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Prepared for:

AGL Gloucester LE Pty Ltd

22 Tate Street
Gloucester, NSW

AGL Gloucester Seismic Survey

Gloucester NSW

Final

AECOM

15 September 2009

Document No.: S7009301_REFFinal_15Sep09_AGL

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AGL Gloucester Seismic Survey
Gloucester NSW

15 September 2009

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1.0 Introduction

1.1 Overview

ENSR Australia Pty Ltd (trading as AECOM and hereafter referred to as AECOM) was commissioned by AGL Gloucester LE Pty Ltd (AGL) to undertake a Review of Environmental Factors (REF) for their proposed 2D and 3D seismic surveys in the Gloucester area.

The Gloucester Gas Project (GGP) recently proposed to develop gas fields in the Gloucester area. A Preliminary Environmental Assessment (PEA) for the Project was submitted for exhibition on August 2008. The Gloucester Gas Project PEA identified a concept area for well development, however did not specify well surface locations as it enabled the flexibility for further exploration to identify areas of greatest development potential with the best environmental suitability.

The environmental assessment (EA) for the Gloucester Gas Project is currently being prepared and identifies well surface locations for the extraction of coal seam gas (CSG) in the Gloucester area. The proposed seismic survey seeks to refine proposed well locations and the basis for this REF, is aimed to identify the most economically and environmentally viable areas for coal seam gas extraction in the Gloucester area as identified by **Figure 1**.

The proposed works are located within the Gloucester Basin PEL 285 Area which lies within the Gloucester and Great Lakes Local Government Areas (LGA). The proposed seismic surveys would cover an area broadly located between the townships of Wards River, Craven, Stratford and Gloucester as shown in **Figure 2**.

The purpose of the REF is to describe the proposal, document the potential impacts of the proposed activities on the environment and to outline management measures to be implemented to address the potential impacts identified.

This REF has been prepared pursuant to the requirements of Section 111 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The REF has been undertaken in accordance with the Department of Primary Industries (DPI) Guidelines (June 2006) as the activity is linked to AGL's Petroleum Exploration License (PEL). A condition of the PEL is that such activities be subject to a REF to be submitted to DPI for approval.

The description of the proposed works and associated environmental impacts has been undertaken in the context of Clause 228 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

The findings of the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an Environmental Impact Statement (EIS) under Section 112 of the EP&A Act;
- The significance of any impact on threatened species as defined by the TSC Act, in Section 5A of the EP&A Act and therefore the requirement for a Species Impact Statement (SIS); and
- The potential for the proposal to significantly impact a matter of national environmental significance or Commonwealth land and the need to make a referral to the Commonwealth Environment Minister in accordance with the EPBC Act.

1.1.1 Structure of this REF

The REF is structured in accordance with Appendix B of the DPI Guidelines:

- Chapter 1 provides an introduction of the proposal, defines the proposed activities, location of works and provides justification for the undertaking of the activities.
- Chapter 2 details the planning context of the proposal and the requirements for the REF.
- Chapter 3 describes the existing environment of PEL 285 including landform and ecology.
- Chapter 4 provides the assessment for the seismic surveying activities and identifies the potential impacts of the works to the local and region environment.
- Chapter 5 provides comment on any rehabilitation activities to be undertaken as part of the proposal.
- Chapter 6 summarises the consideration of environmental factors under the EP&A Regulation and EPBC Act.
- Chapter 7 summarises the assessment and proposed mitigation measures and provides a conclusion to the REF.

1.2 Description of the Activity

AGL is proposing to complete 2D and 3D seismic surveys within the Gloucester area using two 7.7 tonne trucks and geophone receivers. The seismic surveys would be completed within land subject to the Petroleum Exploration Licence (PEL) 285 issued to AGL (formerly the Joint Venture between Lucas and Molopo) under the *Petroleum Onshore Act 1991* (PO Act) as shown in **Figure 1**.

The proposed works would primarily involve a seismic survey truck traversing the project area in order to conduct the following:

- 2D surveying comprising of a series of 13 seismic lines across a total of approximately 77.5 km; and
- 3D surveying comprising of a seismic pattern using a 64 m spacing grid over 5000 ha. (It is important to note that for the 3D surveys AGL would commence works with a trial area to identify if the 64m spacing can be expanded to further minimise timeframes and potential disruption to landholders).

It is currently proposed that the two survey types (2D and 3D) would be carried out concurrently, but over different timeframes. The 2D surveys are expected to be completed over a 4-6 week period, while the 3D surveys are proposed to be completed over a period of approximately 3 months.

The proposed surveys are shown in **Figure 2**. It is expected the 2D surveys would commence in late October 2009 and the 3D surveys would commence in December 2009. The surveys are proposed to be undertaken within the operating hours of 6am and 6pm.

1.2.1 Methodology

Seismic Reflection Profiling

The proposed works intend to utilise a seismic reflection profiling method. The method works by bouncing sound waves off boundaries between different types of rock which are collected by receivers and recorded to produce an image of subsurface structures and layers. Seismic reflection profiling uses a controlled source to generate seismic waves. On land, truck-mounted vibrators are used as a source (the "Vibroseis" method) and the reflected signals are recorded by geophones. Once the data is recorded, it can then be processed using specialist software which will result in processed seismic profiles being produced. These profiles or data sets can then be interpreted for possible hydrocarbon reserves.

It is anticipated that the seismic survey subject to the purpose of this REF would utilise two 7.7-tonne seismic trucks (**Plate 1**) as well as a recording truck, and a cable and geophone (receiver) spread. Sound waves will be generated by the truck at regular intervals (intervals approximately 11m) along the seismic lines from which the reflections will be recorded by the geophones set up at 16m intervals along the seismic lines via cable (**Plate 2**).

The 2D survey lines would utilise existing access corridors to minimise disturbance with minor grass cutting required for access. These lines have been selected along flat easily accessed lands, with a high proportion within road corridors to minimise disturbances to residents. It is anticipated that up to 15km per day would be traversed in the 2D surveying (on average).

The 3D survey lines would be located in a grid pattern approximately 64m apart. This is the recommended separation for seismic lines to achieve suitable results. This may require grass trimming to allow for easier access and to cater for the geophone receivers. It should be noted that prior to the undertaking of the 3D seismic survey, a trial would be completed to determine if the spacing of the seismic lines can be increased from the 64m. This would have the benefits of reducing the potential impacts to the survey area through a decrease in the number of lines required. The trial will determine the ability to achieve suitable results from the increased spacing. Additional benefits from increased spacing would also include a reduction in timing for the survey and a reduction in cost associated with the decrease in time and number to lines. It is anticipated that 0.5 sq km grid per day would be covered in the 3D survey.

The trucks proposed for the survey are of a low impact vibrator system optimised for operation in environmentally restricted or populated areas. The advanced system features include high fidelity and broad band width, low source generated ground pressure, low vehicle generated ground pressure and sound limiting systems. 3D surveys would involve the use of GPS for real-time positioning without the need for surveyed Vibrator Points. The trucks have high manoeuvrability in the field with low environmental impact compared to traditional seismic methods.

Implementation

The trucks and personnel would use only existing access routes and roads to undertake the seismic surveying. No new access roads would be constructed for the activities.

The methodology for the 2D and 3D surveys requires the slashing of grasses and other small vegetation to three inches in height, as well as reasonably flat land, in order for the seismic receiver disk to operate efficiently. The slash area proposed for the activities is approximately 1.2 m wide to cater for the geophone receivers, and 2.5 m for the surveying trucks. It is noted that in the majority of the 2D surveying slashing would be minimised where possible through utilisation of road corridors and existing mown or slashed areas. All slashing activities would be undertaken in consultation with relevant landholders to identify the need for modification to timing and other constraints.

The trucks and proposed survey methodology are not limited to a straight path as they are flexible and are able to manoeuvre around obstacles such as trees. Therefore, the proposed surveys would not require the clearing of any trees as vegetation in the area is quite sparse and comprises predominately of existing cleared areas such as pasture land. Additionally, the survey lines have been planned to minimise the requirements of vegetation clearing and to avoid any significant trees.

The survey lines and trucks would manoeuvre around trees and other sensitive areas where encountered. Should any logs and other debris be encountered on the survey route, these items would be moved aside for the duration of the survey, and then be returned to its original location upon completion.

The trucks would not traverse any creek lines or rivers. The method would see geophones laid up to the water course and then continue from the opposing side. Trucks and machinery would use the nearest farm access to go around the watercourse in a safe manner.

The proposed methodology is non-invasive as it requires no drilling, clearing or significant altering of ground surface or land use. It is proposed that the survey be completed with minimal environmental impact.

1.3 Justification of the Activity

The objective of this activity is to obtain better understanding of the underlying geology and therefore assist coal seam gas extraction within PEL 285. The results of the survey would refine the locations proposed in the current EA. This supports the ultimate construction of coal seam gas wells to extract, compress and transport gas from the Gloucester area to Hexham.

Natural gas has the advantage that it burns cleaner than other fossil fuels, such as oil and coal, and produces fewer greenhouse gas emissions per unit of energy released. For an equivalent amount of heat, burning natural gas produces about 45%less carbon dioxide than burning black coal (AER, 2007). Coal seam gas (CSG) currently contributes 8% of total natural gas supplies in NSW. However, it is forecasted that by 2020 CSG will account for up to 40% of eastern Australia's gas demand.

CSG is found closer to the surface and under lower pressure, making it easier to access and reduce environmental/geological disturbance than conventional natural gas. Therefore CSG is in high demand. CSG usually has higher concentration of methane, lower levels of impurities and is closer to sales markets resulting in less environmental and financial costs.

The seismic surveys support the Gloucester Gas Project which represents an indigenous energy supply for NSW. The surveys would enable the analysis of soil stability, depth to bedrock, and potential fault location under planned well locations and pipeline routes.

1.4 Evaluation of the Alternatives

Other alternatives considered as part of this REF include:

- Do nothing;
- Investigations through drilling boreholes along the proposed seismic grid and lines;
- Seismic reflection profiling utilising explosive shots as an energy source rather than the vibroseis method.
- Existing studies and previous report data modelling and mapping;

Without the proposed surveys, the 'do nothing' method would result in the inability to provide the accurate information required to develop well fields as part of the Gloucester Gas Project and capitalise on a valuable and cleaner energy source.

Borehole investigations as well as seismic reflection utilising dynamite would have greater and less controlled impacts on the environment, and would also incur greater timing and economic costs. This would also result in greater inconvenience for landholders and provide further restrictions to use of land during the proposed activities. Due to the sensitive nature of Gloucester and the surrounding area and potential for significant impacts, this option is not considered viable for the survey method.

Existing geological studies may be unreliable in regards to accurately identifying underlying information for specific point locations in the project area. In some cases this information is not available for the proposed survey areas. The information obtained through previous studies is unlikely to be as accurate as that of a seismic survey and does not produce the same type of geological profiling with the degree of certainty required for the extraction of coal seam gas. Therefore, this option was not considered the preferred option for the survey.

Consideration of the alternatives detailed above for the proposed activities has revealed that the seismic reflection profiling method is considered the most viable in terms of cost effective research in achieving an accurate understanding of hydrocarbon potential in the proposed survey area. The proposed seismic reflection method would result in a low potential for adverse impacts to the environment, whilst achieving the required outcomes. This option also offers minimal inconvenience to landholders and residents and therefore, has been considered the preferred option for this proposal.

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2.0 Planning Context

2.1 Licenses and Approvals Required

As stated in the Guidelines:

"DPI has a statutory responsibility under Section 111 of the Environmental Planning and Assessment Act 1979 (EP&A Act) to assess the environmental impacts of activities within titles issued under the Mining Act 1992 and Petroleum (Onshore) Act 1991 if such activities have not already been approved under Part 3A or Part 4 of the EP&A Act. To assess these impacts, DPI requires the titleholder to prepare a Review of Environmental Factors (REF) or Environmental Impact Statement."

A Review of Environmental Factors (REF) must be completed to comply with Condition No. 4 (Environmental Assessment) of Petroleum Exploration Licence (PEL) No. 285 that states that a Category 3 activity (in this case "seismic surveys") requires *"…a Review of Environmental Factors in accord with Clause 228 of the Environmental Planning and Assessment Regulation 2000 must be submitted to the Environment Unit, Department of Mineral Resources to enable a determination under Part 5 of the Environmental Planning and Assessment Act to be made…".*

2.1.1 NSW Petroleum (Onshore) Act 1991

The *NSW Petroleum (Onshore) Act 1991* (PO Act) regulates the prospecting and mining of petroleum primarily through the issue of certain licences and/or leases such as Petroleum Exploration Licences (PELs) and Petroleum Production Leases (PPLs).

A PEL allows the holder exclusive rights to prospect for petroleum on the land covered by the licence. Should petroleum be discovered, the holder of the PEL is required to apply for a PPL if they wish to recover the petroleum through mining operations. A PPL allows the holder to undertake petroleum mining operations on the subject land as per Clause 41 of the PO Act. This REF does not require a PPL as recovery of petroleum is not subject to the proposal.

The project area is subject to a PEL issued under the PO Act, known as PEL 285. Future operations as part of the Gloucester Gas Project within the survey area would require the issue of a PPL however, this is not required for the surveying of the site.

It is by virtue of the PEL issued under this Act that requires a REF to be undertaken however, and submitted to DPI in accordance with the *Environmental Planning and Assessment Act 1979.*

2.1.2 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act* (EP&A Act) and its Regulation (EP&A Regulation) provide the framework for environmental planning in NSW and include provisions to ensure that proposals which have the potential to impact the environment are subject to detailed assessment, and provide opportunity for public involvement.

The proposed seismic survey has been assessed (in this REF) under Part 5 of the *EP&A Act as required by condition 4 of the* PEL (refer to **Section 2.1**). Section 111 of the *EP&A Act* outlines the duty of determining authorities to consider the environmental impacts of activities.

2.1.3 Environmental Planning and Assessment Regulation 2000

Under Part 5 of the EP&A Act, factors concerning potential environmental impacts of a development/activity must be addressed. Clause 228 of the Environmental Planning and Assessment Regulation 2000 (EP&A Regulation) identifies the factors to be considered in such and assessment. These factors have been addressed in Section 6 of this REF.

2.1.4 NSW Protection of the Environment Operations Act 1997

Schedule 1 of the *NSW Protection of the Environment Operations Act 1997* (POEO Act) prohibits any person from causing pollution of waters, or air, and provides for penalties for air, water and noise pollution offences. Schedule 1 of the POEO Act identifies "scheduled activities" which are required to be licensed by the DECC.

The proposed seismic surveys are not listed as a scheduled activity under Schedule 1 of the POEO Act and therefore do not require an Environment Protection Licence (EPL).

2.1.5 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires the approval of the Commonwealth Minister for the Environment, Water, Heritage and the Arts for actions that may have a significant impact on matters of National Environmental Significance (NES).

The EPBC Act lists seven matters of NES which must be addressed when assessing the impacts of a proposal. These matters are addressed in **Section 6** of this REF.

2.2 Zoning

The survey area lies within the Gloucester and Great Lakes LGAs and is therefore subject to zoning and provisions of any local environment plans (LEP) and development control plans (DCP) in place. The Gloucester LEP and Great Lakes LEP are discussed in the sections below in terms of permissibility and the application of the planning instrument to the seismic survey activities. No DCPs are currently in place for either LGA.

under the EP&A Act a development is defined as:

a) the use of land, and

b) the subdivision of land, and

c) the erection of a building, and

d) the carrying out of a work, and

e) the demolition of a building or work, and

f) any other act, matter or thing referred to in section 26 that is controlled by an environmental planning instrument,

Therefore, the proposed activity is classified as a development as, although temporary in nature, it requires the "use of land". As such, the following planning instruments are relevant to the proposal.

2.2.1 Gloucester LEP

Land within the Gloucester Council area is governed by the Gloucester Local Environmental Plan 2000 (GLEP). Under GLEP 2000 the land comprising the survey area is primarily zoned Rural 1(a) and partially Environment Protection (Scenic) 7(d) and Environment Protection (Scientific).

Permissibility

Clause 6 of the Gloucester LEP adopts the *Environmental Planning and Assessment Model Provisions 1980* (Model Provisions) with the exception of:

- the definition of agriculture and rural worker's dwelling, and
- clauses 15 and 29, and

- Schedule 1, clause 9 as it relates to undertaking of forestry activities on land in Zone 7 (d) (Environment Protection (Scenic) Zone),

While the model provisions were repealed in 2005, Schedule 6 of the EP&A Act includes provision to allow the continuation of the Model Provisions in planning instruments that have adopted them prior to 2005. As such they are relevant to the GLEP 2000.

The *Model Provisions* provide the following definition for a public utility undertaking:

> *'any of the following undertakings carried on or permitted or suffered to be carried on by or by authority of any Government Department or under the authority of or in pursuance of any Commonwealth or State Act:*
>
> - railway, road transport, water transport, air transport, wharf or river undertakings,
> - undertakings for the supply of water, hydraulic power, electricity or gas or the provision of sewerage or drainage services,
>
> *and a reference to a person carrying on a public utility undertaking shall be construed as including a reference to a council, county council, Government Department, corporation, firm or authority carrying on the undertaking.*

The Proponent for the Project (AGL) is the holder of a PEL issued under the PO Act (a State Act) which covers the project areas for the proposed surveys. This PEL allows AGL exclusive rights to undertake petroleum exploration in the locality for the supply of gas.

Therefore, in relation to the proposed works, AGL comprise a corporation or firm carrying out an undertaking in pursuance of a State Act. The project is therefore defined as a 'public utility undertaking', being an undertaking for the supply of gas as identified in the Model Provisions.

Part 2 of GLEP 2000 specifies development which can be carried out with or without development consent with all other development not listed under these categories being prohibited.

Under Part 2 of GLEP 2000 Public utility undertakings are identified as not permissible with or without consent within the Rural 1(a), Environment Protection 7(d) or 7 (j) zones and are therefore deemed to be prohibited. However, Clause 35 of the Model Provisions states that:

> *Nothing in the local environmental plan shall be construed as restricting or prohibiting or enabling the consent authority to restrict or prohibit:*
>
> - the carrying out of development of any description specified in Schedule 1,
> - Schedule 1 to the Model Provisions includes:
>
> *The carrying out by persons carrying on public utility undertakings, being water, sewerage, drainage, electricity or gas undertakings, of any of the following development, being development required for the purpose of their undertakings, that is to say:*
>
> - development of any description at or below the surface of the ground, and
>
> *f) any other development except:*
>
> *i. the erection of buildings, the installation or erection of plant or other structures or erections and the reconstruction or alteration, so as materially to affect the design or external appearance thereof, of buildings, or*
>
> *ii. the formation or alteration of any means of access to a road.*

The proposed works constitute public utility undertakings for gas at the surface of the ground, and are therefore permissible within the Rural 1(a), Environment Protection 7(d) or 7 (j) zones of the GLEP 2000.

For each of the relevant zoning classifications, objectives for land use have been identified in the GLEP 2000 to ensure appropriate development. These objectives are identified below:

Zone 1 (a) – Rural Zone:

a) to encourage continued growth in the area's rural economic base

b) to protect and conserve agricultural land and to encourage continuing, viable and sustainable agriculture

c) to maintain the scenic amenity and landscape quality of the area

d) to promote the protection and preservation of natural ecological systems and processes

e) to provide proper and coordinated use and protection of rivers and water catchment areas

f) to promote provision of roads that are compatible with the nature and intensity of development and the character of the area

g) to allow mining where environmental and cultural impacts do not exceed acceptable limits and the land is satisfactorily rehabilitated after mining

h) to recognise and encourage agriculture as a significant contributor to the area

i) to encourage other forms of development, including tourism, that are compatible with agricultural activities and do not create undesirable environmental and cultural impacts.

The proposal is considered to be consistent with the objectives of zone 1 (a) as it seeks to identify suitable locations for the extraction of CSG. This would increase the potential economic base of the area. The proposed activities would not inhibit the use of land and would not adversely impact the natural environment. All activities proposed are short term in nature and all disturbed areas would be rehabilitated on completion of activities.

Zone 7 (d) – Environment Protection (Scenic) Zone

a) to encourage the preservation of existing wooded hilltops, parts of river valley systems, major scenic corridors and other local features of scenic attraction

b) to enable development of a similar nature to that intended for Zone 1 (a), except for development that by its nature would be visually destructive or intrusive, provided such development is carried out in a manner which minimises its visual impact

c) to ensure that development in this zone on land adjoining land in Zone 8 (a) is compatible with the management objectives for that land

The proposed activities would not have a lasting impact to the scenic nature of zone 7 (d). While some minor short term visual changes may be observed during the activities (such as slashing of grasses and the presence of trucks), these are short term in nature and would not have a lasting impact on the land. Therefore, the proposal is considered consistent with the objectives of zone 7(d).

Zone 7 (j) – Environment Protection (Scientific) Zone

d) To provide protection for areas of land identified to contain natural features, flora or fauna that are of recognised scientific value.

The proposed activities would not have a lasting impact to the Zone 7 (j). While some minor short term changes may be observed during the activities (such as slashing of grasses and the presence of trucks), these are short term in nature and would not have a lasting impact on the land. The proposed activities would not impact the natural features or flora and fauna of the land in an adverse way. Therefore, the proposal is considered consistent with the objectives of Zone 7 (j).

2.2.2 Great Lakes LEP

Land within the Great Lakes Council area is governed by the Great Lakes Local Environmental Plan 1996 (LEP 1996).

Permissibility

Clause 15 of LEP 1996 addresses particular activities which are deemed to be unaffected by the provisions of the LEP. The clause states that:

Nothing in this plan restricts, prohibits or requires development consent for:

- the use of existing buildings under the control of the Crown by the Crown, or
- any activity listed in Schedule 1.

Schedule 1 to LEP 1996 includes the following forms of development:

Public utility water, sewerage, drainage, electricity or gas undertakings comprising:

- development of any description at or below the surface of the ground, or
- The proposed seismic survey comprises purposes for a gas undertaking which is completed at the surface of the ground and is therefore permissible without consent under LEP 1996.

Under LEP 1996 the land comprising the survey area is zoned Rural 1(a). The objective of this zone is *to restrict development to those uses which are unlikely to:*

e) prejudice in a significant manner the agricultural production potential of land within the zone, and

f) generate significant additional traffic, or create or increase a condition of ribbon development on any road, relative to the capacity and safety of the road, and

g) have an adverse impact on the area's water resources, and

h) create unreasonable or uneconomic demands for the provision or extension of public amenities or services.

Given the transient and non-invasive method of works, the proposed method of undertaking the seismic surveying and minimal impacts to the environment, the proposed seismic surveys are considered consistent with the objectives of the zone.

2.3 Stakeholder Consultation

The proposed survey would require access to properties owned by various landholders as well as permission required from Council to undertake the seismic surveying activities.

AGL has undertaken extensive consultation with affected landholders as part of this REF and has included discussions with both Great Lakes and Gloucester Shire Council who were satisfied with the proposed works given the transient and non-invasive nature of the surveys.

Consultation has been undertaken with the majority of landholders affected by the 2D survey in regard to gaining access to private properties and potential disturbances to usual activities during the surveying. AGL is in the process of finalising landholder access agreements with these landholders which identifies the required use of the land and any negotiated agreements for potential compensation where the seismic surveys are required to traverse croplands or land used for dairy farming or other agricultural business.

Consultation with landholders affected by the 3D survey is ongoing with all stakeholder consultation and agreements to be finalised prior to the commencement of any seismic surveying activities.

3.0 Existing Environment

3.1 Regional Context

The survey area lies within the northern portion of the Greater Hunter Region of NSW. The Hunter Region covers an area of approximately 31,000 sq km and includes 11 LGAs. The region encompasses a diverse range of geographic landforms, environments, land uses, industries and population centres. Major industries of the region include manufacturing, coal and mining, agriculture, viticulture and winemaking, power generation, equine, tourism defence and aerospace (HEDC, 2008).

3.1.1 Land Use

Much of the Hunter Region has been cleared for agricultural production since European settlement. The majority of land is managed by private landholders comprising a high proportion of family owned and operated farms, corporate farms and small lifestyle farms. In 2005-06 the total area of land devoted to agricultural activity in the Hunter Region was approximately 1.4 million ha (HVRF, 2008). Over 80 per cent of agricultural land was dedicated to grazing during this period.

The Hunter Coalfields are the largest coal producing area in NSW, containing 60 coal seams in three measures: the Greta Coal Measures; the Wittingham Coal Measures; and the Wollombi Coal Measures. Most of the coal is at a shallow depth compared to other coal producing areas and is easily accessible to large-scale, multi-seam open cut mining operations (HVRF, 2008).

The Gloucester area comprises similar land uses to the surrounding Greater Hunter Region, however is more oriented toward agriculture as well as some coal mining. Throughout the survey area, agricultural land for grazing and pastoral use is the dominant land use. Some small pockets of rural residential properties occur in the vicinity of the towns, and the Stratford Colliery open cut operations are located within the 3D survey area.

The land identified for the seismic surveying comprises largely rural/agricultural land within the Gloucester and Great Lakes LGA's. Some areas of environmental protection occur in the vicinity of the township of Gloucester and in isolated parts of the 3D seismic area. The dominant land uses within the survey areas are grazing and pastoral activities with some land existing as coal mining areas for Gloucester Coal.

3.2 Landforms and Geology

The area for survey is located approximately 100 km north of Newcastle in the Gloucester geological basin, generally between the townships of Wards River, Craven, Stratford and Gloucester. The landform of the locality is characterised by two regions being the Gloucester Basin Region to the north and the Hunter Valley Region to the south. The landscapes comprise gently undulating to rolling hills with broad floodplains, surrounded by steep rises and incised slopes of the Barrington Tops. Soils in the area are highly dispersible and are commonly Sodic Soils.

The Gloucester Basin geology displays steep dips of up to 60 degrees on its flanks, dipping towards the north south trending basin axis and a relative flattening towards the central basin. To the northern part of the Gloucester Basin, a prominent circular feature is evident in the regional magnetics and the surface geological mapping. SRK Consulting (2005) identifies two major basement structural domains have been defined. A northern domain has been defined over the circular basement anomaly, where shortening has been predominantly by folding. A southern domain over the remainder of the Basin has been defined, where shortening has been predominantly by thrusting along NNW-striking fault zones.

The Gloucester Basin contains around 13 coal seams thicker than 2.5m, with an average net coal thickness of around 40m at depths of 200m to 700m. Measured average gas contents range from 12 m3/t to 20 m3/t (daf), with methane contents of 95-99% (SRK Consulting, 2005).

3.3 Climate

The Hunter Region experiences relatively elevated temperatures during summer, with average maximum January temperatures of approximately 29–32°C. Winters are mild, with average maximum July temperatures of 17–18°C. The average maximum temperature is 24.5°C and the average minimum temperature is 10.5°C (Gloucester Shire Council).

Annual rainfall varies across the Hunter region with and average of approximately 650 mm/year. The average rainfall at Gloucester is higher than the regional average, at around 981 mm/year (Gloucester Shire Council, 2006). Peak precipitation typically occurs between January and March, while the driest months are typically from July to December, however, the variability in quantity and timing of rainfall from one year to the next is high.

Wind roses in the Gloucester Region indicate the prevailing winds are generally NW during morning hours, and SE during afternoon hours (BOM, 2004).

4.0 Environmental Impacts and Management

4.1 Flora and Fauna

4.1.1 Background

An ecological assessment was undertaken by AHA Ecology to assess the potential direct and indirect impacts of the proposed seismic survey on threatened species and endangered communities under the relevant legislation and guidelines.

For the purpose of this REF, the assessment involved a review of available literature and databases, field investigations and impact assessment. Databases searches were conducted for the survey area utilising the DECC (formerly National Parks and Wildlife Service) *Atlas of NSW Wildlife* and the Department of Environment, Water, Heritage and the Arts *EPBC Protected Matters Search Tool* and were aimed at identifying threatened species and communities likely to occur within the area that are listed under the TSC and EPBC Act, respectively. The list of species identified by the search of the databases is provided in the Ecological Assessment Report (**Appendix A)** and summarised in **Table 1** below.

Table 1: Summary of database reports for threatened species within 10 km of proposal site

Type	EPBC listed	TSC listed
Amphibia	2	4
Aves (Birds)	3	25
Mammalia	4	23
Reptilia	0	1
Plants	8	10

A targeted field survey was undertaken by AHA Ecology on 28 and 29 July 2009 to verify database search results and to identify the potential or actual occurrence of other species within the locality.

It was noted during background searches and literature reviews that the potential for listed species to occur in the area would be confined to the vegetated areas within conservation areas, within remnant vegetation in private ownership, and in riparian areas and along coastal waterways. Hence, the field survey focused primarily on drainage lines, creeks, rivers and any areas adjacent to blocks of native vegetation.

The field survey concluded that although several species are listed as having the potential to occur, the survey area lacks the complexity required to provide sufficient habitat for the majority of these species. Three species were identified as having sufficient habitat to potentially occur within the survey. These species and details of their habitat are provided in **Table 2** below.

Table 2: Threatened species for which habitat occurs locally

Species	Conservation Status	Habitat	Likelihood of occurrence
Green & Golden Bell Frog *Litoria aurea*	E-TSC V-EPBC	Marshes, dams & streamsides particularly those containing *Typha* or *Eleocharis*.	Potential habitat on Jacks Lane

Species	Conservation Status	Habitat	Likelihood of occurrence
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	V-TSC	Open woodland, particularly those with intact understorey.	Known to occur at the northern end of the Tiedemans block and is likely to occur in other nearby woodland areas.
Grass Owl *Tyto capensis*	V-TSC	Tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.	Cleared paddocks. Unlikely-but may occasionally forage across wetter paddock areas.
Note: TSC = NSW *Threatened Species Conservation Act 1995*. EPBC = Commonwealth *Environment Protection and Biodiversity Conservation Act 199*. V = Vulnerable, E = Endangered.			

4.1.2 Existing Environment

The PEL area subject to the assessment is contained within the Gloucester Basin, and situated within an area known as the Gloucester Valley. The landforms of the Gloucester Valley are characterised by north-south oriented linear ridges with intervening undulating lowlands and floodplains. The topography consists of grassy flats and gentle rises.

The locations of the 2D and 3D seismic survey areas are mostly located within highly modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and used for grazing of stock and mining activities.

The canopy of vegetated areas is largely dominated by Spotted Gum *(Corymbia maculate)* and several *Eucalyptus* species. The numerous creeks and drainage lines in the vicinity of survey routes have been cleared to the bank, with remaining strips of native vegetation existing along the banks of the larger rivers such as the Gloucester River. Riparian areas are often heavily disturbed by weeds including Camphor Laurel (*Cinnamomum camphora*), Lantana (*Lantana camara*), and privet (*Ligustrum* species). The most intact vegetated area was identified as Tiedemans Block (**Figure 3**), which is the location most likely to provide good quality habitat for a range of native fauna within the study area.

The EPBC Act Protected Matters Report identified several endangered ecological community that may potentially occur within the survey area (**Appendix A**). However, the assessment concluded that none of the listed EECs occur within the survey area as the majority of remnant vegetation is Ironbark communities, none of which form part of an EEC.

4.1.3 Potential Impacts

The potential impacts of the proposal are limited to the survey period. The identified potential impacts include:

- Slashing of vegetation;
- Vibration of sound waves; and
- Increase in overall noise levels.

The proposed surveys require the slashing of grass and groundcover along the proposed survey routes to allow access for the trucks and for the deployment of geophones. The majority of vegetation to be slashed is agricultural pasture species and pasture weeds, as trees larger than a sapling would be avoided.

A key area for ecology within the survey area is the Tiedemans property. This area is the most likely to provide good quality fauna habitat and hence slashing of vegetation in this property may result in the disturbance of some species. It is noted that this site has been identified as an area of habitat for the Grey Crowned Babbler, an identified threatened species. The 3D seismic survey would traverse the area of Tiedemans block requiring the slashing of a 1 m to 2.5 m wide path through shrubs and groundcover in a 64m grid spacing.

Indirect impacts on fauna from the seismic surveys are considered unlikely as surveying would occur during daytime hours only and is for a short duration. AHA Ecology concluded that changes in behaviour and foraging patterns are unlikely to be affected by the generated sound wave and that noise impacts from the movement of trucks are temporary and are expected to have a minimal impact on fauna.

As shown on **Figure 2**, some of the proposed seismic lines cross rivers and creeks. No truck would cross these waterbodies and would instead travel around via farm access and resume surveying from the other side. Degradation of riparian zones would be avoided.

Habitat exists for three threatened species (see **Section 4.1.2**) and hence, as required under Part 5A of the EP&A Act and the EPBC Act, Assessments of Significance and Significant Impact Criteria have been considered. It was concluded that due to the minor temporary nature of potential impacts, and as management measures could be implemented, a Species Impact Assessment would not be required and the proposed works is unlikely to be considered a controlled action.

Impacts of the proposal on flora and fauna are expected to be minor and temporary in nature as the ground cover vegetation will naturally regenerate and no fauna habitat would be altered over the long term.

4.1.4 Mitigation Measures

The following mitigation measures are proposed for the seismic survey to ameliorate any potential impacts to the flora and fauna within the locality.

- Surveys through areas of known Grey Crowned Babbler habitat should be timed to occur outside nesting season (July to December);
- Personnel would be briefed on the importance of the Grey Crowned Babbler and a laminated photograph of the Grey Crowned Babbler placed in each vehicle for identification;
- Known Grey Crowned Babbler habitat would be walked by a suitably qualified environmental personnel, and Grey Crowned Babblers identified in the location will be gently encouraged to move away from the area for the period of works;
- Where 2D survey lines verge on roadside remnant woodland, the route would be shifted slightly to the road surface to avoid these areas;
- Slashing of vegetation along riparian zones would be avoided;
- The Avon River crossing near Jacks Lane would be avoided;
- Staff would be briefed on fauna awareness (Personnel Management); and
- Before slashing, fallen logs and debris would be moved aside and later returned to approximately the same area.

4.2 Soils

4.2.1 Existing Environment

Within the survey area soils are predominantly alluvial, high in compounds and dark in colour. A high proportion of Sodic Soils exist in the landscape which are highly erodible and weakly structured. Potential soil landscapes limitations related to the area as identified by the Dungog Soil Landscape Sheet include generally:

- High erosion potential;
- Dispersible soils; and
- Seasonal water logging.

Other limitations that have the potential to influence the proposed activities are the presence of acid soils and poor soil drainage, including swamps. These limitations are likely to increase instability of the surface and may impact on the suitability and manoeuvrability of vehicles along the lines. Consideration of these factors was included in the site planning of the 2D surveys to reduce the likelihood of bogging and excessive water. As such, the proposed routes are mainly adjacent to roadways and in agricultural land away from drainage lines and depressions. Such areas will be avoided where possible with the 3D surveys.

4.2.2 Potential Impacts

Potential impacts associated with the seismic surveying are likely to be limited to soil compaction, 'bogging' of vehicles and surface depressions of soils due to wet weather conditions and stormwater. These potential compaction and depressions of the surface may exacerbate erosions and lead to increased sedimentation and ongoing landscape issues.

The movement of trucks over exposed areas also has the potential to generate dust which may inconvenience residents and landholders.

4.2.3 Mitigation Measures

The management of these potential impacts and limitation issues would be through stringent erosion and sedimentation controls and maintaining route along clearly identified seismic lines which have been selected to avoid water logged and swamp lands. Given the potential to compact and depress surface soils, a rehabilitation plan would be prepared by AGL to repair any damage to soils immediately on completion of activities. This would ensure no ongoing erosion impacts are experienced by landholders post survey activities.

Should excessive rainfall or water be encountered during field operations, an additional assessment of site suitability would be undertaken to determine continued surveys. Should it be deemed inappropriate to continue, the survey would relocate to another suitable location or postpone activities until suitable conditions are present.

Other mitigation measures would include:

- Preparation of a management plan for erosion and sedimentation in dry and wet weather conditions.
- Avoid waterlogged or boggy soils;
- Adhere to identified survey lines and proposed survey methods, unless the potential for significant impact is likely to occur;
- A recovery plan that would outline the method and procedure for vehicle recovery should a truck become bogged;

- Avoid clearing of vegetation and the exposure of bare sediment to minimise erosion potential;
- Water sprays of exposed soils where the potential for dust impact is likely to occur;
- Where depressions are made in the landform as a result of trucks operating in wet weather, the ground would be restored and rehabilitated; and
- Only use existing access roads, where possible.

4.3 Water

4.3.1 Existing Environment

Gloucester and surrounding low-lying land and river flats are prone to flooding, having experienced severe floods in 1929 and 1978. The rivers and creeks within the proposed area are subject to flooding and water velocities in these rivers can be high after heavy rainfall. Watercourses that occur in proximity to the survey areas include:

- Gloucester River;
- Avon River; and
- Several unnamed intermittent and ephemeral creeks

Avon River and Gloucester River, as well as other unnamed and smaller creeklines, would not need to be crossed as part of the proposed activities. The proposed surveys would have the geophones set up across the watercourse with trucks to drive around via the nearest existing crossing and resume the survey from the other side.

4.3.2 Potential Impacts

Potential impacts to surface water due to surveys requiring to cross watercourses include:

- Increased potential for erosion / sedimentation along watercourse banks where riparian vegetation is disturbed for the purposes of the surveys; and
- Spills of fuel/chemicals from the trucks to nearby watercourses.

4.3.3 Mitigation Measures

Strategic mitigation survey measures for watercourses have been devised as follows:

- No crossing of major watercourses by trucks or machinery or people;
- In the event of flooding, all activities would cease, vehicles and machinery would be moved to higher ground and rainfall would be monitored;
- Recontouring of surfaces to match the surrounding land (in the event of bogging or surface soil disturbance).

It is expected there would be no impact on the bed and banks of watercourses as they will not be entered or crossed during the proposed surveys. Given the temporary and transient nature of the proposed works, potential impacts on water are expected to be minimal provided mitigation measures are implemented.

4.4 Traffic

4.4.1 Existing Environment

Major roadways that service the Project Area include:

- The Bucketts Way (MR90);
- Pacific Highway (SH10);
- New England Highway (SH9); and
- Sydney to Newcastle Freeway (F3) (F6003).

There is a range of smaller rural roadways that service the isolated residential and agricultural areas surrounding and within the survey area. The majority of the minor roadways in the vicinity of the surveys comprise unsealed roads running in an east-west and north-south grid formation. The minor or local roads that may be utilised for access as part of the survey include:

- Jacks Road;
- McKinley's Lane;
- Faulkland Road;
- Fairbairns Roads;
- Gloucester Tops Road;
- Wenham Cox Road;
- Crowthers Road;
- Wheatleys Road;
- Bowen Road;
- Upper Avon Road;
- Woods Road; and
- Parkers Road.

The road network for the proposed survey area is shown on **Figure 2**. It is expected that these minor roads would be utilised to access seismic lines and access may also be required to roads and tracks on private property. Some of the proposed survey lines occur adjacent to roadways within the road corridor.

4.4.2 Potential Impacts

Impacts on traffic would be temporary in nature for the duration of the surveys as a result of infrequent delays and temporary road occupancy by trucks utilising public and private roads for access. The delivery truck would be limited to movements in and out of the survey area.

Some temporary road closure and delays for loading and unloading vehicles may be required, however appropriate road closure certificates and approvals from the RTA and Council would be obtained prior to commencement of activities.

4.4.3 Mitigation Measures

A plan to address traffic management during road occupancy would be prepared to minimise delays and ensure safety. Surveys would only be conducted within the designated work hours of between 6am and 6pm.

There would be no permanent set up area required for the surveys as they will be set up daily on a different area. No further traffic mitigation measures are anticipated to be required.

4.5 Air

4.5.1 Existing Environment

Air quality in the Gloucester basin is dominated by predominantly agricultural emissions with lesser contributions from coal mining operations and vehicular traffic moving along The Bucketts Way and other major and minor roadways.

An Air Quality Impact Assessment (AQIA) was undertaken as part of the Gloucester Gas Project to which this REF supports. This AQIA has been adopted for the purposes of this REF as it encompasses the same subject area identified in this report.

Existing levels of these pollutants in NSW predominantly fall below assessment criteria, only approaching or exceeding the national standards prescribed in the National Environment Protection Measure (NEPM) for Ambient Air Quality on occasion. Pollutant levels in the area around the proposed project have not been studied in detail due to a lack of acceptable short or long term monitoring data, however, given the population of the Stratford area, generally low vehicular traffic levels and distance from any large population centre or industrial development, the air quality is expected to be acceptable.

4.5.2 Potential Impacts

Potential impacts on air quality are expected to be limited to:

- Generation of dust from survey vehicle movements; and
- Localised exhaust emissions from vehicle movements on minor roads and private land.

  As the proposed seismic surveys are non invasive and temporary, potential impacts are expected to be localised and minimal.

4.5.3 Mitigation Measures

Mitigation measures that would be implemented include:

- Vehicle speed limits;
- Emission control devices on vehicles (clean/low exhaust vehicles);
- Water sprays to control dust (where necessary);
- Control of access via existing roadways and tracks;
- Rehabilitation of disturbed soils; and
- Procedures to address any complaints received.

4.6 Noise and Vibration

4.6.1 Existing Environment

Site investigations undertaken as part of the Gloucester Gas Project confirmed that the Gloucester area is subject to seasonal prevailing winds and temperature inversions. Winds are generally NW during morning hours, and SE during afternoon hours (BOM, 2004).

It is recognised that the effects of meteorological conditions can enhance or reduce noise propagation and noise experienced at distant receptors. In the near field, wind has minor influence on measured down wind sound levels. Wind effects become more important as distances increase. Depending on wind speed and distance from a noise source, up wind noise measurement levels compared to down wind conditions can vary by over ±10dBA. Temperature gradients create similar enhancement effects to wind, however the effects are generally less than wind effects and uniform in all directions.

Existing noise sources that are predominant in the survey area is generated from traffic along roadways, farming and agricultural activities, and local mining activities. Noise sources are generally localised and don't often contribute to high noise emissions.

4.6.2 Potential Impacts

Potential noise impacts may arise from the movement of heavy vehicles along main roads as well as private access roads. In an urban environment, vibroseis-generated waves are less than background noise generated by buses, trucks, and trains. Rural ambient noise levels would be slightly lower than urban environments, however it is still not anticipated that the survey would generate noise levels that would impact on existing residential dwellings given the short term nature of the activities.

The vibration of the vibroseis can be felt immediately adjacent to the source but dissipates well before the sound, and is therefore not anticipated to result in any significant impacts. No impact to infrastructure or houses is expected as a result of vibration.

4.6.3 Mitigation Measures

The design of the proposed seismic lines and use of access roads has included extensive consultation with potentially affected landowners in order to establish landowner concerns and preferences and has been based upon detailed constraints analysis including a consideration of the potential for noise impacts. As such, the design and planning process itself represents a safeguard against significant noise impacts. However, it is recognised that there would be certain noise impacts as a result of the proposed project, largely related to the surveying trucks. Given the short term nature of the works these impacts would be minimal and temporary.

Management during the surveying would include implementing hours of operation which would result in the least noise disturbance to residential receivers. The works would be undertaken strictly within the hours of 6am and 6pm for the duration of the survey period.

Advanced notification of commencement of surveys would be given to potentially affected landowners indicating the length of time during which impacts may be experienced, the nature of potential impacts and a contact number for complaints to be recorded and responded to.

4.7 Impact on the Community

4.7.1 Existing Environment

As well as the township of Gloucester itself, other small villages contained in the Gloucester Shire and Great Lakes council are:

- Barrington;
- Bundook;
- Copeland;
- Craven;
- Stratford;
- Wards River; and
- Stroud.

Barrington to the north-west and Stratford to the south are growing in population and housing numbers. The town of Wards River often associates with the Gloucester area for services and facilities due to the close geographic proximity. The survey area is only likely to affect Gloucester, Craven, Stratford and Wards River residents as these townships occur in proximity to the survey lines.

4.7.2 Potential Impacts

The proposed works are unlikely to affect residences due to the minor nature of the works and prior consultation. The potential for impacts as a result of the activities is limited to noise emissions during the completion of seismic surveys by the trucks, and access arrangements with landholders.

There may be some temporary loss of land use during the surveying period and the potential for some loss of crops due to required slashing of vegetation. These impacts are restricted to the survey area and will be short term only.

The community would also be interested in amenity and protection of environmentally sensitive areas such as riparian corridors and areas of dense vegetation.

4.7.3 Mitigation Measures

Measures that would be implemented to mitigate impacts on the community include:

- Advanced notification of timing of the surveys;
- Consultation with potentially affected landowners prior to surveying;
- Hours of operation (6am to 6pm)
- Complaints procedure
- Ongoing consultation and communication

4.8 Heritage

4.8.1 Existing Environment

Aboriginal Heritage

Prior to European settlement, the study area was inhabited by people of two Aboriginal language groups including the Birpai language group in the far northern section of the study area (around Gloucester), and the Worimi language group in the majority of the study area (Aus Anthrop 2008).

A search of the Department of Environment and Climate Change's (DECC) Aboriginal Heritage Information Management System (AHIMS) database was conducted as part of the planning of the Gloucester Gas Project. The search revealed that there are 12 registered Aboriginal sites within the 331.13 km² search area used for the Project, shown in **Table 3**. The search area encompassed the Gloucester area subject to this REF and hence has been referred to for the purposes of this report.

These sites were plotted onto a map of the survey area, revealing that out of the 12 registered sites, there were two located within the survey area (38-1-008 and 38-1-0031) as shown in **Figure 4**.

Table 3: AHIMS Registered Sites within the Search Area

Site No.	Site name	Easting*	Northing*	Site type
37-2-0336	Man 31	398700	6421900	Open Camp Site
37-2-0337	Man 32	398700	6421800	Open Camp Site
38-1-0006	Washpool Bridge	397660	6417050	Bora Ring Site
37-2-0348	MAN 25;Mt Arthur North	398700	6421800	Open Camp Site
38-1-0004	Stroud	403333	6413463	Bora/Ceremonial
38-1-0008#	Craven; Parkers Road	402890	6442590	Bora/Ceremonial
38-1-0027	Honey Scarred Tree	401200	6425800	Open Camp Site, Scarred Tree
38-1-0031#	Isolated find No.1	402400	6446625	None
38-1-0033	Honey Tree (002)	401160	6426300	None
38-2-0092	Darren 1	412050	6424000	Isolated Find
38-2-0093	Darren 2	411220	6420200	Isolated Find
38-2-0095	Winns Creek Trail 2	412130	6416560	Isolated Find

* MGA Coordinates.

AHIMS registered sites within the survey area.

Other Cultural Heritage

The greater Hunter Valley, including the survey area, was closed to free settlement up until 1825 because of its close proximity to the Newcastle penal colony. Europeans first arrived in the Gloucester valley in 1826, when early settlement was encouraged in the area due to its ideal appearance for grazing and agriculture.

The scenic values of the area near Gloucester along The Bucketts Way, which consists of townships, farms and agricultural lands, roads, open cut mines and other infrastructure, are recognised on the Register of the National Estate (RNE) as the Vale of Gloucester. The Vale of Gloucester comprises approximately 25,000 ha between Faulkland, Craven and Gloucester and is listed as an Indicative Place on the RNE. The Vale of Gloucester comprises generally the upper Avon River catchment south of Gloucester, and part of the Gloucester River catchment (shown in **Figure 3**).

4.8.2 Potential Impacts

The proposed activities are not intrusive and unlikely to disturb heritage items given there are no excavations proposed as part of the survey. Soil disturbance is expected to be minimal and significant sites have been avoided through the planning of survey lines. Vibrations from the survey method are not expected to impact on any known artefacts given the nature of the activities and the locations of the artefacts to the proposed seismic survey lines.

Potential impacts are considered negligible and given the temporary nature of the works the scenic value of the Vale of Gloucester will not be detrimentally affected by the seismic survey.

4.8.3 Mitigation Measures

Mitigation measures that would be implemented in order to protect heritage values include:

- No excavation to occur; and
- No disturbance of existing and identified relics.

4.9 Waste Management

4.9.1 Potential impacts

Waste generated as part of the proposed development would be restricted to slashed grasses and groundcover. This would be required to allow for access to the survey area for the trucks and geophones.

It is proposed that the slashed grass is mulched and reused at the site to assist in the regeneration of the slashed areas and to reduce competition for weed species in the disturbed areas.

4.9.2 Mitigation Measures

Slashed grasses would be mulched and reused in regeneration of the survey area.

4.10 Visual Assessment

4.10.1 Existing Environment

The Gloucester area subject to the seismic survey is situated within the Manning River Catchment and is located in the lowlands and floodplains of the Avon and Gloucester Rivers, characterised by cleared alluvial plains which comprise agricultural and pastoral land uses. The topography is gently undulating, comprising grassy flats and gentle rises.

The visual landscape of the area is predominately influenced by existing land uses. Agricultural land uses are dominant, with cleared pastoral lands comprising a majority of the survey area. Visual features comprise agricultural structures such as fencing, dividing the land into regular shaped blocks, sheds and other structures, and networks of access tracks throughout properties. Scattered remnant trees are located throughout the area, and are particularly prominent along roads, near homesteads and along creeklines.

The townships of Wards River, Craven, Stratford and Gloucester, which comprise clusters of residential and rural residential properties, are also located within the survey area.

4.10.2 Potential Impacts

The surveys would require two small trucks to traverse the survey area as well as some slashing of grasses and groundcover vegetation. The trucks are mobile and would not be in one place for an extended period of time as they change location. The potential impacts on visual amenity would be short term as vegetation will naturally regenerate and truck movements are temporary.

Given the temporary nature of the survey and relatively minimal visual impact of the process, the works are not anticipated to significantly affect the visual character of the area.

4.10.3 Mitigation Measures

None required.

4.11 Land Use

4.11.1 Existing Environment

The existing land use within the Gloucester region is predominately grazed pasture land and agriculture as can be seen in **Figure 1**.

Land within the Gloucester Shire affected by the surveys is zoned as rural and as environmentally sensitive, which is protected for its scenic and scientific value. Rural lands are currently used for a mix of grazing and rural residential land uses. Land within the Great Lakes Council is also zoned as rural land.

Other surrounding land uses include coal mining, agriculture, rural residential land and National Park (some 30 km from the project area) with key surrounding infrastructure including the Gloucester Coal Rail Loop, North Coast Railway Line and The Bucketts Way.

4.11.2 Potential Impacts

The potential impacts of the project in relation to land use include potential conflict with landowners with respect to access. There would also be some temporary loss of land use while surveying is in progress and access for the general public in the immediate vicinity of the survey vehicles is restricted. The proposed surveys have been planned and considered results of consultation with landowners and other stakeholders with a key aim being to minimise potential impacts to both existing and future land use.

4.11.3 Mitigation Measures

Access arrangements for the 2D surveys have been negotiated with the relevant landholder to ensure that impacts are minimal and manageable. Similar arrangements will be made with landholders within the 3D survey area. Landholders will be notified well in advance of the commencement of the survey on their property. Areas where the potential for landholder conflict to occur have been considered and avoided during the planning of the seismic surveys. Landholder agreements are currently being arranged for access and use of private land.

Given the nature of the proposed surveys, ground cover would naturally regenerate and would allow normal farming practices, or other land uses, to resume. It is not anticipated that the project would impact or limit the potential for future activities on the land or permanently alter the landscape.

4.12 Contaminated Land

While the majority of contaminated land is associated with industrial land use, there is the potential for historical land uses, such as livestock intensive industries, to result in soil contamination. The surveys will cross areas of agricultural and feedstock lands that may have involved activities with the potential to result in contaminated materials. However, an investigation of DECC Contaminated Land records for relevant LGA's (Gloucester and Great lakes) was conducted which revealed no records registered with DECC. It would therefore be unlikely the proposed survey would traverse or disturb any identified contaminated lands.

4.12.1 Potential Impacts

It is considered that no potential impacts are likely from the proposed activities given the nature of the works, the temporary nature and the small scale of the proposed works.

4.12.2 Mitigation Measures

None required.

4.13 Cumulative Environmental Impacts

Existing noise sources comprise predominately of agricultural and farming practices and existing vehicle noise emissions from private properties and The Bucketts Way. Cumulative environmental impacts have been considered in this REF and include potential noise emissions from the survey and recording trucks which may contribute to existing levels. Given the temporary nature of the surveys, it is unlikely cumulative noise effects would be significant.

Other potential impacts were assessed as part of this REF (**Section 4.1 - 4.12**) and it was considered that effects arising from the proposed surveys would not result in any significant contribution to the existing environment.

4.14 Summary of Mitigation Measures

A summary of the mitigation measures and environmental safeguards proposed in **Section 4** of this REF is provided in **Table 4**.

Table 4: Summary of Mitigation Measures

Environmental Issue	Mitigation Measure
Ecology	• Surveys through areas of known Grey Crowned Babbler habitat should be timed to occur outside nesting season (July to December); • Personnel would be briefed on the importance of the Grey Crowned Babbler and a laminated photograph of the Grey Crowned Babbler placed in each vehicle for identification; • Known Grey Crowned Babbler habitat would be walked by a suitably qualified environmental personnel, and Grey Crowned Babblers identified in the location will be gently encouraged to move away from the area for the period of works; • Where 2D survey lines verge on roadside remnant woodland, the route would be shifted slightly to the road surface to avoid these areas;

Environmental Issue	Mitigation Measure
	• Slashing of vegetation along riparian zones would be avoided; • The Avon River crossing near Jacks Lane would be avoided; • Staff would be briefed on fauna awareness (Personnel Management); and • Before slashing, fallen logs and debris would be moved aside and later returned to approximately the same area.
Soils	• Preparation of a management plan for erosion and sedimentation in dry and wet weather conditions. • Avoid waterlogged or boggy soils; • Adhere to identified survey lines and proposed survey methods, unless the potential for significant impact is likely to occur; • A recovery plan that would outline the method and procedure for vehicle recovery should a truck become bogged; • Avoid clearing of vegetation and the exposure of bare sediment to minimise erosion potential; • Water sprays of exposed soils where the potential for dust impacts is likely to occur; • Where depressions are made in the landform as a result of trucks operating in wet weather, the ground would be restored and rehabilitated; and • Only use existing access roads, where possible.
Water	• No crossing of major watercourses by trucks or machinery or people; • In the event of flooding, all activities would cease, vehicles and machinery would be moved to higher ground and rainfall would be monitored; • Recontouring of surfaces to match the surrounding land (in the event of bogging or surface soil disturbance).
Traffic and Access	• A plan to address traffic management during road occupancy would be prepared to minimise delays and ensure safety. • Surveys would only be conducted within the designated work hours of between 6am and 6pm. • There would be no permanent set up area for the surveys
Air	• Appropriate vehicle speed limits will be in place to minimise dust; • Vehicles would be fitted with standard emission control devices (clean/low exhaust vehicles); • Water sprays would be used to control dust (where necessary); • Access would be via existing roadways and tracks; • Rehabilitation would be undertaken for disturbed soils; and • Procedures would be in place to address any complaints received.

Environmental Issue	Mitigation Measure
Noise	• Works would be undertaken within the hours of 6am and 6pm for the duration of the survey period; and • Advanced notification of commencement of surveys would be given to potentially affected landowners.
Community	• Advanced notification of commencement of surveys would be given to potentially affected landowners; • Consultation would be undertaken with potentially affected landowners prior to surveying and would be ongoing for the period of the surveys; • A complaints procedure would be implanted for the works
Heritage	• No excavation to occur; and • No disturbance of existing and identified relics.
Waste	• Slashed grasses would be mulched and reused in regeneration of the survey area.
Land Use	• Landholder agreements would be in place prior to survey activities;

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5.0 Rehabilitation Works

General safeguards to minimise environmental impacts have been previously described in **Section 4.**

Rehabilitation works for the survey would be predominately limited to repair of any compacted or depressed surface areas and allowing the natural regeneration of ground cover affected by the seismic trucks. In some cases the surface may require water sprays to encourage regrowth in bare or withering areas.

Where depressions are made as a result of trucks operating across unforeseeable soft ground, the ground surface would be restored and rehabilitated to its natural condition.

Where slashing of vegetation occurs, fallen logs and debris would be temporarily moved for the trucks to traverse the seismic line. The logs and debris would then be placed back in roughly the same location as to reduce disturbance to potential habitat. Slashed areas would be allowed to naturally regenerate to its original condition.

Due to the low impact and temporary nature of the seismic survey, minimal rehabilitation works would be required.

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6.0 Consideration of Environmental Factors

6.1.1 EP&A Regulation

The factors which need to be taken into account when considering the environmental impact of an activity are listed in Clause 228(2) of the EP&A Regulation. Table 5 below, provides a summary of those environmental factors which may be impacted by the proposed development.

Table 5: Clause 228 Matters of Consideration

Clause 228 Matters for Consideration	Comment
(2) The factors referred to in subclause (1) (b) (ii) are as follows:	
(a) any environmental impact on a community,	The proposed surveys would result in only minor and short term impacts, if any, on the community. Provided the mitigation measures outlined in Section **4.14**, impacts on the community are expected to be minimal and manageable.
(b) any transformation of a locality,	The surveys are non-invasive and would not transform the locality.
(c) any environmental impact on the ecosystems of the locality,	An ecological survey of the area was conducted (Refer **Section 4.1**) and no significant impacts on ecology is expected.
(d) any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality,	The surveys would not reduce any existing values of the Gloucester area. Potential impacts associated with the survey are minor and short term.
(e) any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations,	The proposed surveys are short term with temporary impacts. Any potential effects of the surveys will return to their natural state and thus preserving value for present and future generations.
(f) any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974),	The surveys are not likely to impact on any habitat or protected fauna.
(g) any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air,	An ecological survey of the area was conducted (Refer **Section 4.1**) and no significant impacts on fauna or flora is expected as a result of the proposed activities.
(h) any long-term effects on the environment,	The proposed activities are short term and would not result in any long term impacts.
(i) any degradation of the quality of the environment,	The proposed surveys would not result in any degradation of the quality of the environment.

Clause 228 Matters for Consideration	Comment
(j) any risk to the safety of the environment,	Potential impacts of the surveys are short term and minimal, however, mitigation measures have been proposed to ensure the safety of the environment (**Section 4.14**)
(k) any reduction in the range of beneficial uses of the environment,	The use of land and the environment will not be affected as a result of the proposed surveys.
(l) any pollution of the environment,	The proposed surveys would not result in pollution of the environment.
(m) any environmental problems associated with the disposal of waste,	The only waste stream generated as part of the proposal would be slashed grass which would be mulched and reused as the site. .
(n) any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply,	The proposed surveys do not require any resources that are, or likely to become in short supply.
(o) any cumulative environmental effect with other existing or likely future activities.	Due to the short term nature of the surveys, cumulative environmental effects are negligible when considering future activities. Existing activities will not be affected by the surveys.

6.1.2 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Factors (Commonwealth Legislation)

The EPBC Act requires that the following matters of National Environmental Significance (NES) be considered in an environmental assessment. A Protected Matters search under the EPBC Act was undertaken in respect of the proposal for the purposes of this REF (**Appendix A**). A summary of how the proposal may impact on matters of NES is provided below in Table 6 :

Table 6: Matters of National Environmental Significance

Matter of NES	Comment
World Heritage Properties	There are no World Heritage Properties proximate to the proposed works, or that would potentially be affected by the proposal.
National Heritage Places	There are no National Heritage properties in the vicinity of the proposed works, or that would potentially be affected by the proposal.
Wetlands of International Importance	There are no Ramsar Wetlands within proximity to the proposed works. The proposal is not expected to have an impact on a Ramsar Wetland.
Commonwealth-listed Threatened Species	There is one threatened ecological community and 11 threatened species recorded within a 5 km area of the site. The proposal is not expected to impact upon these threatened species. (Refer to **Section 4.1**).
Commonwealth-listed Migratory Species	There are 11 listed migratory species recorded within a 5 km radius of the site. The proposal is not expected to have an impact on these listed migratory species. (Refer to **Section 4.1**).

Matter of NES	Comment
Nuclear Action	The proposal would not involve nuclear action as defined under the *EPBC Act 1999*.
Commonwealth Marine Areas	There are no Commonwealth Marine Areas proximate to the proposed works that would potentially be affected by the proposal.
Commonwealth Land	The site is not Commonwealth Land, nor would Commonwealth Land likely be affected by the proposal.

Although species have been identified as listed under the EPBC, the proposed works are unlikely to impact on any matters of NES given the proposed methodology. The proposed methods would not affect existing habitat and minimal impact on ground cover is expected, however is temporary in nature (Refer to **Section 4.1**). Given that there would be no impacts on matters of NES, the requirements of the EPBC Act are not triggered and approval from the Commonwealth Minister for the Environment, Water, Heritage and the Arts is not required.

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7.0 Summary of Impacts and Conclusion

The proposal comprises seismic surveys to be conducted within the Gloucester area in order to assess coal seam gas potential as part of the Gloucester Gas Project. The proposed works is non invasive and would only require the trimming of groundcover along seismic lines in order to complete the surveys.

The proposal has been considered under Part 5 of the EP&A Act and this document has been prepared to satisfy environmental assessment requirements in the form of an REF. Consideration has also been undertaken in accordance with the EP&A regulation and the EPBC Act. The works are permissible under local zoning within the GLEP and LEP 1996 and comply with set objectives.

Potential environmental impacts resulting from the proposal have been assessed and environmental safeguards and mitigation measures have been identified to minimise potential impacts.

Considering the temporary and short term nature of the activities and low impacts that the survey would have, and with safeguard and mitigation measures in place, it is expected the proposal would not constitute a significant adverse environmental impact.

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Figures

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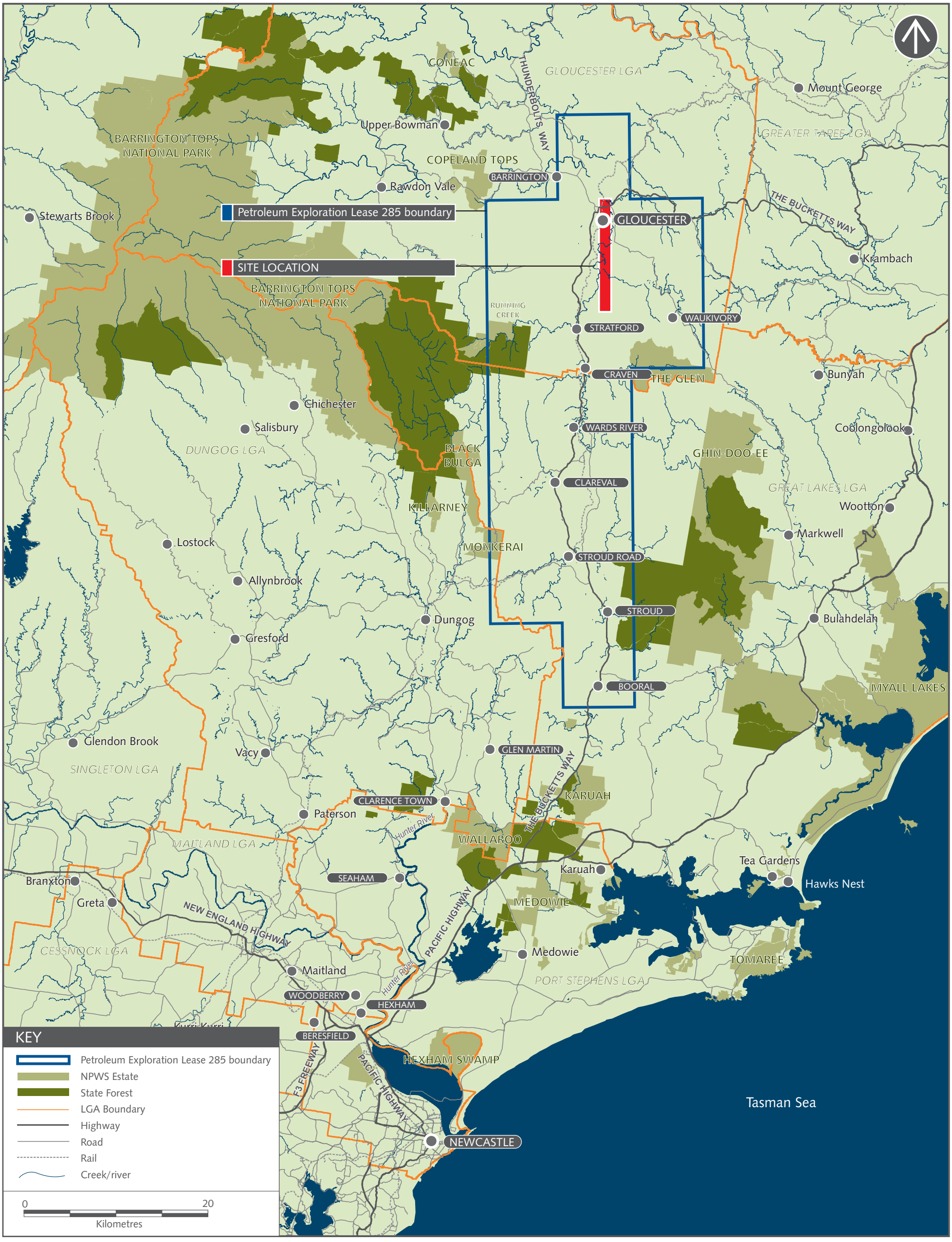

AECOM

GLOUCESTER SURVEY AREA LOCATED WITHIN PEL 285 BOUNDARY

FIGURE 1

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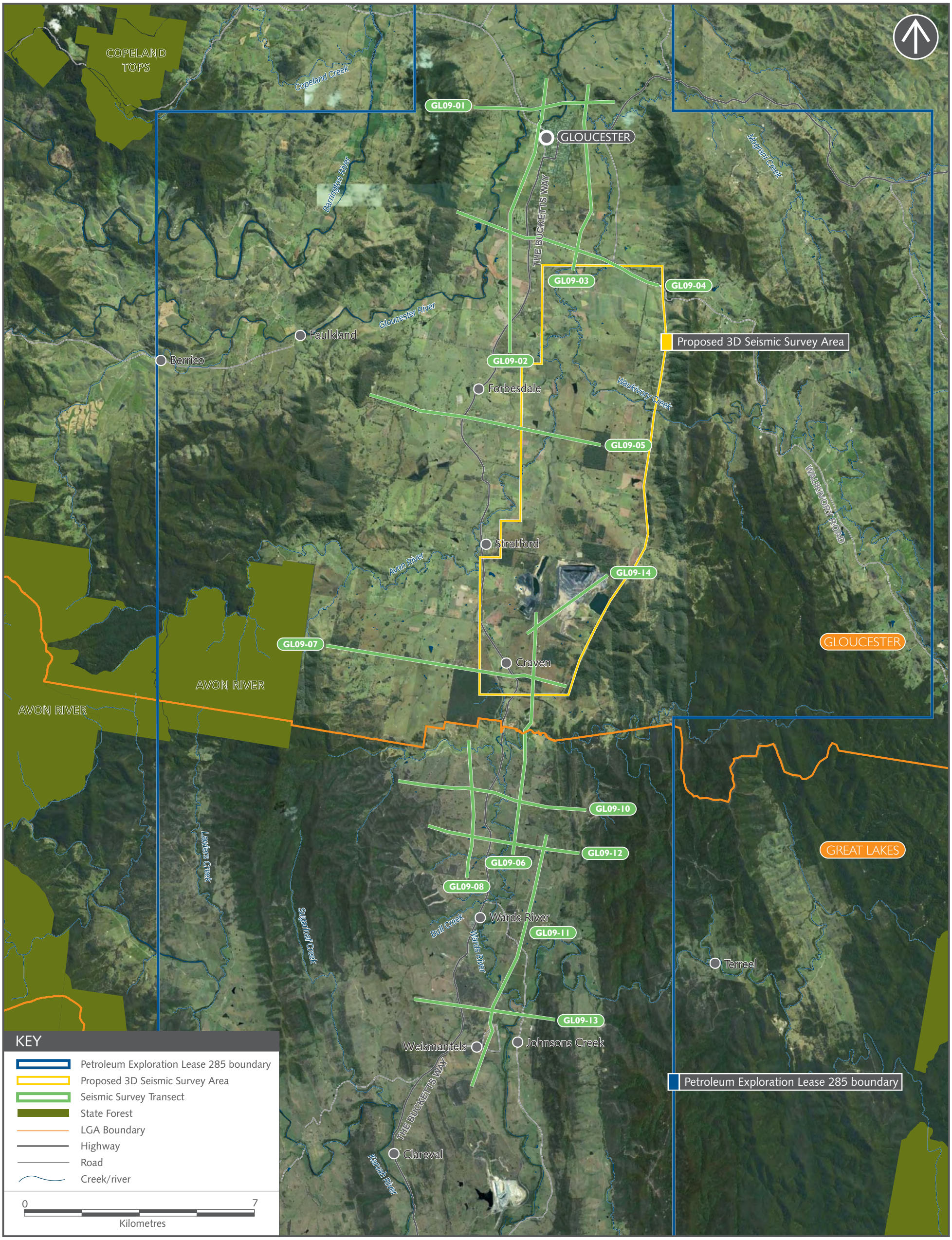

AECOM

GLOUCESTER SEISMIC SURVEYS AND SURVEY AREA

FIGURE 2

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COPELAND TOPS
Copeland Creek
GL09-01
GLOUCESTER
38-1-0003
Barrington River
THE BUCKETTS WAY
Mograni Creek
GL09-03
GL09-04
Gloucester River
Faulkland
Berrico
Proposed 3D Seismic Survey Area
GL09-02
Forbesdale
Waukivory Creek
GL09-05
WAUKIVORY ROAD
38-1-0031
Stratford
Avon River
GL09-14
GL09-07
38-1-0008
Craven
GLOUCESTER
AVON RIVER
AVON RIVER
GL09-10
GL09-12
GL09-06
GL09-08
Lawlers Creek
Sugarloaf Creek
Bull Creek
Wards River
Wards River
GL09-11
GREAT LAKES
Terreel
GL09-13
Weismantels
Johnsons Creek
Petroleum Exploration Lease 285 boundary
THE BUCKETTS WAY
Karuah River
Clareval
38-1-0033
38-1-0027

KEY

- Petroleum Exploration Lease 285 boundary
- Proposed 3D Seismic Survey Area
- Seismic Survey Transect
- State Forest
- Vale of Gloucester
- LGA Boundary
- Highway
- Road
- Creek/River
- AHIMS Site Location

0 7
Kilometres

AECOM

AHIMS LISTINGS WITHIN SURVEY AREA

FIGURE 3

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Plates

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Plate-1: Proposed Seismic trucks

Plate-2: Proposed Seismic Geophones

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Appendix A

Ecology Assessment Report for 2D and 3D Seismic Surveys

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AECOM

AGL 2D & 3D Seismic Surveys
PEL 285
Gloucester Basin

Ecological Assessment Report

September 2009

Alison Hunt and Associates Pty Ltd

TERRESTRIAL | MARINE | AQUATIC

Executive Summary

Alison Hunt & Associates Pty Ltd was commissioned by AECOM to undertake an ecological assessment for the series of 2D and 3D seismic surveys within AGL Gloucester LE Pty Ltd Petroleum Exploration Licence (PEL) No. 285 located near Gloucester in NSW. AECOM is currently preparing a Review of Environment Factors (REF) to be submitted to the Environment Unit, Department of Mineral Resources for determination under Part 5A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The purpose of the study was to assess the potential direct and indirect impacts of the proposal on biodiversity, especially in relation to threatened species and endangered ecological communities.

The 2D surveys involve the acquisition of 13 new seismic lines across a total of approximately 77.5 linear kilometres (km) and these extend from the township of Gloucester in the north to Wards River village in the south. The seismic survey areas are nearly all located on privately owned lands consisting of mostly cleared grazing pastures. The 3D seismic survey is to be completed in a grid pattern with a line spacing of 64 m working generally with north-south and east-west lines over approximately 5,000 hectares (ha). These will be located to the south of Gloucester within the Stratford area. This area includes the Gloucester Coal mining lease and buffer areas, as well as privately owned lands of cleared grazing pastures. For both the 2D and 3D surveys, the seismic exploration activity would utilise non intrusive methods with minimal disturbance to assess the underground geological structures. The method used for these surveys is seismic reflection profiling, which involves a truck mounted vibrator which generates sound waves at regular intervals along the seismic lines and from which the reflections are recorded by sensors set up along the lines. Vegetation would not be cleared and soils would not be disturbed. Instead, vegetation would be slashed to a maximum 4 m width along the 2D seismic survey lines in 1 m to 2.5 m wide lines for the 3D surveys.

Several tasks were addressed in this assessment including a review of available literature and databases to assist with the identification of site values, especially in relation to threatened species, populations and endangered ecological communities, field investigations to ascertain the current site condition and the presence or likely presence of threatened or protected species, an impact assessment to determine the likely effects of the proposal on the ecology of the sites and preparation of preliminary recommendations to ameliorate and mitigate any potential impacts.

The majority of proposed 2D and 3D seismic survey lines traverse highly modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and used for grazing over a considerable number of years. The 2D lines have been located in areas with fewest biodiversity values which is generally along fencelines or roadside verges. The seismic route would be shifted slightly to avoid areas of intact vegetation, for examples along Woods Road, Craven. Rivers and creeks would not be tested as surveys would be discontinued on one side and reinstated on the opposite side. Survey lines would be accessed via existing roads and tracks. The 3D seismic survey lines require a set grid pattern (64 m spacing) which although is flexible enough in its design to avoid trees greater than sapling size, it does require that the entire identified grid be sampled to allow the construction of a 3D image. This will require the slashing of shrub and ground layers in 1 m to 2.5 m wide lines through remnant / regrowth areas, the most intact being Tiedmans block in mid-survey area.

The lack of structural diversity across the majority of the 2D and 3D seismic survey area means that fauna habitat resources, such as trees, shrubs, rocky areas and fallen timber, are extremely limited and in general, habitat suitable for fauna would be limited to those common species of native and introduced fauna regularly found in disturbed areas. In contrast, the generally intact remnant / regrowth vegetation communities within the 3D survey area, would provide good quality habitat for a range of native fauna including macropods, microchiropteran bats, some arboreal mammals and woodland birds. Hollows were evident in some of the larger trees and these could provide habitat suitable for hollow-dependent birds, possums, gliders and microchiropteran bats. Additionally, the entire seismic survey area is scattered with farm dams and drainage lines suitable for a range of amphibians and water birds.

Of the 53 species of threatened fauna listed under the TSC Act and known to occur within the locality, the Green and Golden Bell Frog (*Litoria aurea),* Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) and Grass Owl (*Tyto capensis*), were considered further due to the likely presence of nearby habitat. Assessments of Significance for these species concluded that this proposal is unlikely to have a significant impact on foraging resources. With the implementation of stringent management measures it is unlikely that any of these species would be significantly impacted by this proposal and therefore a Species Impact Statement would not be required. The Green and Golden Bell Frog is also listed under the EPBC Act and assessment under this Act concluded that the Green and Golden Bell Frog is unlikely to be impacted by this proposal due to the highly modified nature of the proposed works areas and the minimum impact this proposal is likely to have on the ecology of potential habitat. Consequently, this proposal is unlikely to be considered a controlled action.

The relatively minor and temporary nature of disturbance from the proposal means that any impacts on flora and fauna are likely to be transitory and minor and could be managed to protect current values. A number of management measures have been outlined, especially in relation to protection of the Grey-crowned Babbler and these should be stringently implemented.

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APPENDICES

1 INTRODUCTION

1.1 Background

Alison Hunt & Associates Pty Ltd was commissioned by AECOM to undertake an ecological assessment for a series of 2D and 3D seismic surveys within AGL Gloucester LE Pty Ltd Petroleum Exploration Licence (PEL) No. 285 located near Gloucester in NSW (Figure 1). AECOM is currently preparing a Review of Environment Factors (REF) to be submitted to the Environment Unit, Department of Mineral Resources for determination under Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The purpose of this study was to assess the potential direct and indirect impacts of the proposal on biodiversity, especially in relation to threatened species and endangered ecological communities.

Key ecological issues that required clarification included:

- The potential for endangered ecological communities, threatened species and / or their habitat listed under the NSW *Threatened Species Conservation 1995 (*TSC Act) to occur within the study area;
- The potential presence of any matters of National Environmental Significance (NES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); and
- Any avoidance, management or mitigation options.

1.2 Proposal

The proposed seismic surveys aim to assess the viability and gain a better appreciation of the sub-surface geological structure of the Gloucester Basin within PEL 285.

The seismic survey area is located to the north of Newcastle, from Gloucester to Wards River, NSW (Figure 1) and falls within the local government areas (LGAs) of Gloucester, Dungog and Great Lakes. The study area is located with the Hunter – Central Rivers Catchment Management Authority and the proposed seismic survey routes cross numerous waterways.

The 2D surveys involve the acquisition of 13 new seismic lines across a total of approximately 77.5 linear kilometres (km). These surveys would be completed over a 4 - 6 week period. The proposed seismic lines are located from the township of Gloucester in the north to the south of Wards River Village to the south (Figure 2 and Figure 3). The seismic survey areas are nearly all located on privately owned lands consisting of mostly cleared grazing pastures. Where possible the 2D survey lines have been located along boundary lines or within road easements to minimise impacts.

The 3D seismic survey is to be completed over approximately 5,000 hectares (ha), located to the south of Gloucester within the Stratford area. This area includes the Gloucester Coal mining lease and buffer areas, as well as privately owned lands of cleared grazing pastures. The 3D surveys would be conducted in a grid pattern with a line spacing of 64 m working generally with north-south and east-

west lines. This survey is estimated to occur over a three month period. Figure 4 shows the 3D survey areas and Figure 5 shows the 3D surveys lines in more detail where they pass through the Tiedman's block. This layout is indicative as pretesting may indicate that line spacing could be widened from the current 64 m grid.

For both the 2D and 3D surveys, the seismic exploration activity would utilise non intrusive methods with minimal disturbance to assess the underground geological structures. The method used for these surveys is seismic reflection profiling, which involves a truck mounted vibrator that generates sound waves at regular intervals along the seismic lines and from which the reflections are recorded by sensors set up along the lines.

The equipment to be employed through this process includes a recording truck, a cable and geophone (sensor) spread, and two moderate-sized six wheel drive trucks (approximately 7.7 tonnes each) which would move slowly along the seismic lines.

For the 2D survey works, disturbance would be minimised to the slashing of vegetation to just above ground level where required, to provide a cleared strip of a maximum of 4 m wide for the full length of each seismic survey line. Approximately 3 km of seismic lines would be established at a time. Access to all of the proposed seismic lines is available from existing farm tracks.

For the 3D surveys, the slashing required for the roughly north-south Source Lines would be approximately 2.5 m wide whilst that for the Receiver Lines would be approximately 1 m wide. The 3D surveys are proposed to begin in the southern end of the mining lease area in January 2010 and work towards the north. Progress through the area would be at a rate of a square kilometre in two days.

Removal of vegetation would include the slashing of some saplings but no mature trees would be removed.

1.3 *Legislative Framework*

A number of legislative requirements would need to be met in relation to biodiversity issues for the proposed works and these may include but not necessarily be limited to:

1.3.1 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) requires assessment of proposed actions that are likely to cause significant impacts on matters of National Environmental Significance (NES) listed under the Act. The EPBC Act identifies seven matters of NES and these include:

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance (Ramsar Wetlands);
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas; and
- Nuclear actions (including uranium mining).

Those matters of NES relevant to this proposal may include threatened species, ecological communities and migratory species. If, after addressing the criteria set out in the Administrative Guidelines for the EPBC Act, it is concluded that a significant impact on matters of NES is likely then a referral to the Department of Environment, Water, Heritage and the Arts (DEWHA) is required.

1.3.2 NSW *Environmental Planning and Assessment Act 1979*

Pursuant to the NSW *Environment Planning and Assessment Act 1979* (EP&A Act) an assessment of the impacts of the proposed works on land that is critical habitat or on threatened species, populations or ecological communities, or their habitats listed under the TSC Act, must be undertaken in the form of an Assessment of Significance. This involves assessing potential impacts of the proposal based on seven criteria that aid in assessing if the proposal is likely to have a significant impact on threatened species or their habitat or endangered ecological communities at the site or that have the potential to occur. If the Assessment of Significance concludes that a significant impact is likely then a Development Application must be accompanied by a Species Impact Statement (SIS).

1.3.3 NSW *Threatened Species Conservation Act 1993*

The NSW *Threatened Species Conservation Act 1995* (TSC Act) applies to terrestrial and aquatic flora and fauna. This Act is administered by the NSW Department of Environment, Climate Change and Water (DECCW). Pursuant to the EP&A Act an assessment of the impacts of the proposed works in areas of critical habitat or is likely to affect threatened species, populations or ecological communities, or their habitats listed under the NSW *Fisheries Management Act 1994* (FM Act), must be undertaken in the form of an Assessment of Significance. This involves assessing potential impacts of the proposal based on seven criteria that aid in assessing if the proposal is likely to have a significant impact on threatened species or their habitat or endangered ecological communities at the site or that have the potential to occur. If the Assessment of Significance concludes that a significant impact is likely then a Development Application must be accompanied by a Species Impact Statement (SIS).

1.3.4 State Environmental Planning Policy 44 - Koala Habitat Protection

State Environmental Planning Policy No. 44 Koala Habitat (SEPP 44) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline by:

- Requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat;
- Encouraging the identification of areas of core koala habitat; and
- Encouraging the inclusion of areas of core koala habitat in environment protection zones.

The policy applies to 107 local government areas including Gloucester LGA and therefore this policy is considered in assessing this proposal.

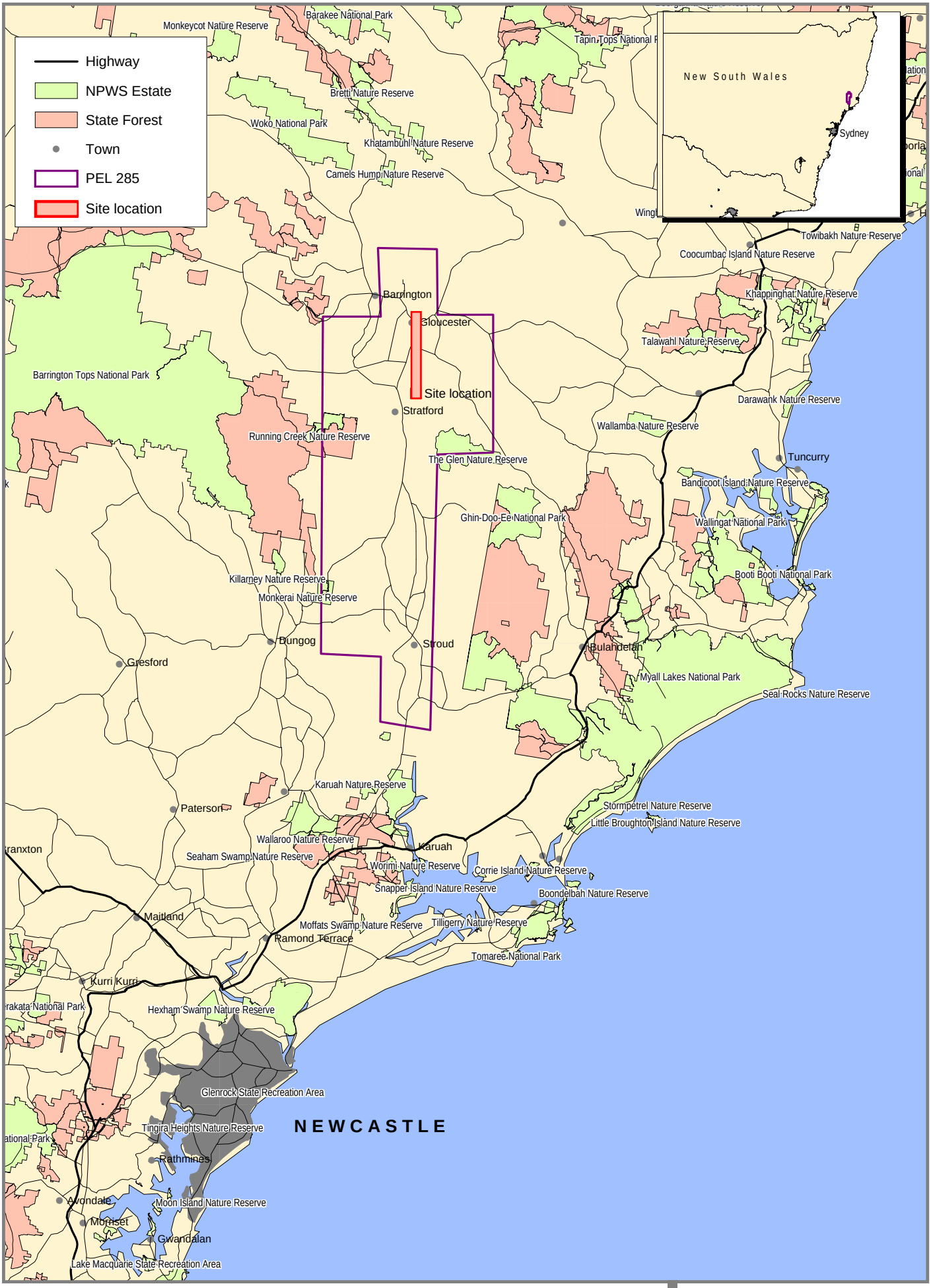

Figure 1 Site Location

Legend

- Proposed 2D Seismic Survey lines
- Roads
- Vehicular Tracks

GL09-01
GL09-02
GL09-03
GL09-04
GL09-05

GLOUCESTER

MOPPY CLOSE
DANGAR ROAD
THUNDERBOLTS WAY
SHOWGROUND ROAD
MACLEAY STREET
MANNING STREET
COOK STREET
COWPER STREET
TYRELL STREET
QUEEN STREET
BOUNDARY STREET
BILLABONG LANE
ELLIOT STREET
GREGSON STREET
PHILIP STREET
HAY STREET
MACLAURIN STREET
LAVERS STREET
WATTLE CLOSE
OAK STREET
CEMETERY ROAD
TATE STREET
LOWE STREET
WAUKIVORY ROAD
MOONLIGHT CIRCUIT
JACKS ROAD
MASLENS LANE
MCKINLEYS ROAD
WELLARDS LANE
BUCKETTS ROAD
GRANTHAM ROAD
THE BUCKETTS WAY
STANTONS LANE
FAULKLAND ROAD
FAIRBAIRNS ROAD
TIEDMANS ROAD
GLOUCESTER TOPS ROAD

AGL

Revision DRAFT
Created 17 June 2009
Author Upstream Gas

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0 0.25 0.5 1 1.5 2

Kilometres

Map Grid of Australia, Zone 56
Geocentric Datum of Australia 1994

Gloucester Coal Seam Gas Project

Figure 2
Proposed 2D seismic survey area - northern zone

Legend

- Proposed 2D Seismic Survey lines
- Roads
- Vehicular Tracks

GL09-07
GL09-08
GL09-10
GL09-06
GL09-12
GL09-11
GL09-13

UPPER AVON ROAD
PARKERS ROAD
PARKERS ROAD
THE BUCKETTS WAY
WOODS ROAD
BLACK KNOB CREEK
BERRICO ROAD
Craven
GLEN ROAD
PAGES ROAD
BURTONS ROAD
MILL LANE
Wards River
MADDENS LANE
TERREEL ROAD
MILL CREEK ROAD
JOHNSONS CREEK ROAD
ANDERSONS CREEK ROAD
MONKERAI ROAD

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Created 17 June 2009
Author Upstream Gas

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Kilometres

Map Grid of Australia, Zone 56
Geocentric Datum of Australia 1994

Gloucester Coal Seam Gas Project

Figure 3
Proposed 2D seismic survey area - southern zone

Legend

- Proposed 3D Seismic Survey Area
- Roads
- Vehicular Tracks

WELLARDS LANE
JACKS ROAD
MASLENS LANE
WAUKIVORY ROAD
MCKINLEYS ROAD
MCKINLEYS LANE
FAULKLAND ROAD
FAIRBARNS ROAD
TIEDMANS ROAD
GLOUCESTER TOPS ROAD
Tiedmans Block
WENHAM COX ROAD
WHEATLEYS ROAD
CROWTHERS ROAD
Stratford
THE BUCKETTS WAY
BOWENS ROAD
DEARDS LANE
GERMONS LANE
UPPER AVON ROAD
PARKERS ROAD
PARKERS ROAD
WOODS ROAD
GLEN ROAD
YATES TRAIL
CPT 2 TRAIL
GLEN ROAD
GLEN ROAD

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Author Upstream Gas

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Kilometres

Map Grid of Australia, Zone 56
Geocentric Datum of Australia 1994

Gloucester Coal Seam Gas Project

Figure 4 Proposed 3D seismic survey area

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Author Upstream Gas

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Kilometres
Map Grid of Australia, Zone 56
Geocentric Datum of Australia 1994

Gloucester Coal Seam Gas Project

Figure 5

Proposed 3D seismic survey lines through Tiedman's block

Sources: AGL Energy, NSW Department of Lands

2 METHODS

This assessment was undertaken to describe the biodiversity values of the seismic survey areas in order to determine the likely potential impacts associated with the proposal within the framework provided by Part 5 under the EP&A Act, TSC Act, FM Act and Commonwealth EPBC Act and with reference to the *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007) and *EPBC Act Policy Statement 1.1 – Significant Impact Guidelines: Matters of National Environmental Significance* (DEH 2006).

Several tasks were undertaken including:

- A review of available literature and databases to assist with the identification of site values especially in relation to threatened species, populations and endangered ecological communities;
- Field investigations to ascertain the current site condition and the presence or likely presence of threatened or protected species;
- An impact assessment to determine the likely effects of the proposal on the ecology of the site with particular reference to threatened species, populations and / or ecological communities; and
- Preparation of preliminary recommendations to ameliorate and mitigate any impacts.

2.1 Literature Review

Available literature and database records pertaining to the site and locality (i.e. within a 10 km radius) were reviewed. The full list of reference materials is provided in Section 7 and those of particular relevance are listed below:

- Department of Environment, Climate Change and Water (DECCW) – Threatened species database records (DECCW 2009);
- Department of Environment, Water, Heritage and the Arts (DEWHA) – Online protected matters search tool for Matters of National Environmental Significance (NES) (DEWHA 2009);
- ENSR Australia Pty Ltd 2008 Gloucester Coal Seam Gas Project. Ecological Assessment. Gloucester to Hexham. Report prepared for Lucas Energy, Gloucester NSW; and
- Alison Hunt & Associates Pty Ltd 2009 Draft Addendum. Gloucester Coal Seam Gas Project. Ecological Assessment. Gloucester to Hexham: Amended Sections. Report prepared for AECOM, Gordon NSW.

2.2 Site Assessment

The locations of the 2D and 3D seismic survey areas are mostly located within highly modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and used for grazing of stock and mining over a considerable number of years. Additionally, a number of ecological assessments have recently been undertaken across the 3D seismic survey areas including those for investigations into coal seam methane gas exploration boreholes (AHA Ecology 2007, Alison Hunt & Associates Pty Ltd 2008), gas field development area and gas pipeline (ENSR Australia Pty Ltd 2008, Alison Hunt & Associates Pty Ltd 2009). Consequently, the biodiversity values of the seismic survey areas are well known and therefore the entire length of the seismic survey lines was not walked. Instead aerial photographs were used to select sites for closer investigation and these areas were targeted on 28 and 29 July 2009. These areas included drainage lines, creeks, rivers and any areas adjacent to blocks of native vegetation.

During the site assessment the dominant plant species were recorded and the likelihood of the presence of threatened fauna and flora was assessed based on the presence of suitable habitat. For plants this included several factors such as the vegetation types present, drainage patterns, weed invasion and present land use activities. A general fauna habitat assessment included an assessment of the nature and condition of habitats, specific resources and features of relevance for native fauna. In addition, indirect evidence of fauna (e.g. scats, feathers, fur, tracks, dens, nests, scratches, chew marks and owl wash) was recorded.

2.3 Limitations

This assessment was aimed at providing an overall assessment of the ecological values of the sites with particular emphasis on the likely presence of threatened species. This was undertaken through integration of data from a number of sources to allow an assessment of the impacts of the proposal. This study was not designed so that all species, whether resident or transitory to the site, would be recorded. It is therefore likely that a number of species not mentioned within this report would also utilise the resources of the site from time to time.

3 RESULTS

3.1 Environmental Setting

Gloucester and the seismic survey areas are situated in the Gloucester Valley, NSW. The landforms of the Gloucester Valley are characterised by north-south oriented linear ridges with intervening undulating lowlands and floodplains. The topography consists of grassy flats and gentle rises. The PEL area contains the geological domain known as the Gloucester Basin or Stroud-Gloucester Syncline. This is a canoe shaped trough containing some 4,000 m of Permian volcanics and sedimentary rocks. Soils comprise moderate to deep, moderately well-drained Brown Sodosols (Yellow Soloths) and moderately well-drained Grey Kurosols (Yellow Soloths) on imperfectly to moderately well drained sideslopes and crests shallow to deep (Lucas 2007).

The broader area contains significant biodiversity values including the world heritage listed Central Eastern Rainforest Reserves (Barrington Tops Area) NSW (Barrington Tops National Park) as well as the Woko National Park, six nature reserves and four state conservation areas. In all, 51,090 ha (approximately 17% of the entire LGA) are dedicated to species and ecosystem conservation, (Gloucester Shire Council 2005). Nonetheless, the LGA continues to lose biodiversity through:

- Land clearing;
- Habitat alteration through weed invasion;
- Domestic and feral animal activity; and
- Poor land management techniques.

With such significant conservation areas the LGA provides habitat for a number of species and endangered ecological communities listed on the schedules of the NSW TSC Act and Commonwealth EPBC Act and these are listed in Gloucester Shire Council's *Supplementary State of the Environment Report 2005*. A review of these lists indicated that the majority of species and ecological communities would be confined to the vegetated areas within conservation areas, within remnant vegetation in private ownership, and in riparian areas and along coastal waterways.

3.2 Climate

Gloucester and surrounding areas experience their highest mean rainfall and highest mean temperatures between December and March with the highest rainfall occurring in March at 127 mm and the highest temperatures in January and February at 29 ^{o}C. During winter, rainfall drops to 47 mm during August and mean maximum temperatures to 19 ^{o}C during June and July and mean minimum temperatures to 6 ^{o}C during July and August (Table 1).

Table 1 Mean rainfall recorded at Gloucester Post Office and mean temperature at Taree

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Mean rainfall (mm)	115	122	127	77	68	67	51	47	52	68	82	104	982
Mean maximum temperature (^{o}C)	29	29	27	25	22	19	19	20	23	25	27	28	24
Mean minimum Temperature (^{o}C)	18	18	16	13	10	7	6	6	9	12	14	16	12
Source: Bureau of Meteorology http://www.bom.gov.au/jsp/ncc/cdio/weatherData accessed 21 April 2009.													

3.3 2D and 3D Seismic Survey Areas

3.3.1 Vegetation

Native vegetation of the Gloucester Valley falls within the *Hunter-Macleay Dry Sclerophyll Forests* vegetation class which are transitional between the *Dry Coastal Valley Grassy Woodlands and Northern Hinterland Wet Sclerophyll Forests* of the steeper and wetter slopes (Keith 2004). Woodlands in the locality have previously been mapped by NPWS (1999) as *Ecosystem (ES) 145 Sydney Peppermint – Stringybark*, *ES 71 Ironbark*, *ES 47 Escarpment Redgum* and *ES 33 Dry Foothills Spotted Gum*. The canopy of vegetated areas is largely dominated by Spotted Gum (*Corymbia maculata*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Grey Box (*E. moluccana*), Grey Gum (*E. punctata*), Small-fruited Grey Gum (*E. propinqua*), Grey Ironbark (*E. siderophloia*) and Forest Red Gum (*E. tereticornis*). The occurrence and dominance of these species is largely dependent on soils, drainage and proximity to drainage lines. Shrubs are characterised by Silver-stemmed Wattle (*Acacia parvipinnula*), Forest Oak (*Allocasuarina torulosa*), Coffee Bush (*Breynia oblongifolia*), Gorse Bitter Pea (*Daviesia ulicifolia*), Peach Heath (*Lissanthe strigosa*). White Root (*Pratia purpurascens*), Mulga Fern (*Cheilanthes sieberi* subsp*. sieberi*), Barbed Wire Grass (*Cymbopogon refractus*), Kangaroo Grass (*Themeda australis*) and Wiry Panic (*Entolasia stricta*) dominate the understorey. These areas grade into the cleared, lower elevation, fertile soils used for agriculture.

The majority of proposed 2D and 3D seismic survey lines traverse highly modified environments that have been cleared of native vegetation, largely revegetated with introduced pasture species and used for grazing over a considerable number of years (Plate 1).

Plate 1 Typical landscape along seismic survey lines

Shows complete clearing to the top of bank of Gloucester River

A number of rivers, creeks and drainage lines occur along the route of the seismic survey lines and these are highly modified and mostly degraded. The riparian areas have been cleared to the top of bank and vegetation remaining occurs along the banks and eroded terraced areas. Some native vegetation occurs along the larger rivers, e.g. Gloucester River, including River Oak (*Casuarina cunninghamiana*), but these areas tend to be dominated by the declared noxious weeds, Camphor Laurel (*Cinnamomum camphora*), Lantana (*Lantana camara*), Small-leaved Privet (*Ligustrum sinense*) and Large-leaved Privet (*Ligustrum lucidum*). The majority of the smaller drainage lines are broad and eroded, grassed or bare ground gullies, the majority of which show signs of pugging by cattle. Common species within these drainage lines include Blady Grass, Spear Thistle (*Cirsium vulgare*), Giant Parramatta Grass (*Sporobolus fertilis*) and *Carex* sp. Even though these areas are largely degraded, seismic surveys would not be undertaken within these areas to avoid further potential degradation. Machinery would be driven around the creeks on existing roads and tracks and the seismic surveys recommenced on the opposite side of the creeks and rivers.

Although the majority of the 2D seismic survey lines traverse paddocks, where possible they have been located along roadside verges to avoid impacts on grazing lands. The majority of these verges have been cleared and are dominated by weeds typical of the roadside verges not containing native vegetation (Plate 2). Woods Road, Craven (Figure 3 and Plate 3) is an exception as this road reserve contains a number of native trees and a substantially intact understorey. Midway along Woods Road there is a remnant area of moderately intact Spotted Gum Forest with Ironbarks as co-dominants. Also scattered throughout are Broad-leaved White Mahogany (*E. umbra*) and Turpentine (*Syncarpia glomulifera*). The understorey is dominated Silver-stemmed Wattle, Coffee Bush, Gorse Bitter Pea, White Root, Purple Coral Pea (*Hardenbergia violacea*), Threeawn Speargrass (*Aristida vagans*), Kangaroo Grass and Spiny-headed Mat-rush (*Lomandra longifolia*). Tall Greenhood (*Pterostylis longifolia*) was also common throughout. At the western extent of Woods Road wetter influences were evident with Grey Gums becoming dominant. White Sally Wattle (*Acacia floribunda*), Common Bracken (*Pteridium esculentum*), Kidney Weed (*Dichondra repens*) and Dogwood (*Jacksonia scoparia*) were also present. In these vegetated areas the route of the 2D survey lines would be shifted to the road surface to avoid intact vegetation and trees.

Plate 2 Typical road reserve

Plate 3 Road reserve along Woods Road, Craven

The 3D seismic survey lines require a set grid pattern (64 m spacing) (Figure 5) which although is flexible enough in its design to avoid trees greater than sapling size, it does require that the entire identified grid be sampled to allow the construction of a 3D image. This will require the slashing of shrub and ground layers as 1 m to 2.5 m wide lines through remnant / regrowth areas, the most intact being Tiedmans block in mid-survey area (Figure 4 and Figure 5). This area has previously been mapped as *Ecosystem (ES) 145 Sydney Peppermint – Stringybark*, *ES 71 Ironbark*, *ES 47 Escarpment Redgum* and *ES 33 Dry Foothills Spotted Gum*.

3.3.2 Fauna Habitat

The lack of structural diversity across the majority of the 2D and 3D seismic survey area means that fauna habitat resources, such as trees, shrubs, rocky areas and fallen timber, are extremely limited and in general, habitat suitable for fauna would be limited to those common species of native and introduced fauna regularly found in disturbed areas, such as the Eastern Grey Kangaroo (*Macropus giganteus*), European Red Fox (*Vulpes vulpes)*, Black Rat (*Rattus rattus*), House Mouse (*Mus musculus*), and domestic cats and dogs. European Red Fox scats were recorded in several areas.

In contrast, the generally intact remnant / regrowth vegetation communities within the 3D survey area, would provide good quality habitat for a range of native fauna including macropods, microchiropteran bats, some arboreal mammals and woodland birds. Macropod scats were recorded and the Eastern Grey Kangaroo and Eastern Wallaroo (*Macropus robustus*) were both sighted. Scratches on some of the smooth barked Eucalypts indicate that these trees were being used by arboreal mammals. Hollows were evident in some of the larger trees and these could provide habitat suitable for hollow-dependent birds, possums, gliders and microchiropteran bats. Additionally, the entire seismic survey area is scattered with farm dams and drainage lines suitable for a range of amphibians and water birds.

3.4 Conservation Significance

3.4.1 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

Although remote to the study area, Myall Lakes which is listed as a Wetland of International Significance (Ramsar Sites) is listed under the EPBC Act as being within the same catchment as the study area.

Predictive modelling indicates that 14 fauna, 13 flora and 12 migratory species listed under the EPBC Act have the potential to occur within the locality of the site (i.e. 10 km) and these are listed in Appendix A along with their likelihood of occurrence. Those species for which potential habitat occurs adjacent to, or within the seismic survey areas, are detailed in Table 2. The Green and Golden Bell Frog which is listed as vulnerable under the EPBC Act may have a low likelihood of occurring within a small body of open water along Jacks Lane near the Avon River crossing and under the precautionary principle is considered further.

3.4.2 NSW *Threatened Species Conservation Act 1995*

Endangered Ecological Communities

A number of Endangered Ecological Communities (EEC) are listed as occurring within the Karuah Manning CMA and these are:

- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions;

- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion;
- Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion;
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion;
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion;
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions;
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; and
- Sydney Freshwater Wetlands in the Sydney Basin bioregion.

The seismic survey area is highly modified with the majority of the area comprising paddocks and consequently none of the EECs listed above occur across the survey area. The small areas of remnant / regrowth vegetation are generally Ironbark dominated communities, none of which form part of an EEC.

Species

A total of 63 threatened species listed under the TSC Act have been recorded within the locality consisting of ten species of plant, one reptile, four amphibians, 25 birds and 23 mammals and these are listed in Appendix A. The survey area lacks the complexity required to provide habitat for a range of threatened species as pasturelands generally have few refuge areas or foraging resources, especially for mammals and reptiles. The farm dams and creeks along the proposed seismic lines mostly lack habitat complexity and therefore provide few resources for waterbirds or amphibians although it is considered that there may be marginal habitat for the Green and Golden Bell Frog (*Litoria aurea)* in a small area of open water and Cumbungi (*Typha orientalis*) on Jacks Road near the Avon River crossing. This frog is listed as vulnerable under both the TSC Act and EPBC Act. Woodland areas and the road reserve along Woods Road, Craven may provide nesting and foraging habitat for the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) which is listed as vulnerable under the TSC Act. Similarly, the Grass Owl (*Tyto capensis*) may occasionally forage across the study area as its favoured habitat is tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.

Table 2 Threatened species for which habitat occurs locally

Species	Conservation Status	Habitat	Likelihood of occurrence on site
Green & Golden Bell Frog *Litoria aurea*	E-TSC V-EPBC	Marshes, dams & stream-sides particularly those containing *Typha* or *Eleocharis*.	Potential habitat on Jacks Lane.
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	V-TSC	Open woodland, particularly those with intact understorey.	Known to occur at the northern end of the Tiedmans block and is likely to occur in other nearby woodland areas.
Grass Owl *Tyto capensis*	V-TSC	Tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.	Cleared paddocks. Unlikely-but may occasionally forage across wetter paddock areas.
Note: TSC = NSW *Threatened Species Conservation Act 1995*. EPBC = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.* V = Vulnerable, E = Endangered.			

3.5 Corridors and Connectivity

The survey lines are situated in an agricultural landscape and most of the adjacent lands have been cleared with only isolated pockets of remnant bushland remaining within the broad valley area around Gloucester. The Gloucester River and Avon River and unnamed tributaries would provide the strongest linkages along the valley floor. This project is unlikely to affect movement corridors and connectivity for any species of plant or fauna within the locality as impacts are confined to the slashing of shrub and ground cover vegetation to just above ground level where required, to provide a cleared 1 m to 4 m wide strip for the full length of each seismic survey line.

3.6 SEPP 44 - Koala Habitat Protection

An assessment under *State Environment Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44) is required as the Gloucester LGA is listed under Schedule 1 of SEPP 44. This SEPP requires the identification and protection of core koala habitat within the LGA. Core koala habitat means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (i.e. females with young) and recent sightings of and historical records of a population. Potential koala habitat means areas of native vegetation where the trees of the types listed in Schedule 2 of the Act, constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. The proposed 2D seismic survey line areas could not be considered core koala habitat or potential koala habitat as the proposed route lacks trees and in particular those species listed under Schedule 2 of this SEPP. The vegetated areas of the 3D survey lines could provide habitat for the Koala although these vegetated patches are generally isolated and are not known to provide habitat for this species. Consequently no further provisions of SEPP 44 need apply to this application.

4 IMPACT ASSESSMENT

There are a number of disturbances that would be associated with the proposed works and these are listed in Table 3.

Table 3 Disturbances associated with the proposal

Proposal Stage	Disturbance
Slashing of vegetation	Slashing of pasture or roadside vegetation to just above ground level where required, to provide a maximum 4 m wide cleared strip.
Vibration and sound waves	Production of vibration and sound waves at around 64 m intervals for 3D surveys and 10 m for 2D surveys.
Increase in overall noise levels	Movement of a recording truck and two moderate sized 6 wheel drive trucks (approximately 7.7 tonnes each) which would move slowly along the seismic lines.
	Noise produced through activation of the vibration plate.

As a consequence, a number of direct and indirect impacts associated with the proposal have the potential to occur and these are discussed below.

4.1 Direct Impacts

4.1.1 Vegetation Clearance

In general, the proposed 2D and 3D seismic survey line routes are characterised by cleared land which has been used for grazing of stock and mining over a number of years and consequently, the majority of vegetation slashed would be agricultural pasture species and pasture weeds as trees larger than a sapling would be avoided. Where remnant woodland exists within roadside verges, the 2D survey line route would be shifted slightly to the road surface to avoid these areas.

The 3D seismic survey grid route would traverse some remnant / regrowth woodland areas, e.g. Tiedmans block, that have intact ground and midstorey layers. Slashing of a 1 m to 2.5 m wide path through these shrubs and groundcover would be required across the grid. This may include slashing of saplings but the removal of trees would not be required as the grid lines can be varied slightly to avoid these areas.

4.1.2 Loss of Fauna Habitat

Some small and temporary loss of grazing habitat would be removed within the agricultural and mining areas where slashing is undertaken but with vast areas of grazing land available within the area this is unlikely to substantially impact on native grazing species, such as the Eastern Grey Kangaroo. Where the proposed 3D lines pass through remnant / regrowth, ground and shrub cover would also be slashed in a 64 m grid pattern in 1 m to 2.5 m wide lines. These areas would provide habitat for some

ground-dwelling mammals and woodland birds. The isolated and degraded nature of much of the surrounding landscape means that ground-dwelling mammals are likely to be over represented by introduced species, such as the House Mouse and Black Rat. However, there is the potential for bird species with narrower habitat requirements, such as the Grey-crowned Babbler, to be disturbed during this process and potential impacts on this species are detailed below in Section 4.5.

4.2 Indirect Impacts

4.2.1 Disturbance of fauna

Seismic surveys have the potential to impact on marine life such as mammals, fish, turtles, corals and other invertebrates, plankton and birds although only a few faunal groups are affected and only for a limited duration (WA Department of Industry & Resources 2007). The effects on terrestrial fauna are less clear although a report produced for a South African electricity company (http://www.eskom.co.za/content/ApACnoiseimpact.pdf) concluded that faunal disturbance from seismic testing is not likely as the testing takes place during the day and is of short duration.

The potential for disturbance as a consequence of seismic testing required under this proposal is unclear. The Envirovibe units to be used for these surveys produce vibration and sound waves which travel downwards and outwards to 16 m from the source (Toni Laurie, AGL, pers. comm.) and this would limit the range of impact and the length of time ground-dwelling fauna would experience direct vibration and sound waves. A single short-intensity vibration and / or sound wave is unlikely to substantially change behaviours and patterns of usage of resources by fauna species although it may trigger a startle response in diurnal species.

4.3 Threatening Processes

Key threatening processes (KTP) listed under the TSC Act / EPBC Act which may be relevant to this proposal include:

4.3.1 Clearing of native vegetation / land clearance

The clearing of native vegetation may result in:

- 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.

This proposal does not require vegetation to be removed or soils disturbed but instead a relatively narrow strip (1 m to 4 m wide) of vegetation would be slashed. Fallen logs and other debris along the seismic route which passes through remnant or regrowth vegetation would be moved to the side before slashing and replaced once vehicles have moved through the area. Major waterways, or creeks with substantial vegetation, would be avoided by crossing from one side to another via tracks and roads. As vegetation would not be removed but slashed there would be few additional opportunities for weeds to become established in the landscape. Leaf litter would not be removed from any of the proposed routes. Consequently it is considered that this threatening process is unlikely to be exacerbated by this proposal.

4.3.2 Predation by the European Red Fox

It is possible that this proposal may result in increased predation by the European Red Fox as this species prefers to move through landscapes along tracks and along edges of habitat. Considering that habitat would be slashed it may allow for an increased ease of movement for this species, but allowing for the extent of the current modification of the landscape, it is unlikely that this proposal would substantially exacerbate this KTP.

4.4 Priority Actions for Gloucester Shire Council LGA

There are 90 priority actions identified as being 'High priority' in the Gloucester Shire Council LGA and these include actions which apply to 31 threatened species, populations and communities, and one key threatening process. None of the actions of this proposal are inconsistent with any of the strategies or actions identified for this area.

4.5 NSW *Environmental Planning and Assessment Act 1979*

Three threatened species may potentially be impacted by this proposal and therefore Assessments of Significance as required under Part 5A of the EP&A Act, have been undertaken as a precautionary measure. These species are:

- Green and Golden Bell Frog (*Litoria aurea*);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*);and
- Grass Owl (*Tyto capensis*).

The Assessments of Significance for these species are provided in Appendix B.

The vast majority of the 2D and 3D survey areas are agricultural paddocks which have been cleared for many years and in general these areas do not provide habitat for any of these species. In areas where habitat would be impacted these impacts would be relatively minor and temporary and it is considered that management measures could be implemented to ensure that impacts are not significant and consequently it is considered that a Species Impact Statement is not required.

4.6 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The site supports very limited habitat for native fauna and flora as it is highly modified through clearing and agricultural landuses. However, marginal potential habitat for the Green and Golden Bell Frog (GGBF), which is listed as endangered under the EPBC Act, may occur at one site and consequently this species has been considered using the Significant Impact Criteria for Endangered Species listed in the EPBC Act *Administrative Guidelines for Significance* (Commonwealth of Australia 2006). This assessment is contained in Appendix C.

As the route would not pass through the potential Green and Golden Bell Frog habitat, it was concluded that this proposal is unlikely to significantly impact on this species. Consequently, this proposal is unlikely to be considered a controlled action.

4.7 Cumulative Impacts

Cumulative impacts are those that add to the deterioration of the ecological values of a site or locality and generally occur when remaining native vegetation is removed or altered, fauna habitat is removed or altered and / or the natural hydrology of the area is altered. There are unlikely to be cumulative impacts associated with this proposal as native vegetation would not be removed but slashed and fauna habitat would not be altered over the long-term.

5 RECOMMENDATIONS

This proposal has few potential impacts associated with it as vegetation would not be cleared and soils would not be disturbed. However, several measures are recommended to protect biodiversity and these include:

- Road verges along Woods Road, Craven, which contain remnant vegetation, should be avoided and the survey line shifted to the road surface;
- The small open water on Jacks Lane at the Avon River crossing, should be avoided and the proposed route moved to the adjacent area of Blady Grass; and
- Slashing of vegetation along river and creek banks should be avoided altogether.

In addition, where the proposed 3D survey route passes through remnant / regrowth vegetation patches, impacts on Grey-crowned Babbler habitat are possible as shrubs and groundcovers would be slashed and fallen logs and other debris temporarily pushed aside to allow machinery access. Although this project is relatively low impact a number of recommendations and management measures are available and should be implemented to mitigate and ameliorate potential impacts. Central to these measures should be the preparation and implementation of plan to assist with Grey-crowned Babbler habitat protection.

Protection measures for this species should include:

- Where possible surveys through known Babbler habitat should be timed to occur outside of nesting (July – December);
- All seismic personnel should be briefed on the importance of the Babbler. This briefing should include a photo of the bird and a laminated copy of this photo should be placed within each vehicle;
- Each section through known or potential Babbler habitat should be walked by suitably qualified environmental personnel prior to slashing or surveying;
- Any nests encountered should be flagged and Babbler activity would be recorded;
- Slashing and surveys should only proceed once Babblers have been gently encouraged to move away from the area;
- Environmental personnel should keep watch to ensure that Babblers do not return to the site whilst machinery is operating;
- Before slashing, fallen logs and other debris should be shifted to the side; and
- Once vehicles have moved through the area fallen logs and debris, including slashed vegetation, should be replaced in roughly the same area.

6 CONCLUSIONS

The proposed route of the 2D and 3D seismic survey lines would not be cleared or soils disturbed. Instead slashing of vegetation would be undertaken along the lines and the width of these would vary from 1 m to 4 m. The nature of disturbance associated with the proposal means that any impacts on flora and fauna are likely to be temporary and minor and could be managed to protect current values. A number of management measures have been outlined, especially in relation to protection of the Grey-crowned Babbler. Assessments under the NSW EP&A Act, including those species, populations and communities listed under the TSC Act concluded that with the implementation of stringent management measures, significant impacts are unlikely and that a Species Impact Statement is not required. Similarly, it was concluded that matters of NES listed under the Commonwealth EPBC Act would not be significantly impacted and consequently is unlikely to be considered a controlled action.

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APPENDIX A

THREATENED SPECIES RECORDED WITHIN THE LOCALITY OF PEL 285

Threatened Species recorded within the locality of PEL 285

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
FLORA			
Asperula asthenes	V-TSC V-EPBC	Damp sites along river beds.	Mostly cleared paddocks. Unlikely-no habitat.
Angophora inopina Charmhaven Apple	V-TSC V-EPBC	Occurs must frequently in woodland / forest, wet heath, sedge woodland.	Mostly cleared paddocks. Unlikely-no habitat.
Callistemon linearifolius	V-TSC	Grows in dry sclerophyll forest on the coast and adjacent ranges.	Mostly cleared paddocks. Unlikely-no habitat.
Cynanchum elegans	E-TSC E-EPBC	Most frequently on the edge of dry rainforest vegetation.	Mostly cleared paddocks. Unlikely-no habitat.
Slaty Red Gum *Eucalyptus glaucina*	V-TSC V-EPBC	Grows in grassy woodland and dry eucalypt forest	Mostly cleared paddocks. Unlikely-no habitat.
Grevillea guthrieana	E-TSC E-EPBC	Grows along creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil.	Mostly cleared paddocks. Unlikely-no habitat.
Small-flower Grevillea *Grevillea parviflora* ssp. *parviflora*	V-TSC V-EPBC	Occurs in a range of vegetation types from heath and shrubby woodland to open forest.	Mostly cleared paddocks. Unlikely.
Melaleuca groveana	V-TSC	Grows in woodland, heath and shrubland, often in exposed sites, at high elevations.	Mostly cleared paddocks. Unlikely-no habitat.
Brush Cherry *Syzygium paniculatum*	V-TSC V-EPBC	Occurs on gravels, sands, silts and clays in rainforests.	Mostly cleared paddocks. Unlikely-no habitat.
Tetratheca juncea	V-TSC V-EPBC	Mainly in low open forest / woodland with a mixed shrub understorey and grassy groundcover.	Mostly cleared paddocks. Unlikely-no habitat.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
FAUNA			
Stephens' Banded Snake *Hoplocephalus stephensi*	V - TSC	Rainforest and eucalypt forests and rocky areas.	Mostly cleared paddocks. Unlikely-no habitat.
Wallum Froglet *Crinia tinnula*	V - TSC	Paperbark swamps and sedge swamps of the coastal 'wallum' country.	Mostly cleared paddocks. Unlikely-no habitat.
Green & Golden Bell Frog *Litoria aurea*	E-TSC V-EPBC	Marshes, dams & stream-sides particularly those containing *Typha* or *Eleocharis*.	Cleared paddocks. Perhaps marginal habitat on Jacks Lane.
Booroolong Frog *Litoria booroolongensis*	E-EPBC	Along the western-flowing streams of the Great Dividing Range.	Mostly cleared paddocks. Unlikely-no habitat.
Davies' Tree Frog *Litoria daviesae*	V - TSC	Permanently flowing streams above 400 m elevation.	Mostly cleared paddocks. Unlikely-no habitat.
Black-necked Stork *Ephippiorhynchus asiaticus*	E - TSC	Permanent freshwater wetlands. Feeds on fish, frogs, eels, turtles, crabs and snakes.	Mostly cleared paddocks. Unlikely-no habitat.
Powerful Owl *Ninox strenua*	V - TSC	Large tracts of forest from, from woodland and open sclerophyll forest to tall open wet forest and rainforest.	Mostly cleared paddocks. Unlikely-no habitat.
Grey-crowned Babbler *Pomatostomus temporalis temporalis*	V - TSC	Open woodlands.	Known to occur on Tiedmans block.
Speckled Warbler *Pyrrholaemus sagittatus*	V - TSC	Eucalypt communities with grassy understorey.	Mostly cleared paddocks. Unlikely-no habitat.
Sooty Owl *Tyto tenebricosa*	V - TSC	Rainforest and moist Eucalypt forests.	Mostly cleared paddocks. Unlikely-no habitat.
Masked Owl *Tyto novaehollandiae*	V - TSC	Lives in dry eucalypt forests and woodlands.	Mostly cleared paddocks. Unlikely-no habitat.
Glossy Black-Cockatoo *Calyptorhynchus lathami*	V-TSC E-EPBC	Open woodlands with stands of She-oak.	Mostly cleared paddocks. Some foraging habitat along creeklines.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
Magpie Goose *Anseranas semipalmata*	V - TSC	Mainly found in shallow wetlands with dense growth of rushes or sedges.	Mostly cleared paddocks. Unlikely-no habitat.
Australasian Bittern *Botaurus poiciloptilus*	V-TSC	Emergent vegetation in freshwater & brackish wetlands.	Cleared paddocks. Unlikely-no emergent vegetation.
Bush Stone-curlew *Burhinus grallarius*	E-TSC	Open forests & woodlands with sparse grassy ground layer & fallen timber.	Mostly cleared paddocks. Unlikely-no habitat.
Brown Treecreeper *Climacteris picumnus*	V-TSC	Eucalypt forests & woodlands of inland plains and slopes of the Great Dividing Range. Less commonly found on coastal plains and ranges.	Mostly cleared paddocks. Unlikely-too coastal.
Barred Cuckoo-shrike *Coracina lineata*	V-TSC	Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses.	Mostly cleared paddocks. Unlikely-no habitat.
Emu *Dromaius novaehollandiae*	EP-TSC	Open forest, woodland, coastal heath, coastal dunes, wetland areas, tea tree plantations and open farmland, and occasionally in littoral rainforest between Evans Head and Red Rock.	Unlikely-not known from area.
Comb-crested Jacana *Irediparra gallinacea*	V-TSC	Inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies.	Mostly cleared paddocks. Unlikely-no habitat.
Black Bittern *Ixobrychus flavicollis*	V-TSC	Forested, freshwater & saline wetlands. Breeding along watercourses.	Mostly cleared paddocks. Unlikely-no habitat.
Hooded Robin *Melanodryas cucullata*	V-TSC	Structurally diverse lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee.	Unlikely-no habitat.
Black-chinned Honeyeater *Melithreptus gularis gularis*	V-TSC	Upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts.	Unlikely-no habitat.
Swift Parrot *Lathamus discolor*	E-TSC E-EPBC	Occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations.	Cleared paddocks. Unlikely-no habitat.
Turquoise Parrot *Neophema pulchella*	V-TSC	Lives on edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	Cleared paddocks. Unlikely-no habitat.
Barking Owl *Ninox connivens*	V-TSC	Breeding HBT >20 cm diam. Forage woodlands, grassy woodlands, forests & into grasslands 250 m.	Unlikely – no substantial woodland areas within 250 m of sites.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
Powerful Owl *Ninox strenua*	V-TSC	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.	Cleared paddocks. Unlikely-no habitat.
Regent Honeyeater *Xanthomyza phrygia*	E-TSC E-EPBC	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak.	Cleared paddocks. Unlikely-no habitat.
Wompoo Fruit-Dove *Ptilinopus magnificus*	V-TSC	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests.	Cleared paddocks. Unlikely-no habitat.
Rose-crowned Fruit-Dove *Ptilinopus regina*	V-TSC	Sub-tropical and dry rainforest.	Cleared paddocks. Unlikely-no habitat.
Superb Fruit-Dove *Ptilinopus superbus*	V-TSC	Rainforest and similar closed forests.	Cleared paddocks. Unlikely-no habitat.
Grass Owl *Tyto capensis*	V-TSC	Tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains.	Cleared paddocks. Unlikely-but may occasionally forage across wetter paddock areas.
Eastern Cave Bat *Vespadelus troughtoni*	V - TSC	Cave-roosting species found in dry open forest and woodland, near cliffs or rocky overhangs.	Cleared paddocks. Unlikely-no habitat.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V - TSC	Prefers moist habitats with trees >20 m. Roosts in HBT or under bark or in buildings.	Cleared paddocks. Unlikely-no habitat.
Golden-tipped Bat *Kerivoula papuensis*	V - TSC	Rainforest and adjacent sclerophylla forest.	Cleared paddocks. Unlikely-no habitat.
Large-eared Pied Bat *Chalinolobus dwyeri*	V-TSC V-EPBC	Roosts in caves, derelict mines frequenting low to mid elevation dry open forest and woodland close to these features.	Cleared paddocks. Unlikely-no habitat.
Little Bentwing-bat *Miniopterus australis*	V - TSC	Moist Eucalypt forests whilst roosting in caves and man-made structures	Cleared paddocks. Unlikely-no habitat.
Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis*	V - TSC	Roosting – caves, derelict mines, storm-water tunnels, buildings. Foraging - forested areas.	Cleared paddocks. Unlikely-no habitat.
Eastern Freetail-bat *Mormopterus norfolkensis*	V - TSC	Dry sclerophylla forest & woodland. Roosts - hollows & under bark or man-made structures.	Cleared paddocks. Unlikely-no habitat.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
Large-footed Myotis *Myotis adversus*	V - TSC	Forages over streams and pools catching insects and small fish by raking their feet across the water surface	Cleared paddocks. Unlikely-no habitat.
Greater Broad-nosed Bat *Scoteanax rueppellii*	V - TSC	Woodland, moist and dry eucalypt forest, and rainforest but prefers tall wet forest.	Cleared paddocks. Unlikely-no habitat.
Grey-headed Flying-fox *Pteropus poliocephalus*	V-TSC V-EPBC	Subtropical & temperate rainforests, tall sclerophylla forests & woodlands, heaths & swamps.	Mostly cleared paddocks. Unlikely-no habitat.
Spotted-tailed Quoll *Dasyurus maculatus*	V - TSC	Forests and heathlands.	Mostly cleared paddocks. Unlikely-no habitat.
Koala *Phascolarctos cinereus*	V - TSC	Eucalypt forests and woodlands.	Cleared paddocks. Limited habitat. None would be cleared.
Squirrel Glider *Petaurus norfolcensis*	V - TSC	Eucalypt forests and woodlands.	Mostly cleared paddocks. Unlikely-no habitat.
Rufous Bettong *Aepyprymnus rufescens*	V - TSC	Tall, moist eucalypt forest to open woodland, with a tussock grass understorey.	Mostly cleared paddocks. Unlikely-no habitat.
Eastern Pygmy-possum *Cercartetus nanus*	V - TSC	Rainforest, sclerophylla forest & woodland to heath – but heath & woodland preferred. .	Mostly cleared paddocks. Unlikely-no habitat.
Parma Wallaby *Macropus parma*	V - TSC	Moist eucalypt forest with thick, shrubby understorey.	Mostly cleared paddocks. Unlikely-no habitat.
Yellow-bellied Glider *Petaurus australis*	V - TSC	Occur in tall mature eucalypt forest generally in areas with high rainfall.	Mostly cleared paddocks. Unlikely-no habitat.
Squirrel Glider *Petaurus norfolcensis*	V - TSC	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest with heath understorey in coastal areas.	Mostly cleared paddocks. Unlikely-no habitat.
Brush-tailed Rock-wallaby *Petrogale penicillata*	E-TSC V-EPBC	Rocky escarpments, outcrops, steep slopes or cliffs – especially those with caves, ledges or overhangs & shrub cover.	Mostly cleared paddocks. Unlikely-no habitat.
Brush-tailed Phascogale *Phascogale tapoatafa*	V - TSC	Dry sclerophylla open forest with sparse groundcover. Also heath, swamps, rainforest & wet sclerophylla forest.	Mostly cleared paddocks. Unlikely-any potential habitat too isolated.

Species / Community	Conservation Status	Habitat	Likelihood of occurrence on site
Common Planigale *Planigale maculata*	V - TSC	Rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas.	Mostly cleared paddocks. Unlikely-no habitat.
Long-nosed Potoroo *Potorous tridactylus*	V-TSC V-EPBC	Inhabits coastal heaths and dry and wet sclerophyll forests.	Mostly cleared paddocks. Unlikely-no habitat.
Red-legged Pademelon *Thylogale stigmatica*	V - TSC	Forest with dense understorey and ground cover.	Mostly cleared paddocks. Unlikely-no habitat.
Note: TSC = NSW *Threatened Species Conservation Act 1995*. EPBC = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. V = Vulnerable, E = Endangered, Mig = Migratory, EEC = Endangered Ecological Community, EP = Endangered Population.			

APPENDIX B

ASSESSMENT OF SIGNIFICANCE UNDER THE EP&A ACT

APPENDIX B

Assessment of Significance

Background

As required under the Section 5A of the *Environmental Planning & Assessment Act 1979* (EP&A Act), Assessments of Significance were undertaken to determine the significance of impacts of the proposal on threatened species listed on Schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act). A number of threatened species were listed as occurring within the locality but habitat for only a very small percentage of these occur over the seismic survey area due to its highly modified nature. Therefore, Assessments of Significance have been undertaken only for those species for which potential habitat occurs either across the study area or within the near locality. Those species addressed are:

- Green and Golden Bell Frog (*Litoria aurea*);
- Grey-crowned Babbler (*Pomatostomus temporalis temporalis*); and
- Grass Owl (*Tyto capensis*).

Grey-crowned Babbler

Grey-crowned Babbler (GCB) (*Pomatostomus temporalis temporalis*) (eastern subspecies) is listed as Vulnerable under the TSC Act. This species is found throughout large parts of northern Australia and in south-eastern Australia. In NSW, the eastern subspecies occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. This species is a laborious flyer so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas. GCB feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. Across their range, breeding can occur throughout the year. However, within NSW, almost all observations of breeding activity have been from July to December (Higgins & Peters 2002).

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.

Some slashing (1 m to 2.5 m wide x 64 m wide grid) of known habitat would be undertaken in the northern section of the Tiedmans block and potential habitat in some other areas. Slashing of ground habitat would not directly affect Babbler nests as these are generally located in trees or larger shrubs away from ground level. However, if a Babbler nest is encountered the seismic survey route would be altered slightly to avoid the nest and shrub / sapling. Additionally, these surveys are proposed to be undertaken from January 2010, beginning in the southern section

and working north to areas of potential or known habitat. This timing should avoid the nesting period of the Babbler in this area.

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.

Not an endangered population.

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

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.

Not an endangered ecological community.

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

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.

Some slashing (1 m to 2.5 m wide x 64 m wide grid) of known habitat would be undertaken in the northern section of the Tiedmans block and potential habitat in some other areas although no vegetation removal or soil disturbance would occur. The shifting of fallen timber and other debris would also be required temporarily to allow movement of the survey vehicles along the lines. However, these would be replaced into roughly the same position once the vehicles have moved through the area (within the day). Although Babblers are particularly sensitive to gaps in habitat as they are poor flyers, slashing of vegetation is unlikely to substantially cause disruption to movement especially given that fallen timber and other debris, including the slashed vegetation would be replaced into roughly the same position. All known Babbler habitat is important in and around the Gloucester area as widespread clearing has resulted in degradation of large areas of habitat and isolation of patches of Babbler habitat.

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 species.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Although the Grey-crowned Babbler Retention Plan – Gloucester Shire Council (Parsons Brinckerhoff 2005) deals with potential family groups outside of the study area, several of the management measures are applicable to management of the GCB within the study area and these are:

1. Habitat protection and maintenance: to maintain and protect woodland remnants that form part of a corridor network and other habitats that have potential for regeneration for the longer term benefit of the species; and
2. Road and traffic management: prevent / reduce the incidence of collision of GCB with motor vehicles through the implementation of go slow areas and increasing public awareness through signage.

This proposal would temporarily modify 1 m to 2.5 m wide strips in a 64 m grid pattern of current or potential habitat for this species. However, vegetation would not be removed or soils disturbed. Other habitat, such as fallen logs and debris, would be shifted to allow passage of the seismic survey vehicles and then replaced. The relatively slow movement of the seismic vehicles through the landscape is unlikely to cause an increase in incidence of bird-strike. However, environmental personnel would keep watch within known or potential habitat to ensure that Babblers do not inadvertently enter the works area whilst machinery is moving.

DEC have also identified five strategies to help recover the species (DEC 2005) and these include community and land-holder awareness, development and implementation of protocols and guidelines, habitat rehabilitation / restoration, research and survey / mapping and habitat assessment. None of the actions of this proposal are inconsistent with any of the strategies or actions outlined in the PAS.

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.

It is unlikely that any key threatening processes listed under the TSC Act would be substantially exacerbated by this proposal as vegetation would be slashed and not cleared and fallen timber and debris would be shifted to allow movement of the survey vehicles and replaced once the work has been completed. It is possible that this proposal may result in increased predation by the European Red Fox as this species prefers to move through landscapes along tracks and along edges of habitat. Considering that habitat would be slashed it may allow for increased ease of movement for this species but considering the extent of the current modification of the landscape it is unlikely that this proposal would substantially exacerbate this KTP. Threats identified by DEC (2005) include clearing of woodland remnants, heavy grazing and removal of woody debris and nest predation by bird species. None of these threats would be increased as a consequence of this proposal.

Conclusion

The vast majority of the 2D and 3D survey areas are agricultural paddocks which have been cleared for many years and in general these areas do not provide habitat for the Grey-crowned Babbler. There are however, a number of remnant / regrowth patches of vegetation within the 3D survey areas that provide known or potential habitat for the Grey-crowned Babbler and therefore there is the potential that this species could be impacted by this proposal. However, vegetation would not be removed and soils would not be disturbed. Disturbance would be temporary as vegetation would be slashed instead and fallen logs and other debris would be moved aside and replaced once the survey vehicles have passed. It is anticipated that surveys would be undertaken beginning in January and so avoid the nesting period for this species. A number of additional management measures would also be included in a plan (see Section 5: Recommendations) which would be stringently applied and therefore it is considered that the proposal would be unlikely to significantly impact this threatened species and that no further requirements under the EP&A Act and TSC Act need apply.

Grass Owl

The Grass Owl (*Tyto capensis*) is listed as Vulnerable under the TSC Act. Grass Owls have been recorded occasionally in all mainland states of Australia but appear to be more commonly recorded in northern and north-eastern Australia. In NSW they are more likely to be found in the north-east. Grass Owl numbers often increase when rodent numbers increase. They are found in areas of tall grass, including grass tussocks in swampy areas, grassy plains, swampy heath, and cane grass, or sedges on flood plains. They rest by day in a 'form' - a trampled platform in a large tussock or other heavy growth. They also nest in trodden-down grass (DECC 2005).

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.

Disturbance to grassed and tussocky areas within paddocks would be minimal and temporary. Substantial areas of foraging and nesting habitat would remain within the locality and consequently it is unlikely that this species would be adversely affected or placed at the risk of extinction as a consequence of this proposal.

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.

Not an endangered population.

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

III. 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

IV. 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.

Not an endangered ecological community.

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

IV. The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

V. 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

VI. 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.

The proposal would only temporarily disrupt potential habitat for this species. Disturbance would be minimal as the seismic survey routes would be slashed and not cleared and would be allow to regrow. Slashing would occur along narrow lines and such minimal slashing would not be likely to disrupt movement of such a mobile species.

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 species.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

There has not been a recovery plan or threat abatement plan prepared for the Grass Owl. Five PAS have been prepared for the Grass Owl and this proposal would not be inconsistent with any of the objectives of these PAS (DEC 2005a).

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.

It is unlikely that any key threatening processes listed under the TSC Act would be substantially exacerbated by this proposal as vegetation would be slashed and not cleared and fallen timber and debris would be shifted to allow movement of the survey vehicles and replaced once the work has been completed. It is possible that this proposal may result in increased predation by the European Red Fox as this species prefers to move through landscapes along tracks and along edges of habitat. Considering that habitat would be slashed it may allow for increased ease of movement for this species but considering the extent of the current modification of the landscape it is unlikely that this proposal would substantially exacerbate this KTP. Threats identified by DEC (2005) include clearing of woodland remnants, heavy grazing and removal of woody debris and nest predation by bird species. None of these threats would be increased as a consequence of this proposal.

Conclusion

It is considered unlikely that this proposal would result in significant impacts on this species as disturbance to any potential habitat would be minimal and temporary and habitat would be allowed to regrow.

Green and Golden Bell Frog

The Green and Golden Bell Frog (GGBF) (*Litoria aurea*) is listed as Endangered under the TSC Act. This species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.

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.

The GGBF has not been recorded within the Gloucester Shire Council LGA (Gloucester Shire Council 2007). The closest record is approximately 50 km to the south-west of the study area near Dungog. However, potential habitat is located on Jacks Lane where it crosses the Avon River which is on the route of the 2D seismic surveys in a small area of open water and Cumbungi (*Typha orientalis*). This area would be avoided by shifting the route slightly through an adjacent area of Blady Grass (*Imperata cylindrica*). Consequently, should the GGBF occur in the small area of open water it is unlikely that this species would be impacted by this proposal.

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.

Not an endangered population.

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

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.

Not an endangered ecological community.

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

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.

This proposal would not remove potential habitat for this species and consequently a reduction in the area of potential occupancy would not occur. This proposal is unlikely to fragment existing populations as habitat for this species is unlikely to be removed or habitat corridors interrupted.

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 species.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A Draft Recovery Plan (DEC 2005b) for the GGBF has been prepared. This plan lists habitat loss, modification and disturbance, fragmentation and isolation of habitat, disease, predation by introduced fish and water quality as threats. The plan consists of five specific objectives including prevention of further habitat loss. GGBF habitat will not be removed as a result of this proposal and the proposal does not contravene the specific objectives of the draft recovery plan.

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.

Two Key Threatening Processes have potential relevance to this proposal. These are Predation by Gambusia holbrooki (Plague Minnow) and Infection of frogs by amphibian chytrid causing the disease chytridiomycosis. The adjacent potential habitat is likely to already contain the invasive Plague Minnow which is a known predator of tadpoles of the GGBF although it was not recorded on the day of assessment. If this invasive species is not currently present it is unlikely that this proposal would introduce it to the study area. The fungal pathogen, Frog Chytrid Fungus, is a known threat to the GGBF. Chytrid fungus is probably transferred by direct contact between frogs and tadpoles, or through exposure to infected water. This proposal would not involve the moving of frogs or tadpoles, exposing frogs to infected water or handling of frogs in any way.

Conclusion

It is unlikely that this proposal would significantly impact on the Green and Golden Bell Frog as impacts on any potential habitat would be avoided and consequently no further requirements under the EP&A Act and TSC Act need apply.

APPENDIX C

ASSESSMENT UNDER THE EPBC ACT

Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

The study area supports very limited habitat for native fauna as it is highly modified and predominately agricultural lands. However, marginal potential habitat for the Green and Golden Bell Frog (GGBF) (*Litoria aurea*), which is listed as endangered under the EPBC Act, could potentially occur in a small area of open water on Jacks Lane at the Avon River crossing and consequently this species has been considered below using the Significant Impact Criteria for Endangered Species listed in the EPBC Act *Administrative Guidelines for Significance* (Commonwealth of Australia 2006).

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

- Lead to a long-term decrease in the size of a population;
- The GGBF has not been recorded within the Gloucester Shire Council LGA (Gloucester Shire Council 2007). The closest record is approximately 50 km to the south-west of the study area near Dungog. However, potential habitat is located on Jacks Lane where it crosses the Avon River which is on the route of the 2D seismic surveys in a small area of open water and Cumbungi (*Typha orientalis*). This area would be avoided by shifting the route slightly through an adjacent area of Blady Grass (*Imperata cylindrica*). Consequently, should the GGBF occur in the adjacent area it is unlikely that this species would be impacted by this proposal.
- Reduce the area of occupancy of the species;

  This proposal would not remove potential habitat for this species and consequently a reduction in the area of potential occupancy would not occur.
- Fragment an existing population into two or more populations;

  This proposal is unlikely to fragment existing populations as habitat for this species is unlikely to be removed or habitat corridors interrupted.
- Adversely affect habitat critical to the survival of a species;

  Potential habitat has not been identified as critical habitat within the recovery plan for this species or listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act and so is unlikely to provide habitat critical to survival of this species.
- Disrupt the breeding cycle of a population;

  This proposal is very unlikely to disrupt the breeding cycle of a population. None are known from the area and should they occur in adjacent areas environmental management of the site during drilling could ensure that these potential habitat areas would be protected from the affects of run-off and sedimentation through the use of sedimentation fences and revegetation. Consequently, should the GGBF occur it is unlikely that the breeding cycle of this species would be disrupted.
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

  This proposal is unlikely to directly impact on potential habitat and management of environmental risks would assist in the protection of this potential habitat and consequently this species is unlikely to decline due to this proposal.

- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;

  The adjacent potential habitat is likely to already contain the invasive Plague Minnow which is a known predator of tadpoles of the GGBF although it was not recorded on the day of assessment. If this invasive species is not currently present it is unlikely that this proposal would introduce it to the study area.

- Introduce disease that may cause the species to decline; or

  The fungal pathogen, Frog Chytrid Fungus, is a known threat to the GGBF. Chytrid fungus is probably transferred by direct contact between frogs and tadpoles, or through exposure to infected water. This proposal would not involve the moving of frogs or tadpoles, exposing frogs to infected water or handling of frogs in any way.

- Interfere with the recovery of the species.

  This proposal would not pose a threat to the recovery of the GGBF as potential habitat of this species would be maintained and protected through environmental management during drilling activities. Recognised threats would not be exacerbated.

The Green and Golden Bell Frog is unlikely to be impacted by this proposal due to the highly modified nature of the proposed works areas and the minimum impact this proposal is likely to have on the ecology of the study area and locality. Consequently, it is considered that this proposal is unlikely to constitute a controlled action under the EPBC Act.

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