REVIEW OF ENVIRONMENTAL FACTORS

GENEVA 2

GENEVA 3

ROUND HILL 3

PEL445
NEW SOUTH WALES

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1. Introduction

This document forms an integral part of the Environment Management Plan for the drilling and exploration of PEL 445 and relates specifically to proposed exploration drilling to three sites, Geneva 2, Geneva 3 and Round Hill 3.

BNG is a subsidiary of Arrow Energy Group. BNG and is the registered holder for Petroleum Exploration Licence No 445, the current term of which expires on 18th April 2010. It was granted to allow for assessment of coal seam gas potential of the coal seams that underlay the area for their potential to yield commercial quantities of methane gas.

PEL 445 is located in North-East NSW in a "horse shoe" shape around Casino. Its Northern boundary is defined by the QLD/NSW State border and extends east to the coast, west past Bonalbo following the edge of the Clarence-Moreton Basin, and south in a line with Casino. The central area immediately around Casino is excluded. The location of the tenure is illustrated in Figure 1.

There is some built-up land within the tenure, mainly around the town of Lismore. There is significant cover of tertiary basalts in the east of the permit, and several national parks and state forests over the tenure, mainly on rugged basalt plateaus and along the South Moreton Anticline.

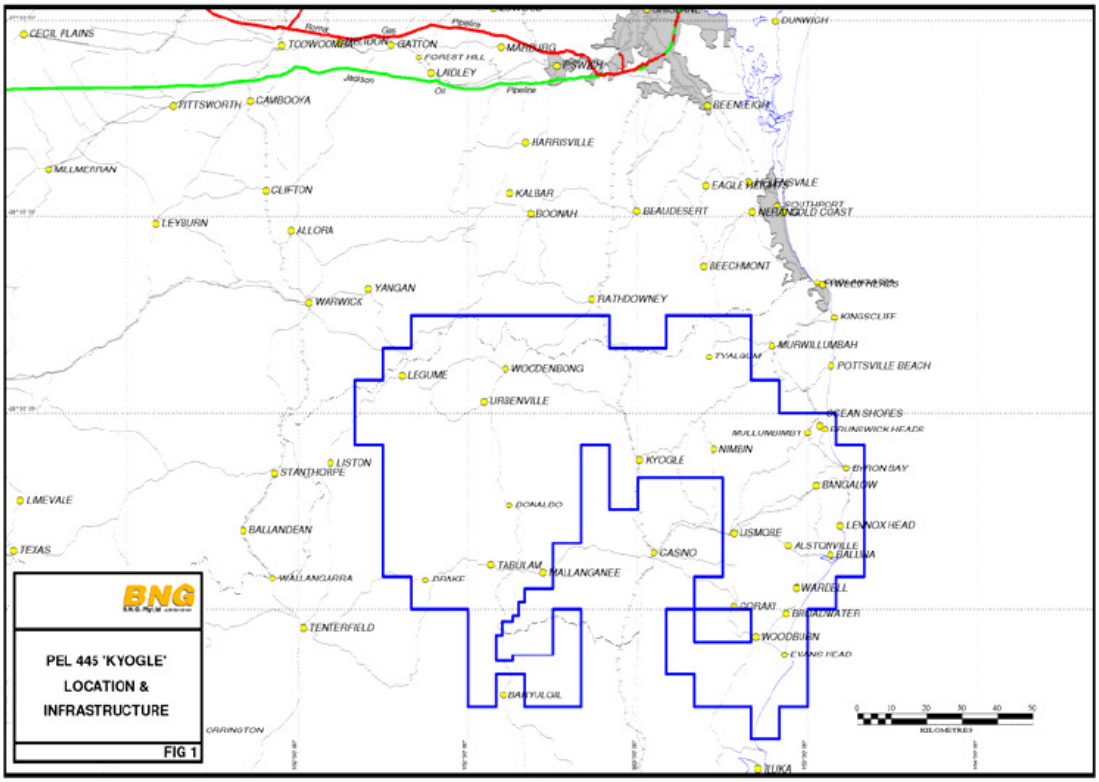


Figure 1: Map of PEL 445

1.1. Location

The location of the three exploration wells are illustrated in Figure 2 and discussed in the following sections.

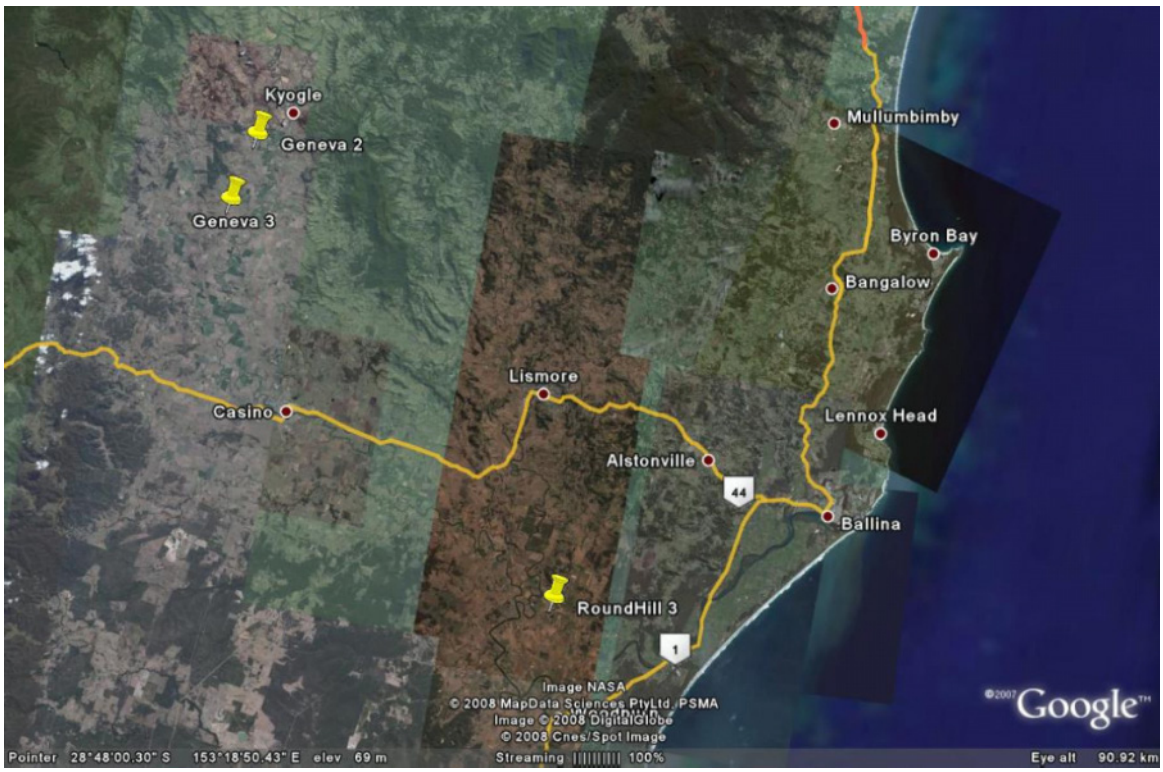


Figure 2: Location of the exploration wells

1.1.1. Geneva 2

The site proposed for the drilling of Geneva 2 is on private property east of Omagh Rd, approximately 3.5km south-west of the Kyogle Township, on an open cattle grazing paddock.

The land forms part of Lot 105, DP873398 of the Kyogle local government area. It is freehold land and is owned by John Tindall and Allan Tindall, with whom Arrow Energy Limited negotiating a land access agreement on 2nd March 2008.

The location of the proposed site is shown on the following Figure 3.The land is presently zoned Rural and information confirms the subject land does not fall within any of the eleven categories of land identified in Section 3.2.1 of Guidelines for (the) Review of Environmental Factors [ESB18 March 2006] that would reserve or protect the land for conservation purposes.

Figure 3: Location of Geneva 2 exploration well

Well I.D.	Datum	Zone	Easting	Northing	Type
Geneva 2	GDA94	56	497 336	6 830 026	exploration

Table 1: Coordinates to Geneva 2 exploration well

1.1.2. **Geneva 3**

The site proposed for the drilling of Geneva 3 is on private property North of Mohoneys Lane, approximately 10 km east of the Kyogle Township, on an open cattle grazing paddock.

The land forms part of Lot 54, DP6029 of the Kyogle local government area. It is freehold land and is owned by Nancy Mogg, with whom Arrow Energy Limited is negotiating a land access agreement.

The location of the proposed site is shown on the following Figure 4.The land is presently zoned Rural and information confirms the subject land does not fall within any of the eleven categories of land identified in Section 3.2.1 of Guidelines for (the) Review of Environmental Factors [ESB18 March 2006] that would reserve or protect the land for conservation purposes.

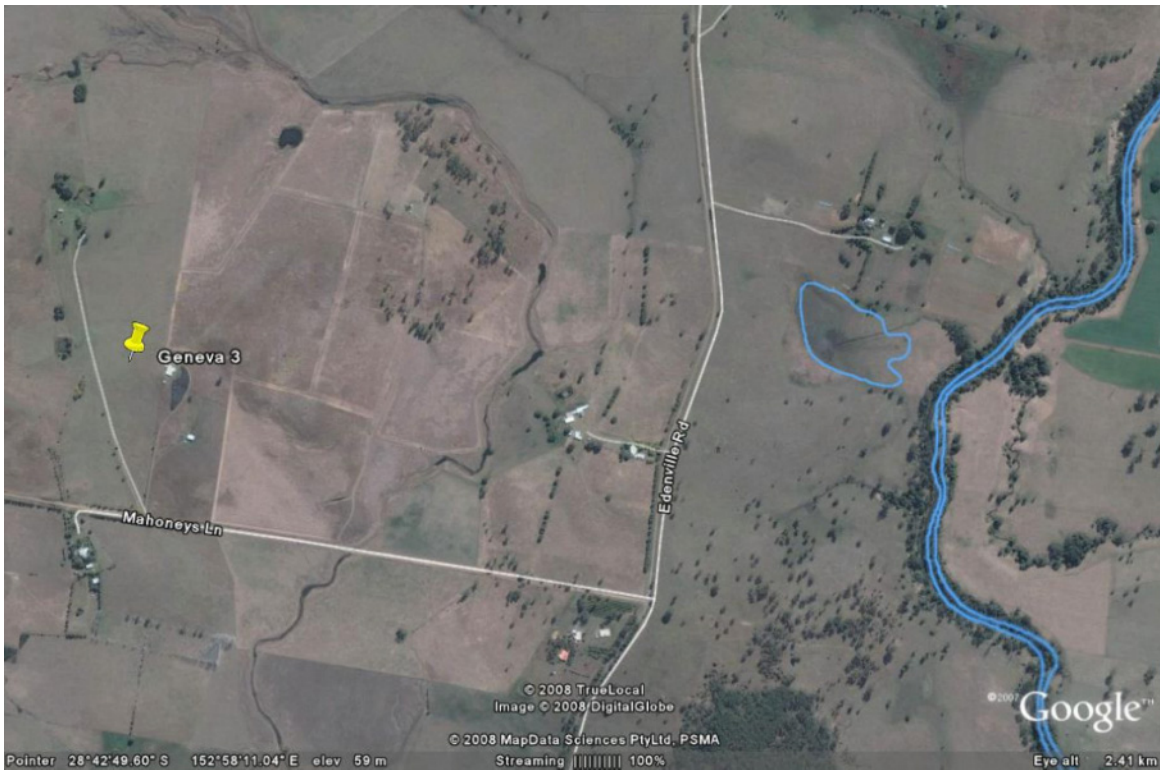


Figure 4: Location of Geneva 3 exploration well

Well I.D.	Datum	Zone	Easting	Northing	Type
Geneva 3	GDA 94	56	495 984	6 823 787	exploration

Table 2: Coordinates to Geneva 3 exploration well

1.1.3. Round Hill 3

The site proposed for the drilling of Round Hill 3 is on private property East of Tuckurimba Road, approximately 3.5km east of the Coraki Township, on an open cattle grazing paddock.

The land forms part of Lot 1, DP564760 of the Lismore local government area. It is freehold land and is owned by Roger Olive, with whom Arrow Energy Limited negotiating a land access agreement signed on 5th June 2008.

The location of the proposed site is shown on the following Figure 5.The land is presently zoned Rural and information confirms the subject land does not fall within any of the eleven categories of land identified in Section 3.2.1 of Guidelines for (the) Review of Environmental Factors [ESB18 March 2006] that would reserve or protect the land for conservation purposes.

Figure 5: Location of Round Hill 3 exploration well

Well I.D.	Datum	Zone	Easting	Northing	Type
Round Hill 3	GDA94	56	531 126	6 793 355	exploration

Table 3: Coordinates to Round Hill 3 exploration well

1.2. Description of the activity

It is proposed to introduce a drilling rig onto the site and to then drill to about 600m in order to test the target formations in the area. The rig to be used is not large in size. The exploration well will be about 4 inches in diameter. A requirement of the safe operation of the drilling process is the establishment of up to three drilling mud containment pits. The largest will be up to 8m by 8m wide and 2.5m deep, a smaller pit at the discretion of the driller and, a flare pit which is constructed in a remote area (30m away from the drill) to contain any emergency discharge of gas

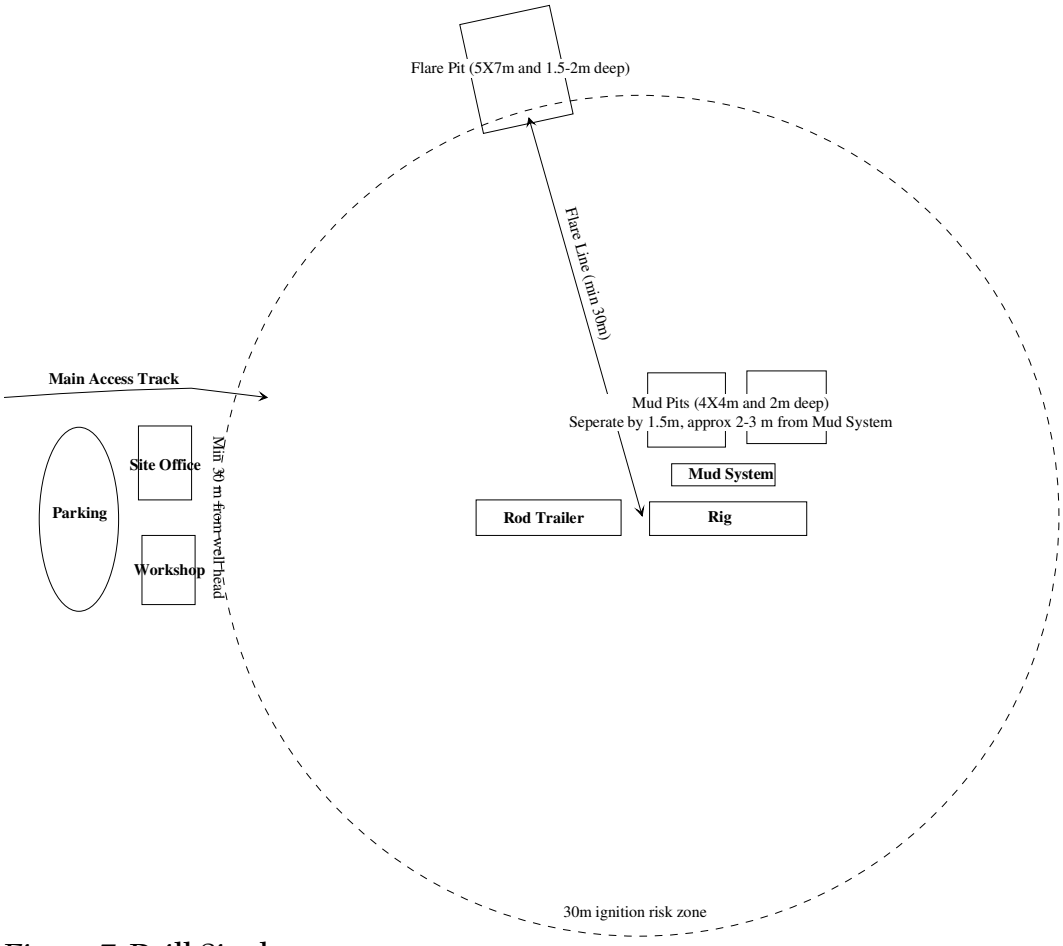


Figure 7: Drill Site layout

1.3. Justification of the activity

The purpose of PEL 445 granted under the *Petroleum (Onshore) Act 1991* is to permit the exploration for hydrocarbons. The purpose of drilling the proposed Three wells is exploration for coal seam gas. As such the justification for the exploration is:

- The granting and the existence of the Permit;
- Its suitability as an exploration site;
- The approved work plan for the permit;
- The intent of the permit holder;
- The consent of the landowner;
- Current and future demand profiles for gas as an alternative to less greenhouse friendly energy sources;
- Current and future demand for natural gas in the region.

1.4. Evaluation of alternatives

As exploration for the region is in its early stages no real alternative exists to establishing the presence of coal and the gas content of that coal, or the composition of that gas. Numerous other sites are available for exploration, but the site selected has been identified by preliminary inspections as being the most suitable site for the purpose of being on suitable ground and a satisfactory distance away from residences, to avoid causing disturbance to local residents. It seems inappropriate to further consider alternatives sites at this stage of exploration.

2. Planning context

2.1. Licences and approvals required

Under a Petroleum Exploration Licence granted under the *Petroleum (Onshore) Act 1991*, where the approval of the DPI - Mineral Resources has been granted as a Part V Determination, and Landowner consent has been granted, no further approval is required to be sought for exploration drilling.

2.2. Zoning

The land in the area of the proposed exploration well sites is currently zoned Rural.

2.3. Stakeholder consultation

At this time stakeholder consultation has been limited to consulting with the landowner. At this early stage of activity and considering its distance from other properties and dwellings only the immediate property is likely to be affected by the exploration activities. Subsequent to approval being granted to undertake drilling at the site, local landowners on adjoining properties and council officers will be advised of the activities to take place. Local residents and council officers are aware of Arrow Energy drilling at other sites in the area.

2.4. Existing environment

2.4.1. Landforms and geology

2.4.1.1.Geneva 2

The site chosen for Geneva 2 exploration well is serviced by public bitumen roads to the property boundary.

The existing environment of the site is shown in Figure 8, and consists of open, fenced and reasonably level improved pasture. Gully erosion is not present in the immediate area of the site nor is declared weeds.

The site proposed for Geneva 2 drains to the Richmond River to the east of the site approximately 1km away. No animals have been seen at the proposed site, but the proximity to the creek suggests fauna may be frequent in the area; however this operation will have no impact on them.

Figure 8: Existing environment at Geneva 2 exploration well

2.4.1.2.Geneva 3

The site chosen for Geneva 3 exploration well is serviced by public bitumen and gravel roads to the property boundary.

The existing environment of the site is shown in Figure 9, and consists of open, fenced and reasonably level improved pasture. Gully erosion is not present in the immediate area of the site nor is declared weeds.

The site proposed for Geneva 3 drains to the Richmond River to the east of the site approximately 2km away. No animals have been seen at the proposed site, but the proximity to the creek suggests fauna may be frequent in the area; however this operation will have no impact on them.

Figure 9: Existing environment at Geneva 3 exploration well

2.4.1.3.Round Hill 3

The site chosen for Round Hill 3 exploration well is serviced by public bitumen roads to the property boundary.

The existing environment of the site is shown in Figure 10, and consists of open, fenced and reasonably level improved pasture. Gully erosion is not present in the immediate area of the site nor is declared weeds.

The site proposed for Round Hill 3 drains to Wilsons River to the west of the site approximately 1.2km away. No animals have been seen at the proposed site, but the proximity to the creek suggests fauna may be frequent in the area; however this operation will have no impact on them.

Figure 10: Existing environment at Round Hill 3 exploration well

2.4.2. Flora and Fauna

A search of the Atlas of NSW Wildlife on the 16th August 2008 recorded fifteen (15) endangered and thirteen (13) vulnerable flora species within the Kyogle Shire; however as the sites are on improved pastures none of these species exist on the site.

Fifteen (15) endangered and fifty three (53) vulnerable fauna species were also identified during the online search. However during site visits no animals have been seen on any of the three well sites. A detailed list of these species is located in Attachments 1 and 2.

Given that the relatively small footprint of each exploration well, the fact that the site has been previously cleared and we are not entering any forest areas, no further impact on existing flora and fauna is expected.

2.4.3. Climate

The area is located about 60km inland from the north coast of NSW and experiences hot humid summers and mild drier winters. Temperature range from 3°C to 40°C and occasional frosts are experienced. Annual rainfall is about 1200mm, occurring throughout the year, though often associated with thunderstorm activity. Drilling activities will be conducted to provide for this. The heaviest rainfalls usually occur during December and March. Plant growth is most vigorous in summer but can occur all year, although germination may be limited to the period from spring to early autumn.

The following climate information was abstained form the Bureau of Meteorology in March 2008 from the Urbenville weather station.

BOM Weather Station Information	
Site Name	Urbenville Old Post Office
Site Number	057020
Latitude / Longitude	-28.47 S 152.55 E
Elevation	370m

Table 5: Urbenville Weather Station details

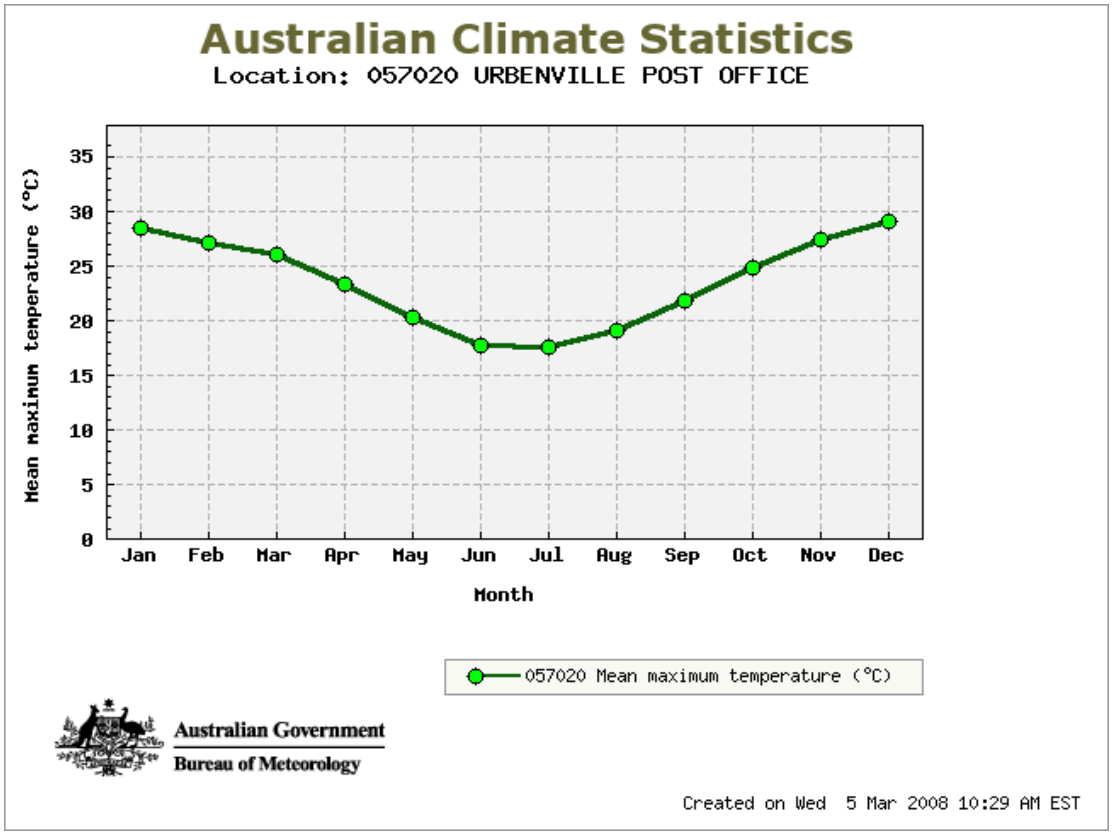


Figure 12: Mean maximum temperature (°C)

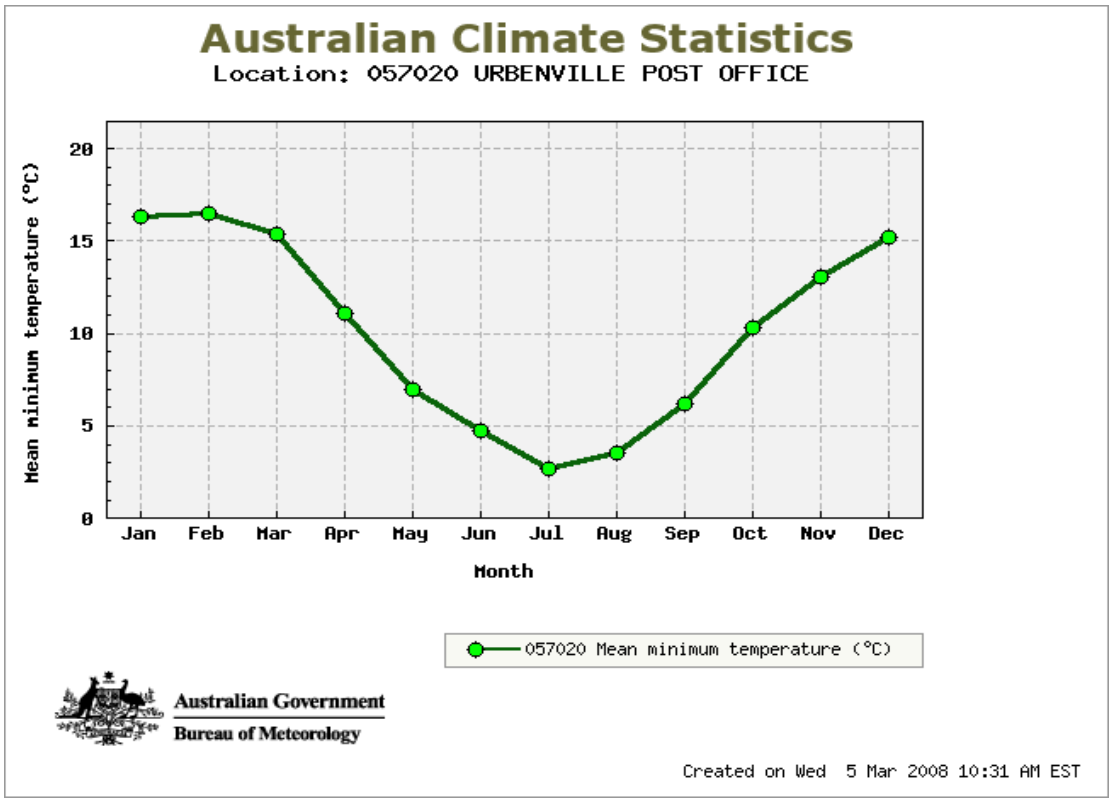


Figure 13: Mean minimum temperature (°C)

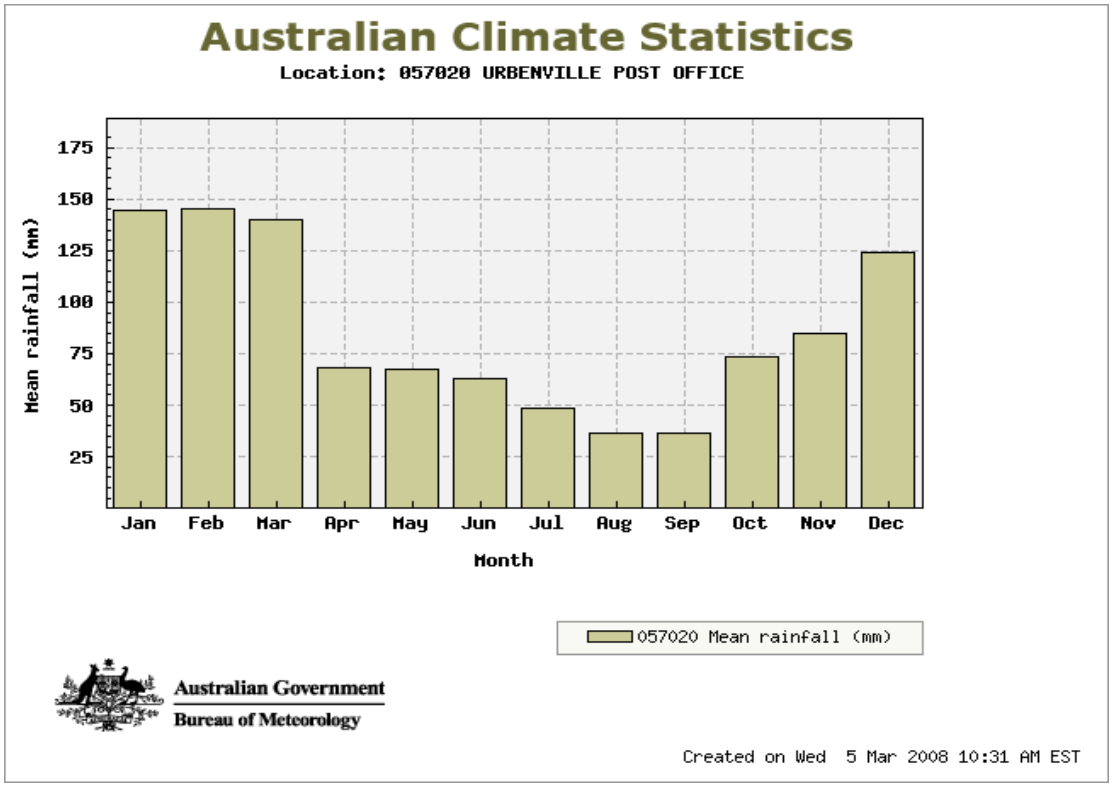


Figure 14: Mean rainfall (mm)

3. Environmental impacts and management

Clause 82 of the *Environmental Planning and Assessment Regulation, 1994* indicates specific factors which the Department of Primary Industries, Mineral Resources, must take into account in determining the likely environmental impacts of a proposed activity. These factors are addressed below.

Given the relatively temporary nature of the gas and water production activities on site those activities will be conducted so as to minimise the disturbance of the existing environment wherever possible with all efforts to preserve the current amenity of the area.

3.1. Air

The petroleum activities that are likely to result in the release of dust or particle matter or both are site preparation activities, vehicle movement and stockpile management. These activities will be management using the mitigation measures below.

3.1.1. Mitigation measures

Goals	To minimise the impact of petroleum activities related to vehicle and dust emissions on neighbouring residents and sensitive areas.
Performance Objective (s)	• Receive no complaints from local residents in relation to air emissions. • Minimise the generation of dust during construction activities.
Mitigation measures	• Water unsealed roads and construction site(s) during dry and windy conditions, as required. • Vehicle speeds shall be restricted to minimise dust. • Machinery and equipment shall be fitted with appropriate mufflers on the exhaust systems. These shall be maintained and replaced if excessive noise is produced.
Performance Measures	• No air related complaints received during construction.
Monitoring	• During construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • Maintain complaints register relating to dust and other air emissions. • A record of air quality complaints received will be maintained and the investigation of the sources and corrective actions undertaken will be documented by the Construction Manager.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register. Correction actions shall be closed out by senior management according to an agreed responsibility and timescale. • Suspension of construction should dust suppression measures be unsuccessful.

Table 6: Air mitigation measures

3.2. Water

The petroleum activities likely to impact on water quality are site preparation activities, the potential for spills of products or chemicals and surface and groundwater flow regimes. These activities will be managed using the mitigation measures below.

3.2.1. Mitigation measures

Goals	• To minimise the impacts of petroleum activities in relation to water quality on neighbouring residents and sensitive areas.
Performance Objective (s)	• To manage surface water flows and to minimise potential adverse impacts associated with altered flows
Mitigation measures	• A survey detailing the original contours of water crossings will ne undertaken prior to construction activities. • All chemicals used during operations shall be transported, stored, handled and disposed of in accordance with the requirements of relevant legislation and industry standards. • Areas of Acidic Sulphate Soils will be avoided.
Performance Measures	• Appropriate water management to be evident on site. • No evidence of sedimentation or erosion. • No complaints received in relation to water.
Monitoring	• During construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.

Table 7: Water mitigation measures

3.3. Soils

The petroleum activities likely to impact on soil quality are site construction activities, vehicle movement, stockpile management, site management and rehabilitation techniques. These activities will be managed using the mitigation measures below.

3.3.1. Mitigation measures

Goals	• To ensure that there is no erosion and sedimentation occurring to site or adjacent areas as a result of petroleum activities.
Performance Objective (s)	• To minimise the potential for soil loss and degradation, both on and off site.
Mitigation measures	• Ground disturbance and vegetation clearing (if necessary) shall be minimised as far as practicable. • The period for which the soil is left exposed to erosion shall be minimised. • Appropriate measures shall be developed to address wet weather consideration including access and the minimisation of soil erosion and sedimentation.
Performance measures	• Erosion and sedimentation related complaints received during construction.
Monitoring	• During construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • In response to complaints, monitoring will be undertaken at locations close to where the activities are occurring.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.

Table 8: Soil mitigation measures

3.4. Noise and vibration

The petroleum activities likely to impact noise and vibration levels are site construction activities, vehicle movement, well construction activities and the use of machinery and equipment. These activities will be managed using the mitigation measures below.

3.4.1. Mitigation measures

Goals	• To ensure that noise and vibration from petroleum activities are within actable limits at adjacent residential premises and other noise sensitive areas.
Performance Objective (s)	• Minimise the level and time of noise disturbance.
Mitigation measures	• Landholder shall receive adequate notice of potential noise incursions. • Heavy traffic use of local roads will be restricted to the hours of 6 am to 6 pm Monday to Saturday. • Where practicable, excessively noisy construction activities shall be scheduled for periods, which are less likely to result in a noise nuisance. • Construction equipment shall be equipped with appropriate noise abatement devices. • Noise and vibration generating equipment shall be located at appropriate distances from residences and/or will be enclosed or screened if necessary.
Performance measures	• Noise and vibration related complaints received during construction.
Monitoring	• During construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • In response to noise and vibration complaints, monitoring will be undertaken at locations close to where the activities are occurring.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.

Table 9: Noise and vibration mitigation measures

3.5. Flora and Fauna

There a re no threatened species in existence on the three well sites, there for no impact will occur. However the following site management will be implemented minimising any probability of impact on fauna.

The petroleum activities likely to have an impact on fauna communities are site construction activities, vehicle movement, site location and access track location. These activities will be managed using the mitigation measures below.

3.5.1. Mitigation measures

Goals	• To minimise impacts of clearing and construction on flora and fauna in the local area.
Performance Objective (s)	• Minimise impact to regional ecosystems of conservation significance as outlined by the relevant legislation. • Minimise impacts to rare and threatened plant species. • Minimise habitat loss and disruption to fauna activity as a result of petroleum activities. • Rehabilitate all disturbed areas to re-create ecological habitats. • Minimise loss of corridor habitats and un-fragmented areas.
Mitigation measures	• Survey the site for rare and endangered species prior to construction. Notify relevant authorities if any are located and advice of the specific mitigation measure proposed. • Position site away from protected areas. • Requests for additional workspace will be approved by the Environment Manager within regulatory requirements. • Cleared vegetation shall not be burnt and shall be re-spread.
Monitoring	• During construction associated work areas will be regularly inspected. • Monitoring of weed infestations within these communities will be conducted following construction. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • Photo monitoring of selected sites will be instigated prior to construction and continue through the construction period. The sites will be photographed on a regular basis and collated into a Site Photo Register.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register. • Corrective actions shall be closed out by senior management according to an agreed responsibility and timescale.

Table 10: Flora and Fauna mitigation measures

3.6. Chemical and hazardous substances

The petroleum activities likely to use, store or transport chemicals and/ or hazardous substances are vehicle, equipment and machinery use. These activities will be managed using the mitigation measures below.

3.6.1. Mitigation measures

Goals	• To reduce the risk of contamination from fuels, oils or hazardous waste and to respond effectively to incidents such as spills or leaks.
Performance Objective (s)	• Minimise the risk of spills and land contamination. • Ensure all hazardous waste is disposed of appropriately.
Mitigation measures	• Dangerous goods shall be stored, handled and signed as per AS-1940 and relevant legislation. • Material Safety Data Sheets (MSDS) shall be located at the Site Office for all hazardous and dangerous goods stored and used during construction. The Site Safety Officer is responsible for compiling and updating the MSDS. • Spills of hazardous materials will be contained and collected for treatment at a licensed waste disposal facility. • Spill containment and treatment equipment and materials shall be available near storage areas of hazardous materials. • Totally enclosed containment shall be provided for all waste. • Hazardous waste that cannot be recycled must be disposed of to a licensed waste disposal facility.
Performance Measures	• Appropriate storage and disposal of hazardous materials to be evident on site.
Monitoring	• During construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.

Table 11: Chemical and hazardous substances mitigation measures

3.7. Contaminated land

The petroleum activities likely to cause contamination or be located on contaminated land are incidents involving hazardous substance or chemical spills, site location and access track location. These activities will be managed using the mitigation measures below.

3.7.1. Mitigation measures

Goals	• To ensure there is no contamination to the land on which petroleum activities occur.
Performance Objective (s)	• To minimise the potential for land contamination.
Mitigation measures	• Site shall not be located on land which has been previously contaminated. • Dangerous goods shall be stored, handled and signed as per AS-1940 and relevant legislation. • Spills of hazardous materials will be contained and collected for treatment at a licensed waste disposal facility. • Spill containment and treatment equipment and materials shall be available near storage areas of hazardous materials.
Performance measures	• Zero incidents involving spills of hazardous or chemical substances occur during the life of the project.
Monitoring	• During construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • In response to complaints or incidents, monitoring will be undertaken at locations close to where the activities are occurring.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint or incident will be documented and complied within the Complaints or Incidents Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale. • Government authorities will be notified within a reasonable timeframe after a reportable incident occurs.

Table 12: Contaminated land mitigation measures

3.8. Waste minimisation and management

The waste likely to be generated form petroleum activities are domestic and industrial waste such as waste oil, packaging and liquid waste. These activities will be managed using the mitigation measures below.

3.8.1. Mitigation measures

Goals	• To minimise the generation of waste generated form petroleum activities, maximise recycling and ensure waste disposal at approved locations.
Performance Objective (s)	• Minimise the risk of contamination as the result of waste. • Following construction, there is no evidence of foreign waste on work sites.
Mitigation measures	• Non-recyclable materials/wastes (including regulated and hazardous wastes) are disposed of at licensed landfill sites or according to Council regulations. • Techniques for management of solid non- hazardous wastes include: o Stockpiling reusable and recyclable wastes such as timber skids, pallets and drums at a suitable location for salvage; o Development of on-site disposal areas conforming to regulatory authority requirements; and o Collection and removal of all domestic wastes from work sites daily. • Hazardous wastes involved in construction, management measures include: o Managing hazardous wastes in accordance with all relevant regulatory requirements, o All waste chemicals and other toxic materials shall be stored and collected for safe transport to locations approved by regulatory authorities, o Contaminated soils (e.g. major oil/fuel spills) shall be managed according to their concentration, leachibility and area affected and disposed of in consultation with relevant environmental protection authorities.
Performance Measures	• Evidence that waste has been disposed of correctly. • Licensed contractor used for hazardous and non-hazardous waste disposal.
Monitoring	• During construction the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • The Site Safety Officer will maintain material Safety Data Sheets for all potentially hazardous substances used on site. • Spills will be documented by the Construction Contractor and reported to the Environment Manager as soon as possible after

	the event. • Records of waste disposal will be maintained by the Construction Contractor. • The site will be inspected daily by the Superintendents for rubbish and litter not disposed of correctly.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale. • Where complaints are made regarding any waste management strategy the current procedures will be investigated and appropriate action be taken as required.

Table 13: Waste mitigation measures

3.9. Natural resource use

The petroleum activities likely to impact on natural resources are water use, fuel use and location of site. These activities will be managed using the mitigation measures below.

3.9.1. Mitigation measures

Goals	• To ensure there is minimal impact on natural resources as a result of petroleum activities.
Performance Objective (s)	• To use minimal natural resources during the life of the project.
Mitigation measures	• Site shall not be located on environmentally sensitive land. • Ground disturbance and vegetation clearing (if necessary) shall be minimised as far as practicable. • Water will be used sparingly • Requests for additional workspace will be approved by the Environment Manager within regulatory requirements. • Cleared vegetation shall not be burnt and shall be re-spread. • Rehabilitate all disturbed areas to re-create ecological habitats.
Performance measures	• Minimal natural resources wasted during the life of the project.
Monitoring	• During construction, the work will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent.
Corrective Action	• Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.

Table 14: Natural resource use mitigation measures

3.10. Impact on the community

The petroleum activities likely to have an impact on the community are vehicle movement, local business use, local agriculture land use and waste management. These activities will be managed using the mitigation measures below.

3.10.1. Mitigation measures

Goals	• To ensure petroleum activities have a positive impact on the local community
Performance Objective (s)	• To impact positively on the community
Mitigation measures	• Site location will be away from any buildings and/or sensitive places. • Landholder shall receive adequate notice of potential noise incursions. • Vehicle speeds shall be restricted to minimise dust. • All waste shall be disposed of accordingly to regulations. • Landowner shall be compensated for any land on which petroleum activates occurs. • Local businesses will be engaged on an as needed basis.
Performance measures	• Community related complaints received during construction.
Monitoring	• During construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • In response to complaints or incidents, monitoring will be undertaken at locations close to where the activities are occurring.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint or incident will be documented and complied within the Complaints or Incidents Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.

Table 15: Impact on the community mitigation measures

3.11. Visual assessment

The petroleum activities likely to have an impact on the existing visual environment are site location and stockpile location. These activities will be managed using the mitigation measures below.

3.11.1. Mitigation measures

Goals	• Ensure minimal impacts to the existing visual environment
Performance Objective (s)	• To minimise the potential for visual environmental impairment to the existing environment.
Mitigation measures	• Site shall not be located on land near buildings or sensitive areas • Stockpiles shall not be located on land near buildings or sensitive areas • The completed well shall not cause shading on buildings • The completed well shall not obstruct existing views
Performance measures	• Visual assessment related complaints received during construction.
Monitoring	• During construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints or Incidents Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale.

Table 16: Visual assessment mitigation measures

3.12. Cultural Heritage

All the sites have been extensively disturbed and are presently improved pastures with open grazing land use. As such it is unlikely that any cultural heritage artefacts or issues exist on these sites; however Arrow will implement the following management to further reduce the risk of disturbance.

The petroleum activities likely to impact on Aboriginal and other cultural heritage issues are site location and construction and access track location and construction. These activities will be managed using the mitigation measures below.

3.12.1. Mitigation measures

Goals	• Ensure there is no contamination to land on which petroleum activities occur.
Performance Objective (s)	• No damage to heritage sites as a result of petroleum activities
Mitigation measures	• Appropriate approvals obtained prior to any disturbance caused by petroleum activities. • Personnel awareness of these sites and their values to the communities • Detailed inventory of heritage sites maintained during operations • Sites adjacent heritage areas will have barriers installed • Cultural Heritage induction for all personnel.
Performance measures	• Cultural Heritage related complaints received during construction. • Incidents relating to Cultural Heritage areas or items during construction.
Monitoring	• Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • In response to complaints or incidents, monitoring will be undertaken at locations close to where the activities are occurring.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint or incident will be documented and complied within the Complaints or Incidents Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale. • Government authorities, relevant stakeholders and community groups will be notified within a reasonable timeframe after a reportable incident relating to cultural heritage occurs.

Table 17: Cultural Heritage mitigation measures

3.13. Land use

The petroleum activities likely to impact on land use are site location and construction, access track location and construction, waste management and water management. These activities will be managed using the mitigation measures below. At the conclusion of petroleum activities the site will be returned to the original land use.

3.13.1. Mitigation measures

Goals	• Minimal disturbance to current land use operations
Performance Objective (s)	• To Minimise disruption to existing land use rights and practices • To Minimise disruption to residents, landowners and third parties • To maintain appropriate consultation to all relevant landowners
Mitigation measures	• Consultation with relevant landholders and regulatory authorities should be undertaken regarding any special management measures required for an area/property such as weed or disease management provisions, quarantine provisions, certified area provisions (e.g. organic, disease/weed free). • Where practicable, disruptive activities should be scheduled to reduce potential adverse effects. • Where practicable, all relevant residents, landowners and third parties should be notified in advance of any disruptive activities. • To facilitate landowner contact, a database of landowners should be prepared and maintained. • Regular contact with landowners should be maintained and all relevant petroleum operations management issues discussed. • Landowners should be briefed regarding the safety, emergency response and operational considerations of the petroleum activities.
Performance Measures	• Complaints from landholders, authorities and the community.
Monitoring	• During construction work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • The Site Manager shall maintain a complaints register.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register.

Table 18: Land use mitigation measures

3.14. Cumulative environmental impacts

A summary of the likely impacts associated with the planned activity include:

- The preparation of three 40x 60 well pads at the stated locations;
- The drilling and core collection from each of three holes; and
- The plugging, abandonment and rehabilitation of the three wells and drill sites.

The cumulative environmental impacts on the biodiversity of the area are considered insignificant. The clearance of the well pads is considered a minor impact due to the fact that the locations are all within previously cleared areas.

The direct impact of the activity on threatened species of fauna is considered small because of the accumulative size of the well pads along with the location.

The conservation of topsoil stocks is designed to maximise the effectiveness of the rehabilitation program. By doing so, the probability of re-generating the pads to pre disturbance status is significantly increased.

The scale of dust generation and its impacts on the surrounding environment is generally thought to be minimal. Adequate mitigation measures are available during the construction phase to limit the generation of dust in the localised area and where the activity creates greater than normal levels of traffic on the unsealed access tracks inbound and outbound from the site.

The cumulative impacts on items or sites of cultural heritage significance are considered minimal as the location of the pads is in previously cleared and extensively farmed areas.

Positive cumulative benefits for the local business community are an expected result of the proposed activity with the planning and construction phases utilising a range of local service providers.

3.15. Summary of mitigation measures

Mitigation measures include but are not be limited to:

- Strategic site selection to where possible, avoid areas requiring special environmental protection.
- Observation on site of any matters and items requiring protection, preservation or avoidance.
- Where possible, preserve the prior environment.
- Protection and avoidance of sensitive items.
- Prevention of contamination or other avoidable environmental disturbance.
- Restoration of the site prior environment on abandonment, and subsequent inspection.

3.16. Rehabilitation works

All disturbance caused by petroleum operations will be rehabilitated to pre disturbance land use capability. Rehabilitation may be progressive and will be decommissioned at the cessation of the project. These activities will be managed using the mitigation measures below.

Goals	• To rehabilitate all lands disturbed to a land use capability compatible with the surrounding land use. Any rehabilitation will utilise all actable methods to ensure that a stable land form is reinstated.
Performance Objective (s)	• Minimise loss of vegetation and habitat. • Minimise erosion and sediment runoff. • Minimise the risk of subsidence. • Minimise the loss of visual amenity. • Minimise the modification of drainage patterns. • Minimise the damage to any infrastructure.
Mitigation measures	• Minor surface roughness will be encouraged when spreading topsoil to trap water and seed. • Other cleared vegetation will be removed and disposed of in consultation with the appropriate landholder or respread over cleared areas to assist in seed distribution and provide shelter for fauna. • Areas affected by operations and development will be re-profiled to original and stable contours, re-establish surface drainage lines and other land features. • Erosion and sediment controls will be installed if necessary. Existing soil erosion measures will be reinstated to a condition at least equal to the pre-existing state. • The Compressor Station shall be fenced to discourage third party, stock and wildlife entry. • Signs, fences or other barriers shall be installed where

	appropriate to prevent unauthorised easement access. • Warning signs shall be erected where necessary. • In general, revegetation will occur through the re-spreading of cleared topsoil and vegetation where required. • In other areas where seeding or replanting is required, the seed mix will be agreed with the relevant land holder. • Environmental features such as rocks and dead timber will be replaced in cleared areas as appropriate.
Performance Measures	• No new weed species are introduced. • Revegetation shall return areas to similar composition as surrounding vegetation. • Drainage patterns returned following construction.
Monitoring	• Following construction, the work areas will be regularly inspected. • Daily or Weekly reports (as appropriate) shall be completed on site and reviewed by each Supervisor and/or Superintendent. • Regular monitoring of revegetated areas will occur to ensure that natural vegetation regenerates over the affected areas. • Photo monitoring of sites will continue following construction. • It is the responsibility of the Construction Manager to ensure affected land holders are approached to verify that the rehabilitation and repairs have met all their requirements.
Corrective Action	• Investigations/corrective actions undertaken as a result of the complaint will be documented and complied within the Complaints Register. • Correction actions shall be closed out by senior management according to an agreed responsibility and timescale. • Investigate complaints and take steps to restore the area to landholder requirements.

Table 19: Rehabilitation mitigation measures

3.16.1. Rehabilitation cost estimate

The following rehabilitation cost estimate has been developed using the DPI Schedule of Rehabilitation Costs Reference Data sheet.

Activity/ Description	Quantity	Unit amount	Total
Exploration holes	3	$275.00	$825.00
Maintenance of established rehabilitated areas	3	$715.00	$2145.00
Contingency	-	10%	$297.00
Environmental monitoring	-	5%	$148.00
TOTAL			**$3415.00**

Table 20: Rehabilitation cost estimate

3.17. Summary of impacts and conclusions

This REF presents the knowledge of the environment and the potential impacts as they are known at this time. Arrow Energy is confident that the proposed activity will not create any long term, detrimental environmental impacts likely to change the environment or the surrounding region. The proposed activity will not result in any impacts on the biophysical environment including flora, terrestrial and aquatic flora or sites of cultural heritage significance. No ongoing land use or locally/regionally significant infrastructure such as roads will be impacted by the activity.

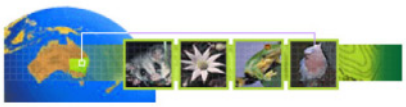
The bulk of the activity will occur over a short period of time (2 to 3 weeks, depending on rainfall and rid availability), be localised and non-permanent limiting any further impacts associated with noise, visual and other impacts in this regard.

The completion of flora, fauna and cultural heritage surveys suggests that the proposed activities for this project can be completed without any long term impacts on species or communities of significance and items of Aboriginal heritage.

The information contained within this document is a representation of the structure which our petroleum operation is to be conducted and that an adequate study of the impacts will be conducted prior to any activity commencing.

It is the opinion of Arrow Energy that the impacts created by the proposed petroleum activities when measured alongside the mitigation measures will create no long term effect on the local environment.

Attachment 1: Kyogle Shire Threatened Fauna Species List



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Search Results

Your selection: Fauna, threatened species, LGA - KYOGLE returned a total of 2540 records of 68 species.
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view map search again clear selection search again

Choose up to 3 species to map.

** Exotic (non-native) species*

clear selection

Amphibia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Hylidae						
	☐	Litoria brevipalmata	Green-thighed Frog	V	12	
Myobatrachidae						
	☐	Assa darlingtoni	Pouched Frog	V	131	
	☐	Mixophyes fleayi	Fleay's Barred Frog	E1	212	
	☐	Mixophyes iteratus	Giant Barred Frog	E1	12	
	☐	Philoria loveridgei	Loveridge's Frog	E1	83	
	☐	Philoria richmondensis		E1	9	

Aves	Map	Scientific Name	Common Name	Legal Status	Count	Info
Acanthizidae						
	☐	Dasyornis brachypterus	Eastern Bristlebird	E1	102	
	☐	Pyrrholaemus saggitatus	Speckled Warbler	V	2	
Accipitridae						
	☐	Erythrotriorchis radiatus	Red Goshawk	E1	2	
Anseranatidae						
	☐	Anseranas semipalmata	Magpie Goose	V	2	
Ardeidae						
	☐	Ixobrychus flavicollis	Black Bittern	V	3	
Atrichornithidae						
	☐	Atrichornis rufescens	Rufous Scrub-bird	V	176	
Burhinidae						
	☐	Burhinus grallarius	Bush Stone-curlew	E1	1	
Cacatuidae						
	☐	Calyptorhynchus lathami	Glossy Black-Cockatoo	V	33	
Campephagidae						
	☐	Coracina lineata	Barred Cuckoo-shrike	V	43	
Ciconiidae						
	☐	Ephippiorhynchus asiaticus	Black-necked Stork	E1	36	
Climacteridae						
	☐	Climacteris picumnus	Brown Treecreeper	V	5	
Columbidae						
	☐	Ptilinopus magnificus	Wompoo Fruit-Dove	V	220	
	☐	Ptilinopus regina	Rose-crowned Fruit-Dove	V	75	
	☐	Ptilinopus superbus	Superb Fruit-Dove	V	9	
Dicruridae						

	Monarcha leucotis	White-eared Monarch	V	40	
Jacanidae					
	Irediparra gallinacea	Comb-crested Jacana	V	6	
Meliphagidae					
	Xanthomyza phrygia	Regent Honeyeater	E1	1	
Menuridae					
	Menura alberti	Albert's Lyrebird	V	154	
Pachycephalidae					
	Pachycephala olivacea	Olive Whistler	V	2	
Podargidae					
	Podargus ocellatus	Marbled Frogmouth	V	36	
Pomatostomidae					
	Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	2	
Procellariidae					
	Pterodroma nigripennis	Black-winged Petrel	V	2	
Psittacidae					
	Cyclopsitta diophthalma coxeni	Double-eyed Fig-parrot	E1	4	
	Lathamus discolor	Swift Parrot	E1	1	
Rallidae					
	Amaurornis olivaceus	Bush-hen	V	4	
Strigidae					
	Ninox connivens	Barking Owl	V	1	
	Ninox strenua	Powerful Owl	V	16	
Turnicidae					
	Turnix maculosa	Red-backed Button-quail	V	2	
	Turnix melanogaster	Black-breasted Button-quail	E1	5	
Tytonidae					
	Tyto novaehollandiae	Masked Owl	V	14	
	Tyto tenebricosa	Sooty Owl	V	92	
Mammalia	Map Scientific Name	Common Name	Legal Status	Count	Info
Burramyidae					
	Cercartetus nanus	Eastern Pygmy-possum	V	3	
Dasyuridae					
	Dasyurus maculatus	Spotted-tailed Quoll	V	32	
	Phascogale tapoatafa	Brush-tailed Phascogale	V	13	
	Planigale maculata	Common Planigale	V	5	
Macropodidae					
	Macropus dorsalis	Black-striped Wallaby	E1	18	
	Macropus parma	Parma Wallaby	V	6	
	Petrogale penicillata	Brush-tailed Rock-wallaby	E1	36	
	Thylogale stigmatica	Red-legged Pademelon	V	25	
Muridae					
	Pseudomys gracilicaudatus	Eastern Chestnut Mouse	V	1	
	Pseudomys oralis	Hastings River Mouse	E1	33	
Petauridae					
	Petaurus australis	Yellow-bellied Glider	V	72	
	Petaurus norfolcensis	Squirrel Glider	V	12	
Phascolarctidae					
	Phascolarctos cinereus	Koala	V	233	

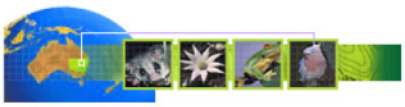
Potoroidae					
	Aepyprymnus rufescens	Rufous Bettong	V	17	
	Potorous tridactylus	Long-nosed Potoroo	V	12	
Pteropodidae					
	Nyctimene robinsoni	Eastern Tube-nosed Bat	V	1	
	Pteropus alecto	Black Flying-fox	V	6	
	Pteropus poliocephalus	Grey-headed Flying-fox	V	32	
	Syconycteris australis	Common Blossom-bat	V	2	
Vespertilionidae					
	Chalinolobus nigrogriseus	Hoary Wattled Bat	V	3	
	Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	18	
	Kerivoula papuensis	Golden-tipped Bat	V	197	
	Miniopterus australis	Little Bentwing-bat	V	67	
	Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	32	
	Myotis adversus	Large-footed Myotis	V	2	
	Nyctophilus bifax	Eastern Long-eared Bat	V	3	
	Scoteanax rueppellii	Greater Broad-nosed Bat	V	19	
	Vespadelus troughtoni	Eastern Cave Bat	V	1	

Reptilia	Map	Scientific Name	Common Name	Legal Status	Count	Info
Elapidae						
		Cacophis harriettae	White-crowned Snake	V	1	
		Hoplocephalus stephensii	Stephens' Banded Snake	V	15	
Scincidae						
		Coeranoscincus reticulatus	Three-toed Snake-tooth Skink	V	73	

** Exotic (non-native) species*

Choose up to 3 species to map.

Attachment 2: Kyogle Shire Threatened Fauna Species list



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Search Results

Your selection: Flora, threatened species, LGA - KYOGLE returned a total of 139 records of 29 species.
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view map | search again | clear selection | search again

Choose up to 3 species to map.

** Exotic (non-native) species*

clear selection

Plants	Map	Scientific Name	Common Name	Legal Status	Count	Info
Apocynaceae						
	☐	Marsdenia longiloba	Slender Marsdenia	E1	3	
	☐	Ochrosia moorei	Southern Ochrosia	E1	2	
Asteraceae						
	☐	Brachyscome ascendens	Border Ranges Daisy	E1	1	
Campanulaceae						
	☐	Wahlenbergia scopulicola	Rock-face Bluebell	E1	4	
Cupressaceae						
	☐	Callitris baileyi	Bailey's Cypress Pine	E1	2	
Fabaceae (Caesalpinioideae)						
	☐	Cassia brewsteri var. marksiana	Brush Cassia	E1	1	
	☐	Senna acclinis	Rainforest Cassia	E1	10	
Fabaceae (Faboideae)						
	☐	Desmodium acanthocladum	Thorny Pea	V	2	
	☐	Rhynchosia acuminatissima	Pointed Trefoil	V	5	
	☐	Sophora fraseri	Brush Sophora	V	10	
Grammitidaceae						
	☐	Grammitis stenophylla	Narrow-leaf Finger Fern	E1	1	
Lamiaceae						
	☐	Plectranthus nitidus	Nightcap Plectranthus	E1	1	
Lauraceae						
	☐	Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	E1	2	
Meliaceae						
	☐	Owenia cepiodora	Onion Cedar	V	28	
Menispermaceae						
	☐	Tinospora smilacina	Tinospora Vine	E1	2	
	☐	Tinospora tinosporoides	Arrow-head Vine	V	3	
Myrsinaceae						
	☐	Rapanea sp. A Richmond River	Ripple-leaf Muttonwood	E1	1	
Myrtaceae						
	☐	Eucalyptus glaucina	Slaty Red Gum	V	5	
	☐	Eucalyptus microcodon	Border Mallee	E1	4	
	☐	Syzygium paniculatum	Magenta Lilly Pilly	V	1	
Orchidaceae						
	☐	Pterostylis nigricans	Dark Greenhood	V	1	

	Sarcochilus hartmannii	Hartman's Sarcochilus	V	1
	Sarcochilus weinthalii	Blotched Sarcochilus	V	2
Poaceae				
	Arthraxon hispidus	Hairy Jointgrass	V	2
Polygalaceae				
	Polygala linariifolia	Native Milkwort	E1	1
Polygonaceae				
	Persicaria elatior	Tall Knotweed	V	3
Ranunculaceae				
	Clematis fawcettii	Northern Clematis	V	15
Solanaceae				
	Solanum limitare	Border Ranges Nightshade	E1	6
Tiliaceae				
	Corchorus cunninghamii	Native Jute	E1	20

** Exotic (non-native) species*

Choose up to 3 species to map.

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