepean River. The scattered River She-oak trees at the edge of the construction site compound will be protected and fenced during site establishment to prevent any impacts, with one exception. One established River She-oak will remain within the construction site layout. Para-webbing will be erected around the root zone of this tree prior to construction to avoid accidental damage. The implementation of the CGP Environmental Management System during construction activities will minimise any potential indirect impacts on the community. Therefore the proposed modification will not have an adverse effect on the extent of the EEC such that its local occurrence is likely to be placed at risk of extinction.

ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

Indirect impacts of the proposed action such as weed invasion, sedimentation and soil nutrification have the potential to adversely modify the composition of the EEC. To avoid weed invasion or other indirect impacts that could result in modification of the EEC, a range of management measures will be implemented in accordance with the Camden Gas Project Environmental Management System. These include removal and appropriate disposal of cleared weeds, vehicle inspection, sediment and erosion control and ongoing weed monitoring and management.

Given the range of management and mitigation measures to be implemented as part of the proposed activities, the activities are unlikely to substantially and adversely modify the composition of the EEC such that its local occurrence is placed at risk of extinction.

d) *in relation to the habitat of a threatened species, population or ecological community:*

i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

The EEC occurs within a fenced strip along the bank of the Nepean River. This area will be avoided by all construction activities. Subject to the implementation of the weed management measures given in the Camden Gas Project Environmental Management System (Landscape and Rehabilitation Management Sub Plan), the community is unlikely to be modified by weed invasion as a result of the proposed modification. Subject to the implementation of the sediment and erosion and water quality controls specified in the EA and the Camden Gas Project Environmental Management System (Soil and Water Management Sub Plan) there will be no adverse impacts to water quality or the stability of the bank of the Nepean River which could degrade the quality of this habitat area. Following the stabilisation of the work pad, the area will be planted with native tubestock. As such, there will be no impacts to the expansion and future habitat of this community.

ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

The proposed infrastructure will be constructed outside the fenced EEC area, and therefore there will be no fragmentation of the EEC as a result of the action.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

No part of the EEC will be removed, fragmented or isolated. Subject to the implementation of the measures given in the Camden Gas Project Environmental Management System, including weed management, sediment and erosion and water quality controls, the EEC is unlikely to be modified by indirect impacts such as weed invasion and soil erosion as a result of the proposed modification.

e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for this EEC.

f) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

No Recovery Plan or Threat Abatement Plan has been prepared for this EEC. However, a number of recovery strategies have been identified to help the recovery of this community, as follows:

- instigate feral animal control programs;
- consider the fire sensitivity of the community when planning hazard reduction and asset management burning;
- undertake restoration, including bush regeneration, revegetation, weed control, and promote public involvement in restoration;
- prevent further clearing and fragmentation of remnants; and
- avoid prolonged or heavy grazing by domestic stock.

The proposed action is generally consistent with these strategies, as it will not involve clearing of the community and weed controls will be implemented prevent further degradation of the EEC. No hazard reduction or asset management burning is carried out by the proponent.

g) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

'Clearing of native vegetation' was listed as a key threatening process on Schedule 3 of the *Threatened Species Conservation Act 1995*. Clearing, as defined by the determination, refers to the destruction of a sufficient proportion of one or more strata (layers) within a stand or stands of native vegetation. The establishment of the proposed construction site compound does not constitute this key threatening process, as the project does not require the destruction of one or more strata layers of native vegetation. Additionally, the future habitat and expansion area of this EEC will be protected by planting species characteristic of this community.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is listed as a key threatening process on Schedule 3 of the TSC Act. Alteration to natural flow regimes refers to reducing or increasing flows, altering seasonality of flows, changing the frequency, duration, magnitude, timing, predictability and variability of flow events, altering surface and subsurface water levels and changing the rate of rise or fall of water levels. Three human processes have predominantly altered flows in streams, rivers and their floodplains, and wetlands in NSW, these are: building of dams, diversion of flows by structures or extraction, and alteration of flows on floodplains with levees and structures.

(ref: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/threat_profile.aspx?id=20002)

The Riverflat Eucalypt Forest endangered ecological community growing adjacent to the proposed site compound and GGL is likely to be dependent on river baseflow from shallow aquifers in the region beneath and alongside the stream bed of the Nepean River, where there is mixing of shallow groundwater and surface water. However, as discussed in Section 3.3.1, no interaction between shallow aquifers in the riparian zone and the deep coal seams is anticipated. Therefore, the proposed drilling and extraction activities are unlikely to have an impact on the river baseflow from shallow aquifers in the region beneath and alongside the stream bed of the Nepean River, where there is mixing of shallow groundwater and surface water, that the Riverflat Eucalypt Forest ecological community is likely to be dependent upon. There are no GDEs associated with the formation water of the deep coal seams as this groundwater is isolated from all other aquifers and water bearing zones and has no surface expression.

Conclusion

The proposed action is unlikely to have an adverse effect on the extent or composition of the EEC such that its local occurrence would be placed at risk of extinction. There is unlikely to be a significant impact on the EEC or its habitats as a result of this action.

Therefore, a Species Impact Statement is not required.

E.1.2 Black-necked stork (*Ephippiorhynchus asiaticus)* and Spotted Harrier (*Circus assimilis*)

The Black-necked Stork is listed as an endangered species within NSW. It is a large glossy black and white stork with very long red legs and a large straight black bill. Its core distribution is northern Australia, although it does not occur in enormous numbers anywhere within Australia. Black-necked Storks breed in the northern NSW river valleys, however few nests occur within each valley. No breeding observations have been recorded south of Port Stephens for a number of years (ref: http://www.environment.nsw.gov.au/determinations/BlackneckedStorkEndSpListing.htm).

Black-necked Storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation. They mainly forage in shallow, still water, preferring open wetlands, and taking a variety of prey, including eels and other fish, frogs, turtles, snakes, and small invertebrates, such as crabs and small insects. Vertebrates form the main mass of the diet, with medium-sized eels contributing the greatest biomass and were also the only food seen to be delivered to nestlings (ref: http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10275)

The Spotted Harrier is a medium-sized, slender bird of prey having an owl-like facial ruff that creates the appearance of a short, broad head, and long bare yellow legs. The upperparts are blue-grey with dark barring, and the wingtips are black. The face, inner-wing patch, and underparts are chestnut. The long tail is boldly banded, with a wedge-shaped tip. Juveniles are mottled and streaked ginger and brown, with prominent ginger shoulders, fawn rump and banded tail.

The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. It occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.

This species builds a stick nest in a tree and lays eggs in spring (or sometimes autumn), with young remaining in the nest for several months. The Spotted Harrier preys on terrestrial mammals (eg bandicoots, bettongs, and rodents), birds and reptile, occasionally insects and rarely carrion.

(ref: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=20134)

The study area contains an area of disturbed grassland which may become inundated during heavy rains, providing potential foraging habitat for these two species. No wetlands occur within the study area that would constitute suitable habitat for the Black-necked Stork.

in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The study area does not occur within the known breeding area for the species and does not contain suitable habitat for breeding. The area provides degraded and low quality potential foraging habitat, however the proposed modification of this is not likely to affect the lifecycle of this species, given the amount of similar habitat within the locality along the Nepean River. Therefore, the proposal is not considered likely to have an adverse effect on the life cycle of the species such that a local population of the species is likely to be placed at risk of extinction.

h) *in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,*

The Black-necked Stork and Spotted Harrier do not have any listed endangered populations. Therefore this question is not relevant.

i) *in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

   i) *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

   ii) *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*

The Black-necked Stork and Spotted Harrier are listed as endangered species. Therefore this question is not relevant.

j) *in relation to the habitat of a threatened species, population or ecological community:*

   i) *the extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

   ii) *whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*

   iii) *the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,*

A total area of 1.6ha of potential foraging habitat consisting of heavily disturbed grassland will be impacted by the proposed activities. This habitat is generally abundant in the immediate area surrounding the site, and is in better condition outside of the area that has previously been sand mined. The removal of this already disturbed potential habitat is considered unlikely to fragment or isolate potential foraging resources for this species in the locality. The habitat to be removed is considered to be sub-optimal for this species and is therefore not considered important to the long-term survival of the species in the locality.

k) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),*

Critical habitat has not been declared for these species. It is considered that habitat critical to the survival of this species would include known breeding habitat areas. No breeding habitat occurs within the study area.

l) *whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,*

A recovery plan or threat abatement plan has not been completed for these species to date. However, recovery strategies have been identified for these species. The recovery strategy most relevant to the study area is the prevention of tall isolated paddock tree clearing that provide (or potentially provide) suitable nesting sites for the species, and avoidance of widespread clearance of floodplain vegetation. The study area is not within the known breeding range of this species, however it is considered that the activities are consistent with this as no mature floodplain vegetation will be removed by the proposed activities.

m) *whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The proposed activities are likely to constitute 'clearing of native vegetation', which is recognised as a key threatening process under Schedule 3 of the TSC Act. However, the study area is already disturbed and contains only highly disturbed areas of native vegetation and weeds.

Clearance of remnant vegetation patches and individual trees constitute one of the major threats to the Black-necked Stork and Spotted Harrier in NSW. Wetland modification also threatens the Black-necked Stork; and although artificial water sources can provide areas of new habitat these are often suboptimal.

(ref: http://www.environment.nsw.gov.au/determinations/BlackneckedStorkEndSpListing.htm). The proposed activities will not remove trees within known breeding habitat or modify wetlands.

Conclusion

Although potential foraging habitat occurs within the study area, the removal of this habitat is not likely to have a significant impact on the local occurrence of these species. The viability of any local population is not considered to be put at risk as a result of the proposed activities, due to the ample foraging habitat in better condition outside the proposed impact area. Therefore, the proposed activities are not likely to have a significant impact on the Black-necked Stork and Spotted Harrier.

Therefore, a Species Impact Statement is not required.

E.1.3 Cattle egret (*Ardea ibis*), Great Egret (*Ardea alba*), Rainbow Bee-eater (*Merops ornatus*) and Latham's Snipe (*Gallinago hardwickii*)

The **Cattle Egret** is small, stocky and mostly white with a short neck and stout yellow-red bill. It is widespread and common according to migration movements and breeding localities surveys. The Cattle Egret breeds in colonies, either mono-specific or with other Egrets/Herons. In Australia the principal breeding sites are the central east coast from about Newcastle to Bundaberg. It also breeds in major inland wetlands in north NSW (notably the Macquarie Marshes) (ref SPRAT – Commonwealth Government Species Profile and Threats Database).

Non-breeding Cattle Egret may remain in breeding areas, but most migrate elsewhere. The population estimate for Australia, New Guinea and New Zealand is 100 000 birds (Maddock & Geering 1994).

The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. The Cattle Egret roosts in trees, or amongst ground vegetation in or near lakes and swamps.

The **Great Egret** has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Kushlan & Hancock 2005; Marchant & Higgins 1990; Martínez-Vilalta & Motis 1992). The species usually frequents shallow waters. The Eastern Great Egret may retreat to permanent wetlands or coastal areas when other wetlands are dry (for example, during drought). This may occur annually in some regions with regular wet and dry seasons or erratically where the availability of wetland habitat is also erratic.

The Great Egret is dispersive and, in parts of its range, migratory (Geering et al. 1998; Kushlan & Hancock 2005; Marchant & Higgins 1990). In Australia, multi-directional post-breeding movements of up to 280 km have been recorded in south-western Western Australia, and similar patterns of movement have been recorded in eastern Australia (McKilligan 2005). The species undertakes some regular seasonal movements, mostly to and from breeding colonies, and towards the coast in the dry season (Marchant & Higgins 1990). There is circumstantial evidence of long-distance migration, with regional differences in reporting rates suggesting that individuals migrate north to winter in tropical northern Australia (Geering et al. 1998; McKilligan 2005), consistent with changes in the availability of suitable wetland habitat.

(ref http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=82410)

The **Rainbow Bee-eater** occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (Badman 1979; Boekel 1976; Fry 1984; Roberts 1979; Storr 1984a, 1984b, 1985a). It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches (Higgins 1999).

The Rainbow Bee-eater occurs in open woodlands and shrublands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands (Gibson 1986; Jones 1986; Leach 1988; Longmore 1978; McEvey & Middleton 1968; Saunders & Ingram 1995; Woinarski et al. 1988, 1989) and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Badman 1989; Gee et al. 1996; Gibson 1986; Gibson & Cole 1988; Henle 1989; Longmore 1978; Storr 1977; Woinarski et al. 1988).

The Rainbow Bee-eater is also common in cleared and semi-cleared habitats (Morris 1976, 1977; Wolstenholme 1925). It occurs in farmland (Fry 1984; Leach 1988; Saunders & Ingram 1995), orchards (McKeown 1923) and vineyards (Chandler 1944; McEvey 1965), and is regularly recorded in other disturbed habitats including roadside vegetation (McKeown 1923; Sedgwick 1986; Wolstenholme 1925) and in quarries, mines or gravel pits, where they often breed (Higgins 1999; Fry 1984; Leach & Hines 1987; Lill 1993; Serventy & Whittell 1976). It has also been recorded in towns and suburbs (Carruthers 1975; Cohn 1927; Howard 1983; Jones 1981; Longmore 1978; Thompson 1978, 1984a; Wheeler 1959b; Wolstenholme 1925), and around homesteads (Barrett 1922; McGill 1944; Morse 1922).

In Australia, **Latham's Snipe** occurs in permanent and ephemeral wetlands up to 2000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977; Naarding 1983; Weston 2006, pers. comm.). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977; Naarding 1983).

In Australia, Latham's Snipe occurs in a wide variety of permanent and ephemeral wetlands (Naarding 1981). They usually occur in open, freshwater wetlands that have some form of shelter (usually low and dense vegetation) nearby (Frith et al. 1977; Naarding 1983; Weston 2006, pers. comm.). They generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters (Frith et al. 1977; Naarding 1983), but various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains (Frith et al. 1977; Naarding 1981, 1983). The structure and composition of the vegetation that occurs around these wetlands is not important in determining the suitability of habitat (Naarding 1983). As such, snipe may be found in a variety of vegetation types or communities including tussock grasslands with rushes, reeds and sedges, coastal and alpine heathlands, lignum or tea-tree scrub, button-grass plains, alpine herbfields and open forest (Chapman 1969; Frith 1970; Frith et al. 1977; Naarding 1983; Wall 1990).

Latham's Snipe sometimes occur in habitats that have saline or brackish water, such as saltmarsh, mangrove creeks, around bays and beaches, and at tidal rivers (Frith et al. 1977; Naarding 1983; Patterson 1991). These habitats are most commonly used when the birds are on migration (Frith et al. 1977). They are regularly recorded in or around modified or artificial habitats including pasture, ploughed paddocks, irrigation channels and drainage ditches, ricefields, orchards, saltworks, and sewage and dairy farms (Fielding 1979; Frith et al. 1977; Lane & Jessop 1985; Naarding 1982, 1983). They can also occur in various sites close to humans or human activity (e.g. near roads, railways, airfields, commercial or industrial complexes) (Frith et al. 1977; Naarding 1983).

The study area constitutes sub-optimal foraging habitat for these species that use flooded grasslands adjacent to waterbodies after periods of heavy rain.

(ref: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=863)

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species

An area of 'important habitat' for a migratory species is (DEH 2006):

habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or

n) habitat that is of critical importance to the species at particular life-cycle stages, and/or

o) habitat utilised by a migratory species which is at the limit of the species range, and/or

p) habitat within an area where the species is declining.

The study area is not considered to constitute an area of important habitat for the Cattle Egret, Great Egret, Rainbow Bee-eater or Latham's Snipe as it does not constitute breeding habitat and is likely to provide sub-optimal foraging habitat.

- *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*

The study area is already heavily disturbed as a result of previous land uses. Invasive species such as the European Red Fox (*Vulpes vulpes*) are present within the study area. The proposed activities are not likely to increase the potential for invasive species not already present, to become established within the study area.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

The study area is not within the known breeding areas for these species. As such, any individuals present would be non-breeding and would be utilising the low quality foraging habitat present. These are not considered to be part of an ecologically significant proportion of the nearly 100,000 population within Australia and New Zealand.

Conclusion

The proposed activities are not likely to constitute a significant impact on the Cattle Egret, Great Egret, Rainbow Bee-eater or Latham's Snipe. **No further assessment is required and a Referral to the Commonwealth Minister for the Environment is not required**.

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