SENATE REFERNCES COMMITTEE ON RURAL AFFAIRS & TRANSPORT

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Impacts of mining Coal Seam Gas

NARRABRI, NSW – TUESDAY, 2 AUGUST 2011

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Moree Plains Shire Council

attn cl. 5, 22, 22

LEICHHARDT RESOURCES

30 June 2011

Dear Landholder,

Letter of introduction and request for an Access Agreement to conduct well program

Leichhardt is seeking an agreement to access your land to drill a core hole on your property.

Leichhardt Resources Pty Ltd (Leichhardt) is the title holder of Petroleum Exploration Licence (PEL) 470 in your area which has been issued by the New South Wales Department of Industry and Investment (DII). Leichhardt, Planet Gas Ltd (Planet) and MBA Petroleum Consultants Pty Ltd (MBA) are working together on this well program under the following arrangement:

- Leichhardt: Title Holder
- Planet: Operator (farming in)
- MBA: Project Manager

As part of this well program, Planet proposes to drill an exploration core hole on your property. The proposed well program is inclusive of all activities from initial site preparation through to remediation.

The proposed well program is scheduled to commence in July and will take approximately four weeks to complete including initial earthworks. The project manager will update you on actual timing as we get closer to the start of operations.

The success of the well program is based on the following outcomes:

1) effective liaison between the Landholder, Leichhardt and Planet so that all parties involved are aware of their rights;

2) mutually agreeable compensation and full restoration of the affected land to the reasonable satisfaction of the Landholder; and

3) efficient scheduling of each stage of the program to minimise inconvenience to the Landholder.

Leichhardt and Planet are confident that these goals can be achieved successfully.

The Petroleum (Onshore) *Act 1991* describes the process by which the holder of a Petroleum Exploration Licence may request permission via an access arrangement (Section 69C) to enter land as well as the rights of the Landholder in relation to that process (Section 69D). These rights include the requirement for an agreed access arrangement, notification in writing of the title holder's intentions (Section 69E), and the right to take the matter to arbitration in the unlikely event the parties are unable to agree on such an arrangement (Section 69F).

In accordance with Section 69E of the *Petroleum (Onshore) Act 1991*, Leichhardt gives notice that the Planet wishes to obtain an access arrangement on your property. If, after 28 days of submission of this initial notice an agreement cannot be reached, an arbitrator will be appointed to resolve any issues relating to access after this period.

Yours sincerely
Leichhardt Resources Pty Ltd

Simon Tolhurst

Writer: Simon Tolhurst | (07) 3002 6749 |
E-mail: info@leichhardtresources.com.au

ACCESS ARRANGEMENT

made the 3rd day of July 2011

BETWEEN **The Person/s described as the Landholder/s in Item 1 of the Reference Schedule ("the Landholder")**

AND **LEICHHARDT RESOURCES Pty Ltd** (Leichhardt Resources)

INTRODUCTION

A The Landholder is the owner or occupier of the lands described in Item 1 of the Reference Schedule ("the Land");

B The Landholder and Leichhardt Resources enter into this Arrangement for the purpose of recording the terms on which Leichhardt Resources may access the Land and compensation payable by Leichhardt Resources to the Landholder.

C Leichhardt Resources is the holder of a Petroleum Exploration Licence over the Lands.

D Leichhardt Resources intends to carry out exploration operations in and on the Land under the terms and conditions of the *Petroleum (Onshore) Act* 1991.

E The *Petroleum (Onshore) Act* 1991, Part 4A, permits Leichhardt Resources to carry out exploration operations as set out in the Reference Schedule with the consent of the Landholder.

Proposed operations: Gurley-1 petroleum exploration core hole

1) The Access Arrangement is valid for the drilling program and associated sampling of the Gurley-1 site only. Any further exploration/production/development activities will require further consultation with the Landholder, and require a separate Access Arrangement negotiated between the parties.

Compensation

2) Leichhardt Resources will pay A$5000 (plus GST) (access compensation within 14 days of receipt of invoice.

Costs

3) a. Leichhardt Resources will pay all reasonable costs and outlays (including stamp duty and government imposts) connected with the negotiation, preparation, execution, stamping and registration of this agreement and all other documents and matters referred to in this Arrangement;

b. Leichhardt Resources will comply with the specific requests by the Landholder in relation to compensation as set out in the Access Arrangement.

Insurance

4) Leichhardt Resources will supply the Landholder with a certificate of currency, if requested, for relevant insurances, including but not limited to:

a. a policy or policies covering the authorised activities and the cost of environmental rehabilitation for the work program;

b. a public liability policy of insurance which covers the Landholder, Leichhardt Resources, any contractors and subcontractors employed by Leichhardt Resources and other interested parties for their respective liabilities for loss of or damage to property (including loss of use of property which has not been physically damaged or destroyed) and death of or injury to any person, for at least $20,000,000;

c. employers' liability and workers' compensation insurance (including common law liability) as required under any applicable workers' compensation statute or regulation. Leichhardt Resources will ensure that each of its contractors, subcontractors and consultants also effects and maintains insurance under these statutes or regulations;

d. motor vehicle insurance in accordance with the laws in Australia to insure all vehicles while being used in the performance of the authorised activities; and

e. third party property damage and personal injury liability insurance for vehicles while being used in the performance of the authorised activities.

Indemnity

5) Leichhardt Resources will indemnify the Landholder for all losses resulting from its activities on the Landholder's land incurred during the duration and as a direct result of its core hole exploration program.

Conditions of Access

6) Leichhardt Resources must not conduct, without the prior written consent of the Landholder, any operations on the Land within 200 metres of any principal residence of the Landholder.

7) Leichhardt Resources must use best endeavours to minimise the noise from its operations where those operations are conducted within the proximity of any dwelling on the Land that is the principal place of residence of the person occupying it.

8) Gravelling of an access road may be required depending on site conditions, and this will be negotiated with the Landholder on a needs basis. Any gravel used during the well program will be stock piled during restoration.

9) The site may be fenced after demobilization of the rig, and this will be negotiated with the Landholder. Any existing fencing that has been altered during the well program will be replaced/renewed during site restoration.

10) Where required, sufficient land will be made available around the lease to allow stock movement during the well program.

11) The Landholder will be provided with a notice of entry for all personnel entering the property prior to, and after, drilling operations. A minimum 48 hours notice will be provided to the Landholder prior to mobilisation of the rig.

12) The entrance gate will be kept closed/latched at all times prior to mobilisation and after demobilisation of the rig. The gate will remain closed during drilling activities.

13) Signs will be erected to control speeds of vehicles accessing the site.

14) All gates will be left as found. Corflute 'gate closed' signs may be attached to relevant gates as required.

15) No employee, contractor or other person associated with Leichhardt Resources will be permitted to bring alcohol, firearms or animals onto the Landholder's property or the site at any time.

16) Leichhardt Resources, its servants, agents, contractors and sub-contractors will remain aware of third party traffic, such as stock transportation, utilising the access road.

Hours of Operation

17) The drilling rig is scheduled to operate on a 24 hour/day basis, 7 days per week.

Dispute Resolution

18) Any dispute or difference whatsoever arising out of or in connection with this Arrangement shall be referred to arbitration in accordance with Part 4A of the *Petroleum (Onshore) Act 1991*.

Environmental Protection Requirements

19) The proposed core hole will be drilled in accordance with Leichhardt Resources' Environment, Health and Safety Management Plan (EHSMP) which outlines Leichhardt Resources' commitment to sound management of environmental aspects and OH&S performance for the Project.

20) The site will be restored as soon as practical after demobilisation of the rig, and by no later than four weeks after conclusion of drilling. Restoration will include the removal of drill cuttings and liquids where required and restoring the site to as near as possible to its original condition.

Costs

21) Leichhardt Resources will pay up to the sum of $500 for the Landholder's legal costs to review this Arrangement and any document required by this Arrangement upon satisfactory proof of expenditure.

Force Majeure

22) Leichhardt Resources is not liable for a breach of this Arrangement if and to the extent that the breach is caused by circumstances outside Leichhardt Resources' direct control and provided Leichhardt Resources:

a. immediately notifies the Landholder of the circumstances; and
b. uses all reasonable efforts during the period for which the circumstances continue to remedy the breach as soon as practicable.

Leichhardt Resources must notify the Landholder forthwith when the breach has been remedied.

Confidentiality

23) All Parties will treat all information received, regardless of how it has been communicated or recorded, as confidential, valuable and proprietary and will be kept as such. All Parties will take such steps as are necessary to ensure that its agents, officers, employees, contractors and consultants are similarly bound.

Governing Law

24) This Arrangement is governed by the laws of New South Wales and each Party submits to the jurisdiction of the Courts of that State and of all Courts competent to hear appeals there from.

Notice

A Notice required to be given or made under this Arrangement must be in writing and will be deemed to have been duly given or made if it is signed by the Party giving or making same and delivered or sent to the address of the other Party.

.....

S. Tolhurst, Managing Director
Leichhardt Resources Pty Ltd

Access Arrangement between Leichhardt Resources Pty Ltd and the Landholder in accordance with the *Petroleum (Onshore) Act* 1991

I/ We .....

Of.....Lot#.....DP#.....

consent to Leichhardt Resources Pty Ltd as the title holder and Planet Gas Pty Ltd as the operating company, accessing our land for the purpose of conducting exploration and the drilling of a core hole within the period not exceeding six months between 1 June, 2011 to 31 November, 2011.

REFERENCE SCHEDULE

1. Name of Landholder and address:

2. Name of PEL: PEL 470

3. Name of core hole: Gurley-1

4. Land requiring access:

5. Exploration activities: All activities associated with the drilling and associated sampling of one exploration core hole.

6. List of equipment and personnel planned to be on site:

Equipment	Est. # on site	Personnel	Est. # on site
Support Truck	1	Geologist	2
Fuel Truck	1	Desorption Tech.	2
Tele-Handle	1	Company Supervisor	1
Rod Sloop	2	Drilling Supervisor	1
B-Double Truck	1	Driller	2
Light Vehicles (4x4)	4	Drilling Assistant	4
Water Truck	1	Camp Chef	1
Portaloo	1	Camp Operator	1
Light Tower	2	Specialist Services	2 (as required)
Mud Tank	1		
Mump	2		
Generator	2		
Tool Container	1		
Site Office	2		
Accumulator	1		

7. Compensation: $A5000.00

8. Operating hours: The rig is scheduled to operate on a 24 hour/day basis, 7 days per week in accordance with the Review of Environmental Factors approved by the Industry and Investment New South Wales.

9. Site and site access tracks where required will be prepared by Leichhardt or its contractor. The reclamation of these sites will be the responsibility for Leichhardt to be performed within four (4) weeks of demobilisation from site.

Fracking chemicals, their uses and hazards

This is a list of *some* of the chemicals used in fracking fluids in Australia. (Source: APPEA, 1 November 2010)
The full list can be seen at
http://www.appea.com.au/images/stories/mb_files/APPEA_fraccing_chemicals.pdf

Fracking fluid mixes vary according to the nature of each task. Not all of these substances are used in all fracking jobs.

Chemical, fracking use.
Common use example
Hazards, safety notes

1-Propanol. Complexor.
Used as a solvent in the pharmaceutical industry.
Hazardous chemical class 3 [1]. Highly flammable. Harmful by inhalation and if swallowed. Irritating to eyes and skin.

2-Butoxyethanol. Surfactant (used to reduce surface tension).
Used in whiteboard cleaners, liquid soaps, cosmetics and lacquers.
Poison. Causes hemoglobinuria as well as histopathologic changes in the liver and kidney. [2]

Acetic Acid. pH buffer (used to adjust pH).
Gives vinegar its taste.
Extremely corrosive and flammable. It requires special storage and handling considerations. Glacial acetic acid causes severe chemical burns to eyes and skin. [3]

Acrylic copolymer. Lubricant.
Used as a soil-repellent coating by the building industry.
Includes methyl methacrylate, methacrylic acid, butyl acrilate and buthyl methacrylate, all toxic chemicals used in solvents.[4]

Ammonium persulfate. Breaker. Used to reduce viscosity (turns a gel into water)
Used in hair bleach, blot gels and glass cleaning products.
Oxidizer with moderate oral toxicity. Airborne dust may be irritating to eyes, nose, lungs, throat and skin upon contact.[5]

Boric Acid. Crosslinker to increase viscosity.
Used in anticeptics to treat cuts and fungal infections (athlete's foot).
Poison. Chronic poisoning occurs in those who are repeatedly exposed to boric acid. Once used to disinfect and treat wounds, patients who received such treatment repeatedly got sick, and some died. [6]

Boric Oxide. Crosslinker to increase viscosity.
Used to produce high strength alloys, glasses and ceramics.
Causes severe irritation of upper respiratory tract with coughing, burns, breathing difficulty, and possible coma. May cause kidney injury. [7]

Disodium Octaborate Tetrahydrate. Gelling agent/Crosslinker to increase viscosity.
Used as a fertilizer.
Affects the gastrointestinal tract , skin, vascular system and brain.[8]

Hydrochloric Acid. Cleaning of the wellbore prior to fracking.
Used to clean swimming pool filters.

Extremely corrosive. Inhalation of vapour can cause serious injury. Ingestion may be fatal. Liquid can cause severe damage to skin and eyes. Threshold Limit Value - 5 ppm. Lethal to fish from 25 mg/l or more. Toxic for aquatic organisms due to pH shift [9]

Methanol. Surfactant. Used to aid gas flow.
A type of alcohol, can be used in wastewater treatment and as an alternative fuel.
Swallowing even small amounts has potential to cause blindness or death. Effects of sub lethal doses may be nausea, headache, abdominal pain, vomiting and visual disturbances ranging from blurred vision to light sensitivity. Repeated exposure by inhalation or absorption may cause systemic poisoning, brain disorders, impaired vision and blindness and worsen conditions such as emphysema or bronchitis. [10]

Ethylene Glycol Monobutyl Ether. Mutual solvent.
Used in household cleaners, fire fighting foam, and to degrease bowling pins and lanes.
Liquid and vapour are combustible. Harmful if inhaled, when in contact with skin and if swallowed. It is irritating to respiratory system. Causes eye irritation, affects central nervous system, blood and blood forming organs, kidneys, liver and lymphoid system. [11]

Muriatic Acid. Used for cleaning the well bore.
Leather tanning and for cleaning.
Irritating and corrosive to living tissue. Brief exposure in low levels produces irritation. Exposure to higher levels can cause breathing difficulties, narrowing of the bronchioles, blue colour of the skin, accumulation of fluid in the lungs and death. [12]

Potassium Chloride. Clay inhinbitor.
Used in making fertilizer, gas-welding flux, in medicines and for lethal injections.
Large doses cause gastro-intestinal irritation, purging, weakness and circulatory problems. [13]

Polydimethyldiallylammonium chloride. Clay control.
Flocculant in waste water treatment. Wetting agent, shampoo ingredient.
Avoid runoff into storm sewers and ditches. [14]

Quaternary Polyamines. Clay control.
Used in waste water treatment
Corrosive, dangerous for the environment. Risk of serious damage to eyes. Very toxic to aquatic organisms. Vapours may cause drowsiness and dizziness.[15]

Sodium Borate. pH buffer.
A component in glass, pottery, and detergents.
Eye irritation, blurred vision, eye damage. [16]

Sodium Hydroxide. pH buffer.
Used in paper-making, food processing, soap, detergents, drain cleaners.
Causes severe skin and eye burns. May cause blindness; severe and permanent damage to gastro-intestinal tract including burns, perforations[17]. Inhalation may lead to chemical pneumonitis, pulmonary edema. Causes severe irritation of, and possible chemical burns to upper respiratory tract – coughing, burns, breathing difficulty. Possible coma.

Tetrakis (hydroxymethyl) Phosphonium Sulfate. Antiseptic.
Used to elimate bacteria in water, petroleum.
Prolonged or repeated skin contact may cause dermatitis, liver and kidney damage. [18]

Tetramethyl ammonium chloride. Clay control .
A salt of ammonia. Few common applications.

Material Safety Data Sheet

DELO EXTENDED LIFE COOLANT PREMIXED

Infosafe™ No. LPS8N **Issue Date** September 2007 **Status** ISSUED by CALTEX BS: 1.10.9

Classified as hazardous according to criteria of NOHSC

1. IDENTIFICATION OF THE MATERIAL AND SUPPLIER

Product Name	DELO EXTENDED LIFE COOLANT PREMIXED
Product Code	2981
Company Name	Caltex Australia Petroleum Pty Ltd (ABN 17 000 032 128)
Address	2 Market Street, Sydney NSW 2000
Emergency Tel.	1800 033 111
Telephone/Fax Number	Tel: (02) 9250 5000 Fax: (02) 9250 5742
Recommended Use	Antifreeze/Coolant.
Other Names	None Listed

2. HAZARDS IDENTIFICATION

Hazard Classification	HAZARDOUS SUBSTANCE. NON-DANGEROUS GOODS. Hazard classification according to the criteria of NOHSC. Dangerous goods classification according to the Australia Dangerous Goods Code.
Risk Phrase(s)	R22 Harmful if swallowed.
Safety Phrase(s)	S2 Keep out of reach of children. S62 If swallowed, do not induce vomiting; seek medical advice immediately and show this container or label.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Information on Composition Contains 2-Ethylhexanoic acid, potassium salt.

Ingredients

Name	CAS	Proportion
Ethylene glycol	107-21-1	30-60 %
Ingredients determined not to be hazardous		Balance to 100%

4. FIRST AID MEASURES

Inhalation If inhaled, remove from contaminated area. Apply artificial respiration if not breathing. If symptoms develop seek medical attention.

Ingestion If swallowed, do NOT induce vomiting. Wash out mouth with water. If symptoms develop seek medical attention.

Skin Wash affected area thoroughly with soap and water. Remove contaminated clothing and wash before reuse or discard. If symptoms develop seek medical attention.

Eye If contact with the eye(s) occurs, wash with copious amounts of water holding eyelid(s) open. Take care not to rinse contaminated water into the non-affected eye. If symptoms persist seek medical attention.

First Aid Facilities Eye wash fountains and normal washroom facilities.

Advice to Doctor Treat symptomatically.

Other Information For advice, contact a Poisons Information Centre (Phone eg Australia 131 126; New Zealand 0800 764 766) or a doctor (at once).

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media Water fog, foam, carbon dioxide or dry chemicals.

Hazards from Combustion Products Non combustible material.

Precautions in connection with Fire Fire-fighters should wear full protective clothing and self contained breathing apparatus (SCBA) operated in positive pressure mode.

6. ACCIDENTAL RELEASE MEASURES

Emergency Procedures Increase ventilation. Wear protective clothing to minimise skin and eye exposure. If possible contain the spill. Place inert absorbent material onto spillage. Mop up material and place into the same container. If the spillage enters the waterways contact the Environmental Protection Authority, or your local Waste Management Authority.

7. HANDLING AND STORAGE

Precautions for Safe Handling

When dealing with this product, repeated or prolonged skin exposure without protection should be prevented in order to lessen the possibility of skin disorders. It is essential that all who come into contact with this material maintain high standards of personal hygiene ie. Washing hands prior to eating, drinking, smoking or using toilet facilities.

Conditions for Safe Storage

Store in a cool, dry well-ventilated area away from heat, sources of ignition, oxidising agents, foodstuffs, and clothing and out of direct sunlight. Keep containers closed when not in use and securely sealed and protected against physical damage. Inspect regularly for deficiencies such as damage or leaks.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

National Exposure Standards

Australian National Occupational Health And Safety Commission (NOHSC) Exposure Standards:

Substance	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³	NOTES
Ethylene glycol	20	52	40	104	Sk

Biological Limit Values

No Biological limit available.

Other Exposure Information

TWA - the Time-Weighted Average airborne concentration over an eight-hour working day, for a five-day working week over an entire working life.
STEL (Short Term Exposure Limit) - the average airborne concentration over a 15-minute period, which should not be exceeded at any time during a normal eight-hour workday.
'Sk' notice - absorption through the skin may be a significant source of exposure. The exposure standard is invalidated if such contact should occur.

Engineering Controls

Use with good general ventilation. If mists or vapours are produced local exhaust ventilation should be used.

Respiratory Protection

If mists are generated then use of an Air Purifying Respirator with an Organic Vapour filter complying with AS/NZS 1715 and AS/NZS 1716 is recommended.

Eye Protection

Where splashing is possible the use of chemical goggles or safety glasses with side shield protection is recommended. Eye protection should conform with Australian/New Zealand Standard AS/NZS 1337 - Eye Protectors for Industrial Applications.

Hand Protection

Impervious gloves recommended. Final choice of appropriate gloves will vary according to individual. Reference should be made to AS/NZS 2161 Occupational protective gloves- Selection, use and maintenance.

Body Protection

Where splashing is possible suitable work wear should be worn to protect personal clothing. Industrial clothing should conform to the specifications detailed in AS/NZS 2919: Industrial clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance

Red liquid.

Odour	Mild odour.
Melting Point	-36.5
Boiling Point	Not available.
Solubility in Water	>10%
Specific Gravity	1.07
pH Value	8-8.6
Vapour Pressure	Not available.
Vapour Density (Air=1)	Not available.
Viscosity	<20 cSt (40°C) 7 cSt (100°C)
Flash Point	Not applicable.
Auto-Ignition Temperature	Not applicable.
Flammable Limits - Lower	Not applicable.
Flammable Limits - Upper	Not applicable.

10. STABILITY AND REACTIVITY

Chemical Stability	Stable under normal conditions of use.
Conditions to Avoid	Extremes of temperature and direct sunlight.
Incompatible Materials	Strong oxidising agents.
Hazardous Decomposition Products	Aldehydes (Elevated temperatures), Ketones (Elevated temperatures).
Hazardous Polymerization	Will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicology Information	This product contains diethylene glycol (DEG). The estimated oral lethal dose is about 50 cc (1.6 oz) for an adult human. DEG has caused the following effects in laboratory animals: liver abnormalities, kidney damage and blood abnormalities. It has been suggested as a cause of the following effects in humans: liver abnormalities, kidney damage, lung damage and central nervous system damage. This product contains ethylene glycol (EG). The toxicity of EG via inhalation or skin contact is expected to be slight at room temperature. The estimated oral lethal dose is about 100 cc (3.3 oz.)

for an adult human. Ethylene glycol is oxidized to oxalic acid which results in the deposition of calcium oxalate crystals mainly in the brain and kidneys. Early signs and symptoms of EG poisoning may resemble those of alcohol intoxication. Later, the victim may experience nausea, vomiting, weakness, abdominal and muscle pain, difficulty in breathing and decreased urine output. When EG was heated above the boiling point of water, vapors formed which reportedly caused unconsciousness, increased lymphocyte count, and a rapid, jerky movement of the eyes in persons chronically exposed. When EG was administered orally to pregnant rats and mice, there was an increase in fetal deaths and birth defects. Some of these effects occurred at doses that had no toxic effects on the mothers. We are not aware of any reports that EG causes reproductive toxicity in human beings. 2-Ethylhexanoic acid (2-EXA) caused an increase in liver size and enzyme levels when repeatedly administered to rats via the diet. When administered to pregnant rats by gavage or in drinking water, 2-EXA caused teratogenicity (birth defects) and delayed postnatal development of the pups. Additionally, 2-EXA impaired female fertility in rats. Birth defects were seen in the offspring of mice who were administered sodium 2-ethylhexanoate via intraperitoneal injection during pregnancy.

Inhalation Inhalation of product vapours may cause irritation of the nose, throat and respiratory system.

Ingestion Harmful if swallowed. Ingestion of this product will irritate the gastric tract causing nausea and vomiting.

Skin May cause irritation in contact with skin. Symptoms may include redness and itchiness. Repeated or prolonged skin contact may lead to dermatitis.

Eye May cause irritation to eyes. Symptoms may include redness, tearing, stinging and blurred vision.

Chronic Effects Prolonged or repeated skin contact may cause defatting leading to dermatitis.

12. ECOLOGICAL INFORMATION

Ecotoxicity Not available.

Persistence / Degradability This product is expected to be biodegradable.

Mobility Not available.

Environment Protection Avoid contaminating waterways.

13. DISPOSAL CONSIDERATIONS

Disposal Considerations Dispose of according to relevant local, state and federal government regulations.

14. TRANSPORT INFORMATION

Transport Information Not classified as a Dangerous Good, according to the Australian Code for the Transport of Dangerous Goods by Road and Rail.

15. REGULATORY INFORMATION

Poisons Schedule S6

Hazard Category Harmful

AICS (Australia) All of the components in this product are listed on the Australian Inventory of Chemical Substances.
.

16. OTHER INFORMATION

Date of preparation or last revision of MSDS MSDS reviewed: September 2007.

Contact Person/Point CHEMICAL EMERGENCIES: 1 800 033 111
TECHNICAL ADVICE: 1300 364 169
Health & Safety Advisor
Tel: (02) 9250 5822 and (02) 9250 5734
PLEASE NOTE that although every care has been taken in compiling the above information, it is solely reliant upon data available to us at the date hereof. We believe the data to be correct, however for the reason just stated we are not in a position to warrant its accuracy. With that in mind and given that the full range of possibilities and conditions under which the information may be applied simply cannot be anticipated, YOU ARE CAUTIONED to make your own determinations as to the veracity and the suitability of the information to the particular circumstances that apply, or may apply, to you from time to time. Consistent with that approach it is recommended that where you have a particular purpose which would necessitate a reliance on information of the nature herein you obtain your own independent expert advice particularly structured to the relevant purpose. If this material is printed, circulated, distributed or copied in any manner, it is not to be modified without prior written permission, and further, it is to include the wording of the above disclaimer.

End of MSDS

Print Date: 25/07/2011 BS: 1.10.9

JOHN DEERE
4830

Dear Sir,

Re: Santos – Review of Environmental Factors Glasserton Pilot Wells – Drilling and Completions – PEL 1 Gunnedah Basin.

I draw your attention to a number of errors in the above Review of Environmental Factors (REF) for the establishment of a Pilot Production Development at the site known as Glasserton, some seven kilometres from Spring Ridge on the Liverpool Plains near Quirindi. The REF can be found at
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0003/368301/santos-review-env-factors-glasserton-pilot-wells-PEL1-gunnedah-basin.pdf

I am disappointed that Santos has applied and has been granted permission to proceed with the establishment of a Pilot Production site in this area. I am concerned that the DII has given permission for the project to proceed when the document has major errors such as wrong location, in the wrong catchment basin and other claims. The DII's response that authorisation to proceed was fine because a site visit was carried out is even more concerning as the accompanying photo appears to be have been taken on the other side of the ridge where existing work is already underway.

As yet the Namoi Water Study has not been completed and given the water intensive nature of pilot production it is arrogant and foolhardy of Santos to continue to work towards the development of a gas field on the prime agricultural land of the Liverpool Plains. Furthermore, current Liberal/National Party government has committed to a strategic land use policy which will preserve this type of agricultural land. Surely the shareholders of Santos would be justifiably outraged that the Board of Santos appears to be gambling on the assumption that this land will be exempted from a strategic land use policy as outlined by the incoming government?

We are concerned that Santos' failure to provide an accurate REF is indicative of future sloppy work practises which will be reflected in their drilling practises and will threaten the integrity of aquifers and the environment. We expect Santos to deliver on their much repeated promises of their company to adhere to work practises of the highest standing and their continued attempts to distance themselves from other gas companies. Furthermore, their promises to work with the community in a transparent and accountable manner are not in evidence in this particular REF which is clearly a cut and paste desktop submission with some serious errors. We ask that Santos resubmit this application with a great deal more care and attention to detail. This application should now fall under the regulations to be drafted for the coalition government's new strategic land use policy. I note that the original submission has now been removed from the website with three appendices left. This does not constitute enough information for a Notice of Determination and as such should be removed from the website. The following is my critique of the Review of Environmental Factors.

Critique of Reveiew of Environmental Factors : Gunnedah Basin Glasserton Pilot Drilling and Completion: PEL 1.

There are many misleading claims and statements made in the REF. It is a requirement that a Review of Environmental Factors (REF) be approved by the Department of Industry and Investment before drilling can commence in the PEL.

For the Glasserton site, Santos has lodged an application stating that they will be operating in and extracting from the Bluevale Subcatchment. The Bluevale subcatchment is located east of Gunnedah and Boggabri. The Glasserton project is located in the Yarraman/Goran Lake Basin south east of Gunnedah. This is a serious error and raises doubts about Santos credibility and professionalism.

The aquifers in this part of the Yarraman catchment are "fractured rock" aquifers. In recent years, irrigation farmers in Zone 7 have had their irrigation allocations reduced by up to 75%. Given the fractured nature of the basin and the amount of water extracted during pilot production, this activity would threaten the integrity of the aquifer and severly deplete the water table.

We are also concerned that the author of this REF would claim that the Pilliga Nature Reserve is located 50kms west of the Glasserton site.[1] The Pilliga Nature Reserve is located some 150kms to the north west of Glasserton and is not in PEL 1.

The REF does not mention the close proximity of Goran Lake which covers over 6000 acres to the north of Glasserton. It is a significant ephemeral wetland and supports a wide variety of rare, endangered and vulnerable species.[2] If "the Commonwealth EPBC Protected Matters database searchers were based on a 20 km radius around the proposed Glasserton 2 site"[3] Goran Lake would fall into this category and should have been considered in this proposal.

As a measure of transparency Santos should have revealed that the Landholder in question is a director of the company Carbon Minerals. Carbon Minerals is a subsidiary of Australia Coalbed Methane Australia P/L which holds leases over the Liverpool Plains. As the landowner resides in Sydney, I doubt that he will "experience the majority of potential social and economic impacts".

The wells know as Glasserton 3 and 4 are located on the boundary of the property. The location of these two wells will impact upon the neighbouring properties in a number of ways. Drilling into the fragile aquifer system will alter the pressures within the aquifer and may well divert water away from existing stock and domestic bores. Any construction on the fragile flood plain will impact upon the remainder of the floodplain. The establishment

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[1] Review of Environmental Factors: Gunnedah Basin Glasserton Pilot Drilling and Completion: PEL 1p45
[2] http://www.nrm.gov.au/nrm/nsw-namo.html
[3] Review of Environmental Factors: Gunnedah Basin Glasserton Pilot Drilling and Completion: PEL 1 p23

of a gravel pad, extra roads and sump ponds will create water diversions on the plain and will result in erosion and water run-off which will affect the seedbed of the neighbouring paddock and beyond. If sump ponds are not correctly constructed and there is run-off of the magnitude as seen in the recent period of heavy rain it is likely that the soil will be sterilized from the overflow from sump ponds. Floodplains have been in many cases exempted from mining in other areas such as the Hunter Valley. Given the fragility of the soils on this floodplain, this area should also be exempted from gas mining.

The location of the temporary workers' accommodation camp is also unsuitable. The homestead of the neighbouring property, Rowena, is extremely close to this accommodation camp. It barely scrapes into the 400 metres as claimed in the REF. Given the transient nature of the workforce associated with drilling and gas companies, Santos should provide the landholder with a "Code of Conduct" guide whereby workers are not allowed to leave the worksite, alcohol and other drugs prohibited and a strict adherence to the Code of Conduct enforced. It is also noted here that Santos, as with the Kahlua site, has failed to notify the Gunnedah Shire Council of the existence of this work camp. This is a requirement for Local Environmental Plans administered by the Gunnedah Shire. I would like Santos to provide written confirmation from Gunnedah Shire that Santos has approached the Gunnedah Shire and received permission.[4]

As of 5th April, the immediate neighbours have not been notified of Santos activities. There has not been direct consultation with these neighbours. Our information has been extracted from DII website.

The claims in the executive summary have not been substantiated.

+ Santos claim that "*impacts on landholders will be negligible*." [5] Yet the closest neighbours to this multiple well drilling site have not been notified of Santos proposed activities. Given the location of the homestead, they are subjected to increased dust and noise from construction, drilling and vehicle movement, night time lights and 24 hour activity. It would be expected that Santos provide air and dust monitoring date during the operation.

+ *Impacts to air quality will negligible, localised and insignificant*.[6] Santos should provide estimated amounts of diesel used to power the drill rigs and the resulting greenhouse gas emissions before making such a claim. Santos have neglected to mention fugitive emissions which are common in all drilling operations at such depths.

+ *Adverse effects on water resources will be negligible.* This is simply an unknown. The aquifers in this are part of a "fractured basin." Fractured basins allow for water seepage in a vertical manner. The extraction from the aquifer will result in changes in pressure in the

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[4] Review of Environmental Factors: Gunnedah Basin Glasserton Pilot Drilling and Completion: PEL 1 p18
[5] Review of Environmental Factors: Gunnedah Basin Glasserton Pilot Drilling and Completion: PEL 1 p5
[6] Review of Environmental Factors: Gunnedah Basin Glasserton Pilot Drilling and Completion: PEL 1 p5

strata and a drawdown on potable water supplies. Being essentially unstable, drilling at depths in this region give ample opportunity for the escape of water, methane and other gases into the surrounding area. This will lead to the contamination of existing potable water supplies. This may result in serious impacts upon the water quality through contamination of introduced chemicals via drilling muds and cross-aquifer contamination. Estimations of quantities of drilling muds are believed to be around 30,000 litres[7] will be used, and as stated to me in a Santos consultation at Spring Ridge in 2009, between 0% and 100% of these fluids will not be recovered.

+ *There will be no significant use of, or impact, natural resources including groundwater*. As discussed previously. Significant amounts of fresh potable water are also required for the drilling process. Santos has not given a clear indication where this water will be sourced.

+ *There will be no significant cumulative environmental impacts* is yet another claim which is an unknown. Dust, noise, erosion and damaged aquifers leading to the escape of groundwater **are** significant environmental impacts for any farmer.

Under the Water Act 1912 Santos states clearly that "Santos must take all precautions against intersecting an aquifer and will obtain Water Bore Licenses." [8] It would be expected that Santos would provide copies of the relevant licenses.

Santos claims to have carried out extensive community consultation. As a veteran of Santos community consultation I am yet to leave without feeling confused by the conflicting information given out by various members of staff. A recent round of consultations called "Guided Conversations" has left me in no doubt that affected landholders and community members are told very little and the manner in which it is delivered does not help with the distribution of information. Community consultations are poorly attended – the last one in February had three people in attendance – one attendee then left very early in the consultation. The people of this area are frustrated by a lack of information and the failure of Santos to disclose any long term plans for this region.

Furthermore, I ask Santos to supply times and dates where our local Federal and State politicians have been briefed on the Glasserton development. I have contacted Tony Windsor, Federal Minister and ex-Independent Peter Draper.[9] Both deny being contacted by Santos in relation to this site.

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[9] Telephone conversations with both men prior to Easter.

The REF states that it will consult with the local Aboriginal Land Council. This area has been the hunting grounds of the Kamilaroi trible. Their involvement with the Red Chief Land Council has been minimal.

Drilling fluids. It is impossible to retrieve **all** the drilling fluids. As freely admitted at a Santos "consultation meeting" recovery of drilling fluids ranges from 0% to 100%. Although MSDS sheets were provided by Santos, we note it is recommended that disposal of fluids "be buried in a land-fill specifically licensed to accept chemical and/or pharmaceutical wastes or incineration in a licensed apparatus". Some carry warnings to prevent spillage into drains, sewers or water courses. Most of the chemicals contain warnings of avoiding contact with hands or eyes or breathing in these chemicals. The type of cement used contains compounds regarded as carcinogenic to humans. Yet these chemicals are being used for drilling into aquifers which are used for not only irrigation but stock and domestic consumption. This is an opportunity for these chemicals to be absorbed into the food chain. Santos has not supplied even estimations of quantities used or indeed well depths.

Throughout the REF there is constant reference to the activities being "temporary" and impacts will be insignificant. However, it is extremely unusual for a pilot production site not to develop into a gasfield. Therefore, the surrounding landowners see this particular Santos activity as being the beginning of long term industrial activity on the Liverpool Plains.

We ask that the former Department of Industry and Investment insist that Santos resubmit this erroneous document with a correct and accurate assessment of environmental factors.

Yours sincerely

Rosemary Nankivell

Chairperson of Coal Seam Gas Committee

Caroona Coal Action Group

ENVIRONMENTAL HAZARDS OF OIL AND GAS EXPLORATION

CONTENTS

Prepared for:
National Parks Association of NSW Inc.
Sydney

C. M. ATKINSON August 2002

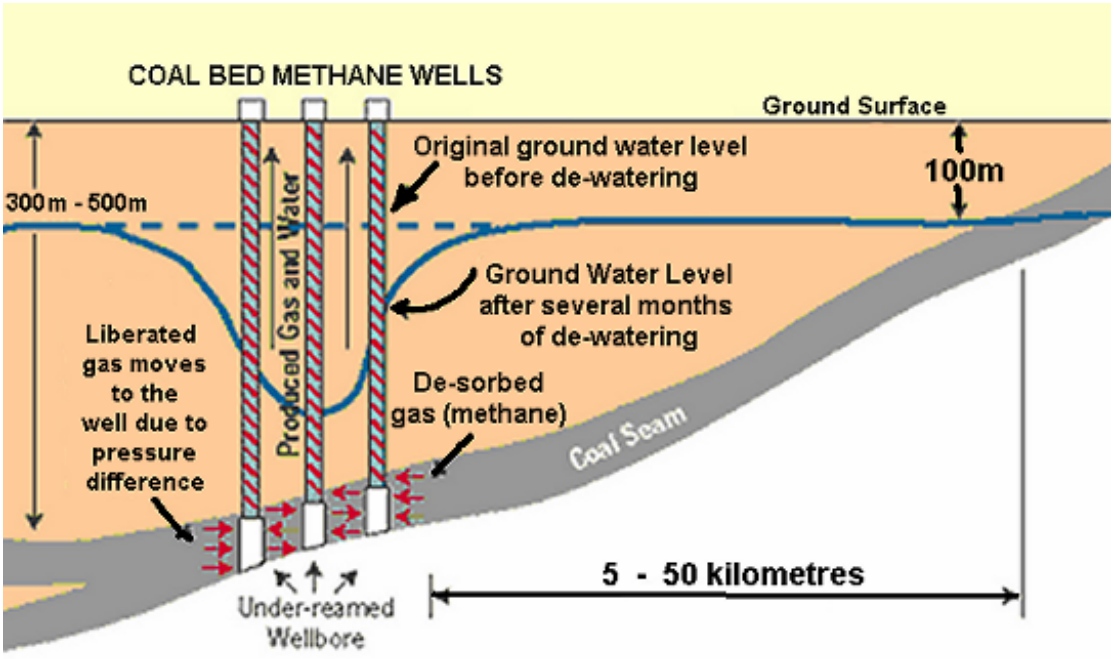
1. PETROLEUM FORMATION AND COAL SEAM METHANE

A complex mixture of oil, gases and coal are produced when of peat and/or other organic material are compacted and heated by burial over geological time. During this process, methane and more complex hydrocarbons are successively produced. The proportions and type of oil and gas depend on the original type of plant material as well as temperature. Conventional oil and gas fields form when these hydrocarbons migrate into porous rocks and are stored in the spaces between the grains of these reservoir rocks. To keep these mobile gases (and liquids) trapped in place, structural or stratigraphic traps have to be present. The commonest traps are impermeable rocks which prevent migration of the gas either upwards, or sideways.

> The term **Petroleum** includes:
> [Crude] Oil -*the liquid fraction*
> and
> Gas/ Natural Gas, (*mostly methane*), including Coal Seam Methane (CSM) / Coal Bed Methane (CBM) –*methane trapped within coal seams*

This coalification process generates methane-rich gas, large quantities of which normally remain within the coal. This 'coal seam methane' gas has been the main cause of disastrous explosions and outbursts in underground coal mines. Coal has only recently been recognized as a storage or reservoir rock for natural gas as well as a generator or 'source rock.'

Coal seam Methane (CSM) is actually soaked up by coal grain faces or micropores, and held there by the pressure of water also present in the seam. Methane is also stored in fractures and cleats. The coal seam therefore acts as the source, reservoir and seal for this type of gas deposit. Coal can potentially hold as much as six to seven times more methane per unit of volume than most conventional reservoir rocks. The methane stored can be released by removing most of the water (de-watering) causing a pressure drop which releases the methane from the coal seam. This dewatering is carried out during test pumping and during early stages of production.



Typical Coal Bed Methane De-watering Well Layout

from Queensland Gas Co Ltd (www.qgc.com.au)

2. PETROLEUM AND MINERAL EXPLORATION

There are substantial differences between the methods used to explore for petroleum and to explore for minerals. The two activities are also covered by separate government legislation.

Mineral exploration initially has a low impact on the landscape. It involves sample collection, and surveys are limited to small areas and relatively shallow drilling. If the mineral exploration continues, the scale and cost gradually increase. The main cost and environmental disturbance only comes during the development and mining phase, for which a formal environmental impact statement is obligatory.

The first on-site activity in on-shore petroleum exploration usually involves one or more seismic surveys followed by deep drilling. By the time any oil or gas field is discovered and a development/production permit is applied for, most of the environmentally damaging work has been carried out: without any formal impact statement.

Each seismic survey line is usually several kilometres in length, and in a single survey programme it is not unusual for the total length of survey lines to exceed 50 kilometres. These survey lines must be cleared to allow the passage of very large all-terrain trucks, and there are no effective rules to prohibit surveys during any wildlife breeding season. The identification and preservation of rare plants or critical plant communities are the exception, not the rule, and there are no subsequent independent and transparent flora or flora surveys to check on the damage to the environment. Drilling for oil or gas often involves the wholesale clearing and soil removal over an area of at least one hectare, with no external audit of the existing flora and fauna, and no community input. Testing of coal seam methane targets involves the removal of very large quantities of groundwater, which in most coal seams is highly mineralised.

3. COAL SEAM METHANE EXPLORATION

Since about 1980 a new type of gas resource has been developed in the USA, called ‘coal seam methane’ (CSM) or ‘coal bed methane’. As a consequence, production of natural gas and water from coal seams has risen dramatically in the U.S.A and this methane now accounts for about 6% of the total annual production. The Powder River Basin in Wyoming and Montana has been one of the most active areas since 1997. In March 1997 there were 270 gas producing wells; by March 2000 there were 2,469 (Rice *et al*. 2000).

The techniques used are similar to those used for more traditional or ‘conventional’ oil and gas exploration, but there are also a number of new features, some of which are potentially extremely harmful to the environment. Instead of the relatively few drillsites needed for tradtional oil and gas exploratiuon, CSM exploration characteristically needs numerous, separate sites. Operationg CSM fields in the USA may have several dozen drillsites each linked by roads and pipelines. Experimental testing of CSM drill holes for strong and consistent gas flows may extend over half a year, with the removal and disposal of groundwater during the early stages. This type of exploration began in Australia in the early 1990s and companies are still experimenting with different techniques to suite local conditions. Discoveries have been made in New South Wales and Queensland, and exploration is also taking place in Victoria.

4. ENVIRONMENTAL HAZARDS

Some of the environmental hazards that are associated with this evolving petroleum industry sector include the following:

Physical damage – drill site clearance; damage by survey line clearing
Groundwater loss
Groundwater contamination
Waste water, or ‘produced water’ – surface contamination by dissolved mineral salts or organic compounds;

Other hazards encountered overseas, mainly in the USA, include gas seepages near drill holes and the drying up of natural springs.

4.1 Physical damage

Seismic surveys are carried out before drilling to provide a three dimensional model of the rock structures underground. These survey lines may extend many tens of kilometres in a single year, and the total seismic coverage after a few years exploration is often over 100 kilometres. These survey lines must be cleared wide enough to allow the passage of very large all-terrain trucks. The use of numerous drill-holes and explosive charges to generate shock waves has largely been replaced by powerful 'thumper' equipment. Unlike the situation in the USA, there appears to be no effective regulations in NSW to require adequate and independent biodiversity surveys and no rules to prohibit seismic surveys during any wildlife breeding season.

A recent example of poorly executed surveys are the Pilliga East and Pilliga East Extension seismic surveys carried out for Eastern Star Gas Limited in Petroleum Exploration Licence 238 (PEL 238) in the East Pilliga State Forest south west of Narrabri. The Company announced to the Australian Stock Exchange on 3 April 2002 that the Pilliga East survey had been completed on 23rd March, and consisted of eight survey lines totalling 39.38 line-kilometres. At least part of this survey was described as "off-road". The announcement also stated that detailed cultural heritage, floral and faunal field studies had been completed. The extension survey, to the south-west, was completed by 3 May, and consisted of four new lines totalling 56.1 kilometres. A field inspection of the area (Yarraman Road west of the Newell Highway) by members of the local community on 4 July 2002 discovered an 800m section of survey line, about five metres wide, cut straight across an area of heathland vegetation locally known as 'broombush plains'. Detailed research has shown that this vegetation is the prime habitat for the rare and listed Pilliga Mouse (*Pseudomys pilligaensis*). An initial impact study should have identified this habitat and the survey line should have deviated to avoid the area. The community inspection found no indications of any attempt to minimise the impact or rehabilitate the swathe of bulldozed vegetation.

Drill sites

"The biggest disturbance associated with the development of a coal bed methane field is caused by the drilling of wells" (Clarke 1996).

Although drill sites for coal seam methane are not substantial by oil industry standards, they involve the total clearing and bulldozing of at least one hectare in size. Recent NSW examples indicate that no flora fauna or land stability surveys need to be carried out beforehand.

Several years after they have been abandoned, some of these drilling areas remain un-rehabilitated scars on the landscape – eg northern Pilliga Forests south west of Narrabri. Some six drill sites in the Bohena area and three additional sites elsewhere in the Pilliga East State Forest were cleared of all sub-soil and vegetation between June 1998 and mid-2000. Each site is at least one hectare in size and many still contain a large 'mud-pit' or dam to hold waste water and chemicals from the drilling operations. Even the earliest of these sites, which is over four years old has not been rehabilitated, the pits still contain coloured liquids, and there is no sign of any substantial vegetation regrowth. Most of these sites have been declared by the operating company to be abandoned. These sites were excavated and used by subsidiaries of Gastar Exploration Ltd of Michigan USA, either First Sourcenergy Group Inc or the associated Forcenergy Australia Pty Ltd. These companies hold the rights to any coal seam methane within PEL 238.

4.2 Groundwater Problems

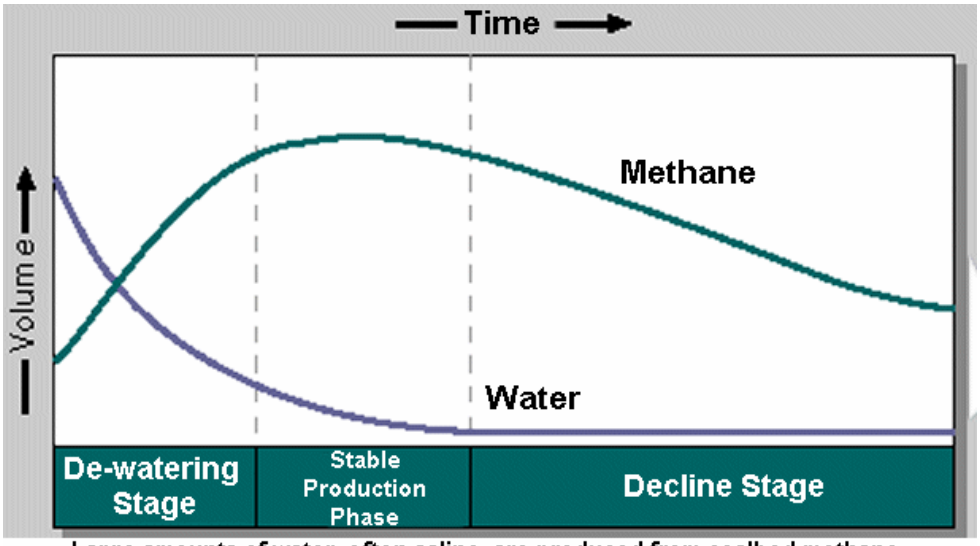
The disposal of co-produced water has proved to be the biggest environmental problem associated with exploitation of coal seam methane fields in the USA, although the quantity and quality of the water can vary enormously between coal basins. Stricter environmental regulations are making direct disposal options increasingly difficult. Sometimes extensive water treatment is necessary before discharge is permitted." (Clarke, 1996)

In Australia, the water produced with hydrocarbon resources is often unsuitable for most domestic or agricultural purposes because of its high salinity. The presence of toxic or radioactive compounds has been largely ignored and unlike most European countries and the USA, tests for these substances do not appear to be routinely carried out in Australia. Total salinities range from about 1,000 milligrams per liter (mg/L; 1,000 milligrams equals 1 gram) to more than 400,000 mg/L. For comparison, the salinity of sea water is 35,000 mg/L and the U.S. EPA's recommended safe drinking-water limit is 500 mg/L **(**USGS Fact Sheet FS-003-97).

4.2.1 Groundwater Levels

In traditional or conventional petroleum wells, the oil or gas is produced over the life of the well, without much water. As soon as the oil or gas well starts to produce water it indicates that the main production period is over. By contrast, in coal seam methane wells the area around the well/drillhole is first drained of groundwater at the underground gas level. Only when the underground pressure is reduced, by removing the groundwater, will any significant amount of gas be produced. Once a number of gas wells have been dewatered and tested a decision may be made to produce gas on a commercial basis. At this time a production lease may be applied for and an environmental impact statement prepared. Large amounts of water are removed from the underground aquifers over the life of the gas field, mainly from the coal seams themselves. **This may lower the water table on a regional scale, and appropriate disposal methods must also be found for this groundwater**. The lowering of the water table, the possibly mixing of previously separate groundwater systems and the disposal of unwanted groundwater all begin within the exploration phase and under an exploration tenement – in New South Wales this is a Petroleum Exploration Licence or PEL.

In 2000 and 2001 the U.S. Government released a series of reports on the side effects of coal seam methane in the Powder River Basin (Rice 2000, Flores 2001). These dealt with the groundwater hazards, both the pollution by mineral-rich groundwater and the pollution of formerly clean groundwater by drilling and pumping activities. By far the most startling revelation is the prediction that within a decade or so, the groundwater level will plummet by 150 m (500 feet) below the current level.



Large amounts of water, often saline, are produced from coalbed methane wells, especially in the early stages.

In New South Wales, coal seam methane production has not been operating long enough to identify any similar changes to groundwater levels caused by dewatering coal seam methane drillholes. However, in the petroleum producing Cooper Basin in South Australia long term petroleum production has produced disturbing results. The producing horizons are very similar to the target horizons in the Pilliga region, that is, coal-bearing rocks of Permian age. In both areas this sequence is overlain by rocks of the Surat Basin, eg the Pilliga sandstones in the Pilliga region. Traditional theories have emphasised the separate nature of the older and younger rocks and also emphasised that lowering or interfering in any way with the deeper Permian aquifers would have absolutely no effect on shallower groundwater resources used widely by agriculture. The results from the Cooper Basin however show that previously unknown and unsuspected faults are acting as conduits allowing water to drain from the upper aquifers of the Artesian Basin into the previously separate lower, Permian layers.

Recent research at the Australian National University has shown that the underground water system of the Great Artesian Basin is still poorly understood. The Pilliga forests and areas to the south have long been regarded as very important recharge areas for the whole Basin. Rainwater falling in this area was thought to spread westwards underground and feed much of the Basin. Recent research (eg Lee 2001) has found that current recharge rates appear optimistic and current usage may be unsustainable. The area studied included the Bogan, Macquarie and Castlereagh Rivers catchments. The research indicated that the Great Artesian Basin was not a single connected unit, but appeared to be a series of almost separate groundwater systems.

Pollution of or lowering of the water table under this model would have a very severe effect over the surrounding district, rather than a smaller effect over the total basin.

4.2.2 Surface Pollution - Produced Water

'Produced water' includes all water produced by drilling, including ground water (or 'formation water') and water introduced by the drilling or testing operations The main type of pollution hazard associated with water produced during the extraction of coal seam methane is the high concentration of dissolved salts. Other possible pollutants include crude oil released by coal-bearing strata into the water in some coalfields. Experience in the USA has shown that it may take from two weeks to six months to completely dewater the area around one drill hole or well, and require the disposal of up to 350m^3/day of water. In contrast to traditional natural gas wells, water production tends to decline through the gas production period. However, water extraction usually does continue throughout the lifetime of the well and it is often necessary to dispose of significant quantities of co-produced water.

More water is produced in coal seam methane extraction than in traditional natural gas extraction. For example, coal seam methane contributes <2% of the total gas production in the USA but almost 13% of the water produced (10 million cubic metres per annum for coal seam methane wells). On average, for wells in the USA conventional (ie not associated with coal seam methane resources) natural gas yields about 0.13 cubic cm of water per cubic metre of gas, whereas coal seam methane produces about 1.74 cubic cm. This is about 13½ times as much water per unit volume of gas produced.

The concentration of total dissolved solids (TDS) ranges in coal seam methane produced waters from 500 mg/l to 27,000 mg/l in the eastern USA and 200-4,000 mg/l in the western USA.

Representative compositions of produced water associated with coal seam methane

Major components *mg/l*		**Trace elements & hydrocarbons** *µg/l*	
Total dissolved solids	4,000	silver (Ag)	1.1
		aluminium (Al)	40
chloride (Cl^-)	2,000	barium (Ba)	2,780
sulphate (SO_4^{2-})	12.9	cadmium (Cd)	5
bicarbonate (HCO_3^-)	597	chromium (Cr)	3
carbonate (CO_3^{2-})	0.008	copper (Cu)	5.6
fluoride (F^-)	2.6	mercury (Hg)	0.13
nitrate (NO_3^-)	3.0	lithium (Li)	92
iron (Fe)	10	manganese (Mn)	250
calcium (Ca)	89	nickel (Ni)	29
sodium (Na)	1,906	lead (Pb)	55
potassium (K)	7.5	antimony (Sb)	30
		selenium (Se)	25
pH	7.8	strontium (Sr)	4,000
		vanadium (V)	5
		zinc (Zn)	109
		total hydrocarbons	210

SALINITY AND SODIC SOILS

Salinity is a measure of the total concentration of all water-soluble salts in water and soil. Two important properties of salt affected soils are: (1) the quantity of soluble salts in the soil, and (2) the exchangeable-sodium percentage. On the basis of these values, the soil can be classed as:-

saline, which denotes excess soluble salts;
s**odic**, a term indicating that excess exchangeable sodium is found in the soil, and,
saline-sodic, which recognizes the presence of both conditions.

In Australia, sodic soils cover about 30% of agricultural land, or five times greater than the area of saline soil.

Sodium carbonate is a very common salt in groundwater in the eastern part of the Great Artesian Basin, and in rocks below the basin. Sodium carbonate has been used traditionally as washing soda, because it has the effect of loosening 'dirt' (by dispersing the clay particles) and removing or partially dissolving organic stains. When sodium carbonate builds up in soil, the same reactions take place. The clay particles dis-aggregate

forming either a slurry, when wet, or a hard impervious layer, when dry. Organic material is dissolved out of the soil helping to destroy the texture, making it a barren material for soil organisms. This dissolved vegetable remains in a soluble state and will re-dissolve whenever ther is enough moisture. The brief description below presents some aspects of the chemistry involved.

If carbonate is an important fraction of the accumulating salts, calcium and magnesium will be in low concentration because of their tendency to precipitate as very slightly soluble carbonates. Calcium carbonate solubility decreases with rising temperature, so precipitate build-up during summer may accelerate due to increased temperatures as well as increased evaporation. Similar to sodium increase, carbonate build-up in the soil can reduce hydraulic conductivity and decrease the downward movement of water.

Excess exchangeable sodium is harmful to plants principally because it produces undesirable physical and chemical conditions in soils. One result is the dispersion of clay, which lowers the permeability of the soil to air and water. Dispersion also results in the formation of dense, impenetrable surface crusts that greatly hinder the emergence of seedlings. Sodic soils low in neutral salts often have a pH as high as 10. **The high pH of sodic soils causes soil organic matter to dissolve. If the dissolved organic matter is carried upward by the capillary rise of water, it may be deposited as a dark incrustation on the surface of the soil.** When present, a dark-coloured surface film is usually indicative of a sodic-soil condition.

Salts such as calcium carbonate and calcium sulphate flocculate colloidal matter in soils. Saline-sodic soils therefore tend to appear deceptively in a better physical state than do non-saline-sodic soils. Under some circumstances, the pH of saline-sodic soils is no higher than 8.5 However, although neutral salts improve the physical state and lower the pH of sodic soils, they do not improve overall conditions for plant growth. If the salts are removed, as by leaching or precipitation, the characteristics associated with dispersed clay and a high pH quickly reappear.

BOHENA

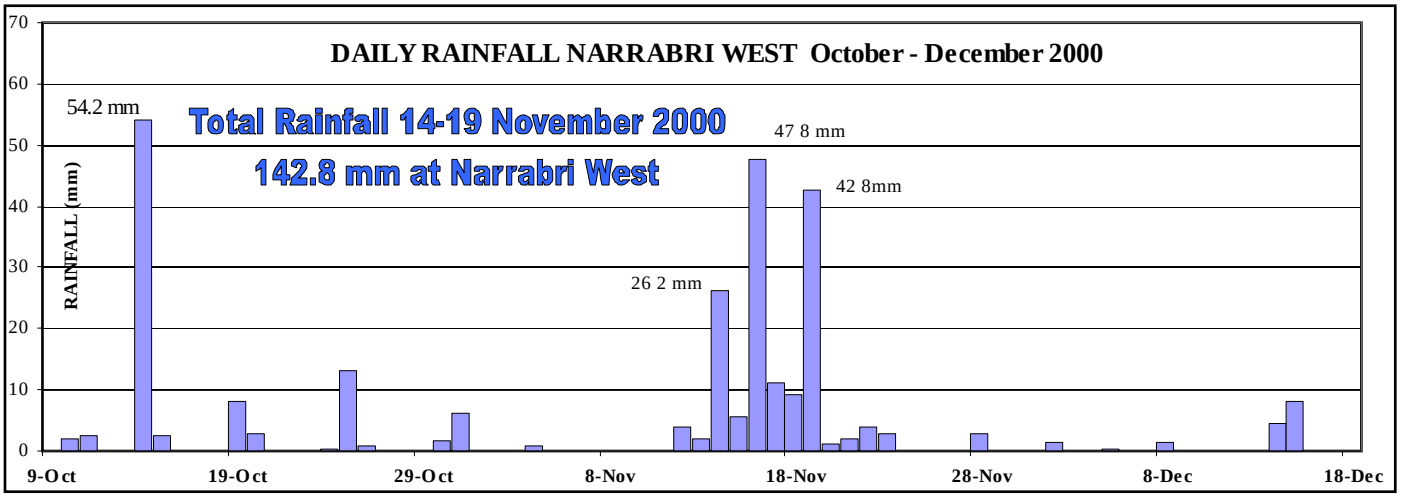
The Bohena No.2 drillsite in the northern Pilliga forest is an extreme case of sodic soil pollution as the direct result of careless exploration practices. Similar effects can also be seen at two other sites in the Bohena area. The Bohena gas prospect, sometimes known as the “Narrabri Gas Field”, is near the junction of the Newell Highway and the Pilliga Forest Way, approximately 30 kilometres south west of Narrabri in the Pilliga East State Forest

The Bohena No.2 well (total depth 908 m) was completed in June 1998, and Bohena 2D, on the same one hectare site, was completed in September 1998. A barbed wire fence now encloses an area of about 80 metres by 90 metres containing the boreholes Bohena 2 and 2D, and the holding dam. This dam was built to contain the ground water pumped from underground, mainly from coal seams. It originally had a spillway in the northeastern corner to drain off excess soda-rich water in to the surrounding forest which is in the catchment of Bohena Creek, a tributary of the Namoi River. Testing of gas-bearing sandstones and coals intersected by these wells continued into 2000. Portions of the settling dam wall collapsed and a very saline/sodic fluid poured in to the forest at the southern edge of the site. This collapse probably followed a heavy storm in November 2000.. The debris from the dam wall break of late 2000 can be clearly seen south of the fence line. Pale coloured silt covers an area about 30m wide and 40m fanning out southwards from the repaired and enlarged dam wall.

The collapse of the retaining dam wall was a separate event from the extensive leakage from the dam (excavated in sandy soil) which resulted in the spread of sodic/saline liquid through the subsoil and shallow aquifers. At least as early as February 2001, trees adjacent to the site began to show signs of dieback, with dead and discoloured leaves. Slight depressions in the forest floor were filled with a black treacle-like liquid. Water in the retaining dam and the black sludge were sampled by the NSW Environmental Protection Agency in April 2001. Limited analyses showed the black sludge contained high levels of tannin. The sodium level in dam water samples was 3,700 mg/litre, or one third to one quarter that of sea water.

The repaired dam wall remained intact but the area of dying vegetation continued to expand at this site. In addition, trees began to die at two other sites (No.4 and No.3) up to a kilometre away where the saline water from No.2 site had been diverted to through a polythene pipe. By November 2001 the pollution front at No.2site could be traced eastwards over distance of 250m and a maximum width of 100 metres. South east of the drill site most trees appeared lifeless, although a small amount of re-sprouting was visible for a short time on some of the larger trees. A lobe of dead vegetation extends northeastwards across a track for 100 metres.

Except for an area immediately below the break in the original dam wall, the surface litter in the present dead zone shows no sign of disturbance by a flood from the dam. It is probable that the current poisoning is being caused by percolating soda-rich fluids in the subsoil or shallow aquifers accessible to the tree and shrub roots. Several long pools of thick black oily liquid persisted for many months on the dirt track about 100m northeast of the drill site. There is no evidence that this fluid had been washed across the surface, and these pools represent liquids from the sodic subsoil saturated with soluble tannins. When these pools dry out a white soda crust develops above the black crust. Sodic soils typically become impermeable due to the effect of sodium on the clay fraction in the soil.



Clean-up work in late 2001 consisted of erecting a new barbed-wire fence around the site, surveying a grid in the affected area, spreading lump gypsum in one area of dead vegetation, and enquiries for grass seed in the local town of Narrabri.

By July 2002, the trees again were leafless, and water levels in the dam had fallen, leaving a thick white crust.

The limited chemical analyses, the persistence of black tannin rich fluids emerging from the sub-soil and the death of normally resistant Casuarinas, all point to a chronic case of sodic soil poisoning, worse than cases described from methane gas fields in the Powder River Basin USA (see website URL: http://www.powderriverbasin.org/). The full extent of the sub-surface pollution, and the final areal extent of the damage is impossible to determine without a series of shallow boreholes to monitor the sub-surface conditions and without expert supervision. In addition, there is no evidence of soil testing, either before work commenced or after the pollution began. The Bohena area is now known to lie within an area where the rare and protected black striped wallaby occurs. No fauna or flora surveys appear to have been carried out.

ORGANIC CHEMICALS

The methane targeted by coal seam methane projects has been formed during the maturation or 'coalification' of plant material over very long periods of time. This methane is thus produced as part of the same process that produces liquid hydrocarbons, and traces of hydrocarbon chemicals are usually present in the associated groundwater. Indeed, these traces are sometimes used in the hunt for oil fields.

Earlier this year (2002) it was announced (eg Sydney Morning Herald 23 March 2002) that the British Government was drawing up legislation to totally ban the surface disposal of water produced during oil and gas production, so-called 'production water'. Other European Governments were also considering similar measures, and Norway will ban the discharge of produced water by 2005. **The reason for this was the discovery that some aromatic hydrocarbons present in produced water from oil and gas wells had a devastating effect on the reproductive capacity of animals, in this case North Sea Cod.** This group of chemicals – *alkylphenols* (Meier et al. 2001) were previously not suspected of causing serious effects at very low concentrations, although at high concentrations they were known to have oestrogenic (feminising) effects on mammals, including humans, as well as several fish species. Tests have shown that even at the lowest level of detection – 0.02 parts per million, the effects could still be detected. Various other similar chemicals,

known collectively as polycyclic aromatic hydrocarbons, or PAH, have been shown to be carcenogenic and affect the immune response.

Unfortunately all the 'produced water' that has been disposed of from coal seam methane operations in New South Wales to date has been regarded merely as moderately salty water. No thorough analyses appear to have been carried out on this water. In the Pilliga it has been allowed to soak into the sub-soil, with severe effects on vegetation, while near Camden it has either been used to spray the local dirt roads, or diluted and sprayed on grazing land. All of this has taken place under exploration licences, not production licences.

5. OIL COMPANY DETAILS

EASTERN STAR GAS LIMITED

Directors

Dr. Wynford Davies	*Non-Executive Chairman*	*Mr. Dennis Morton*	*Managing Director*
Dr. David King	*Executive Director*	*Mr. Patrick Elliott*	*Non-Executive Director*
Mr. Douglas Battersby	*Non-Executive Director*		

Company Secretary *Dr. David King*
Registered Office *Level 8, 124 Phillip Street SYDNEY NSW 2000*
Tel: (02) 9232 6550 Fax: (02) 9232 6880
Email: office@easternstar.com.au *Website: www.easternstar.com.au*

For further information contact:
Mr Dennis Morton *Managing Director* Tel: (02) 9232 6550
Dr David King *Executive Director* Tel: (02) 9232 6550

The Wilga Park-1, exploration well drilled in 1986 near Narrabri by Hartogen subsidiary Consolidated Petroleum, alerted the three foundation Eastern Star directors (Dennis Morton, David King and Doug Battersby — all then members of the Hartogen team) to the region's potential. These three formed a private syndicate to continue work in the PEL 238 permit, drilling Coonarah-1 in 1993. Eastern Star Gas was formed and subsequently listed on the Australian Stock Exchange in February 2001, with a portfolio that included a farm in arrangement to PEL 238. Since then Eastern Star Gas has earned a 20% interest in the permit by drilling three successful appraisal wells at Coonarah and recompleting a fourth. Eastern Star Gas is planning to acquire a 100% interest in PEL 238 subject to shareholder approval.
(from -*A star begins to rise in the east* By Rick Wilkinson, Oil & Gas Today an online publication of Media Dynamics Pty Ltd)

Gastar Exploration, Ltd.

Address: Gastar Exploration Ltd., 133 Kendall Street Point Edward, Ontario N7V 1G6
U.S. Address: 2274 Enterprise Drive, Suite 101 Mt. Pleasant, Michigan 48858
Phone: 517-773-7050 **Fax:** 517-773-0006
E mail: jparrott@gastar.com or vhughes@gastar.com Web Site: www.gastar.com

AUSTRALIA:- First Sourcenergy Group Inc. Culgoora Road Narrabri NSW 2390
Ph 02-6792 3400; Fax 02-6792 3418; Operations Manager 0428 944 884; Field Superintendent 0427 923 400; Administrative Controller 0428 935 225; email:..fsg@firstsourcenergy.cm.au

President, Thom Robinson; Directors - John Anthony Iannozzi, John William Parrott, Richard Kadasinski
Geostar Corporation a private company of which John Parrott holds a 22% interest, is the controlling shareholder of Gastar, and the wholly owned subsidiary **First Sourcenergy Group Inc**.. Gastar Exploration Ltd is listed in Canada.

> "Gastar's dedication to a healthy, symbiotic relationship with the environment and the landowners influences our every decision. We welcome your comments and will be happy to address any additional concerns that you may have. Please email us at info@gastar.com for more information regarding this important topic."

6. SELECTED REFERENCES

Clarke L. B., 1996. Environmental aspects of coal seam methane extraction, with emphasis on water treatment and disposal; *Transactions Institute of Mining & Metallurgy:* A105-A113: May – August 1996

Flores R. M. 2001. Impacts and Issues of COAL SEAM METHANE Development. IN Flores R. M. & six others. A Field Conference on Impacts of Coal seam Methane Development in the Powder River Basin, Wyoming. *US Geological Survey Open File Report 01-126*; US Department of the Interior. (downloaded from http://greenwood.cr.usgs.gov/energy/OF01-126)

Lee, J. Water usage needs urgent review. *ANU Reporter* 32 No.3 16 March 2001 from; [http//www.anu.edu.au/reporter]

Meier, S. T.E.Anderson, L. Hasselberg, O. S. Kjesbu, J. Klungsøyr and A. Svardal, 2001. Hormonal effects of C_4 – C_7 alkylphenols on cod (*Gadus morhua*). From Institute of Marine Research, Bergen, Norway, website.

Rice, C. A., M. S. Ellis, and J. H. Bullock Jr., 2000. Water co-produced with coal seam methane in the Powder River Basin, Wyoming: preliminary compositional data. *US Geological Survey Open File Report 00-372*; US Department of the Interior.

Swartz E., 2001. Testimony Submitted on 4 September 2001 to the Committee on Resources Subcommittee on Energy & Mineral Resources, Washington DC (downloaded from http://www.powderriverbasin.org)

USGS 1997. Coal seam Methane- an Untapped Energy Resource and an Environmental Concern. US Geological Survey Fact Sheet FS-019-97; U.S. Department of the Interior. [downloaded from http://energy.usgs.government/factsheets/Coal seam/coalmeth.html]

USGS October 2000. Coal-Bed Methane: Potential and Concerns. US Geological Survey Fact Sheet FS-123-00; U.S. Department of the Interior.

Web sites for data on sodic soils:

Powder River Basin Resource Council 23 N. Scott Sheridan, Wyoming 82801
E-mail: resources@powderriverbasin.org Web Site URL: http://www.powderriverbasin.org/

Dr P.Rengasamy - **National audits of soil sodicity.**.at:-National Land & Water resources Audit:
http://www.nlwra.gov.au/minimal/30_themes_and_projects/50_scoping_projects/04_methods_papers/26_Rengasamy/Sodicity.html

Seelig, B. D. & J. L. Richardson. Salinity and Sodicity in North Dakota SOILS EXTENSION BULLETIN @ NDSU EXTENSION SERVICE North Dakota State University, Fargo, ND 58105
http://hermes.ecn.purdue.edu:8001/water_quality/formatted/eb-571.nd.ascii

Salinity @ http://www.waite.adelaide.edu.au/school/Soil/salinity.html

Frost, F & G. Orr, 1990. Identifying gypsum-responsive soils**.** Department of Agriculture - Western Australia Farmnote 57/1990 download from: http://www.agric.wa.gov.au/agency/pubns/farmnote/1990/f05790.htm

Sodicity – a dirty word in Australia download from Australian Academy of Science:
http://www.science.org.au/nova/035/035key.htm ; *This contains a good list of publications and web pages as well as activities and field tests.*

Mr David Quince

Title of Referral: Eastern Star Gas Limited/Energy Generation and supply (non-renewable)/Pipeline extends 285-294 km between Wellington and Narrabri/NSW/Narrabri to Wellington gas transmission pipeline.

Date Received: 11 April 2011 Reference Number: 2011/5913.

1. This proposal will necessitate the clearing and subsequent destruction of approximately 560 hectares or 1,383 acres of the Liverpool Slopes and Plains. This is some of the most sought after farming and grazing country in Australia if not the world. This region has unique characteristics. It is believed to be an area that will be least effected by climate change and possess soils rated amongst the top five most fertile areas in the world.
2. The clearing of this land will directly affect three critically endangered species. They are the Box Gum Grassy Woodlands, Weeping Myall Woodlands and Native Grasslands – all protected under the current EPBC Act. The imposition of a 40 meter corridor or zone that excludes all trees will have devastating effects on the health of these three communities and particularly the first two species.
3. The nature of these soils is unique. They are predominantly black friable self-mulching basalt black soils. Eastern Star Gas (ESG) in its application has chosen to ignore – 3.3d Outstanding Natural Feature ticked off as" none". These soils are world renown and are regarded as being amongst the best in world. They are considered to be as good, if not better than, the corn-belt in Kansas USA, Ukraine in Russia, Parna Plateau of South America and China's north-eastern breadbasket region. The latter is now suffering from a severe deficit of groundwater. As self-mulching soils they are constantly turning over. The "self cracking" nature of the soils and continuous movement makes them an unsatisfactory medium for the laying of pipes. The Central Ranges Pipeline that traverses the edges of the Liverpool Slopes and Plains has caused at least eight badly eroded areas. These areas are proving nearly impossible to repair in the farming country as has those areas through heavily vegetated grasslands. Badly eroded gullies and subsidence are also outcomes of this pipeline. Furthermore this pipeline is buried nearly twice as deep and is roughly a quarter the diameter of the ESG pipeline. Another example is the difficulty that Telstra has had burying a telephone cable and similar issues have resulted.
4. Eastern Star Gas has stated very clearly that there is no alternative route to this pipeline. It has been stated in the media on many occasions that the local farmers see that a pipeline down the Newell Highway to be a suitable alternative as the soils along this route are of a lighter nature and the distance is shorter. Consultation with both Federal member Tony Windsor and state politicians has resulted in both Federal and State politicians agreeing in principle that the Newell Highway presents

a far better route. This would be far more accessible for repairs and maintenance as the black soil plains are often inaccessible after even small amounts of rain. This plain also floods easily. Local groups such as the Namoi Catchment Agency (NCA) and the indigenous group known as Red Chief also support the location of the pipeline further to the west.

5. ESG also states in its submission that the pipeline is of primary importance to the State. The gas to be provided to the State is only a small percentage – from 7% - 15% to yet to be built gasfired power station. The remainder is to be sent to Newcastle. Given that the state of NSW has granted a five year royalty holiday from initial extraction to production, the benefits to the state are minimal.

PAGE 1

Statutory Declaration

NEW SOUTH WALES, TO WIT,

OATHS ACT, 1900, NINTH SCHEDULE

* Name in full. **I, the undersigned *** STUART McMINN

† Residence. **of †** TAMBA TAMBAR SPRINGS NSW AUSTRALIA.

‡ Occupation. **In the state of New South Wales, ‡** FARMER **do hereby solemnly**

x The facts to be stated according to the declarant's knowledge, belief, or information, severally. **and sincerely declare and affirm that** x THAT I HAD Following Conversation with Jim Byrne of CNC. Project Management. Concerning Eastern Star Gas Pipeline through my Property. TAMBAR TAMBAR SPRINGS.

(A) Pipeline Three options (1) Newell Highway Route, (2) Travelling Stock Route, (3) Through Private Land. Mullaley Coolah.

(B) Routes 1+2 had their problems e.g. Wildlife, Aboriginal Heritage ~~Indigo~~ Sites. MR Byrne stated that Government Authority would not allow it on T.S.R. as Senior Managers would protect the wildlife on TSR & Agcos would oppose any Pipe on their T.S.R

(C) MR Byrne stated that if I didn't make Agreement shortly I would have no say where the Pipeline would Run on my Property As the 2KM Easement would be Removed.

(D) MR Byrne tried to make me give him options and Access Agreement. Basically he want me to Get the best Route for myself And Inflict the Pipeline on neighbours — PAGE 2

And I make this solemn declaration, as to the matter aforesaid, according to the law in this behalf made, and subject to the punishment by law for any wilfully false statement in any such declaration.

TAKEN and declared at GUNNEDAH in the said State this NSW day of 9. 2. 11. before me

Alex Spence
Justice of the peace
for New South Wales

Justice of the Peace

Signature.....
No - 191716

Catalogue No. 45063500

PAGE (2)

Statutory Declaration

NEW SOUTH WALES, TO WIT,

OATHS ACT, 1900, NINTH SCHEDULE

* Name in full. I, the undersigned * STUART MCMINN

† Residence. of † TAMBA TAMBAR SPRINGS NSW 2381

‡ Occupation. In the state of New South Wales, ‡ FARMER. do hereby solemnly

x The facts to be stated according to the declarant's knowledge, belief, or information, severally. and sincerely declare and affirm that x And CAUSE A DISPUTE WITH THEM.

(E) I TOLD MR BYRNE I WOULD SEEK LEGAL ADVICE – HE TRIED TO PERSUADE ME FROM DOING THIS.

(F) MR BRYNE TOLD ME I WAS ONE OF THE LAST THREE LAND HOLDERS TO SIGN UP.

(G) MR BRYNE TOLD ME IF I DIDN'T CO-OPERATE NOW I WOULD RECIEVE LESS COMPENSATION WHEN THE PIPE LINE CAME THRU.

(H) MR BRYNE STATED WE WILL COMPULSORY TAKE YOUR LAND IF YOU DON'T CO-OPERATE.

I FIND THAT MR BYRNE AND ATHE CNC PROJECT OFFICERS, LIE, TRIED TO INTIMIDATE AND PUSH LAND HOLDERS INTO SIGNING DOUCMENTS AND ACCESS AGREEMENTS. I SAY TO TH PLANNING MINISTER STOP THIS HARASSME AND BULLYING BY THESE PEOPLE AND COMPANIES.

And I make this solemn declaration, as to the matter aforesaid, according to the law in this behalf made, and subject to the punishment by law for any wilfully false statement in any such declaration.

TAKEN and declared at GUNNEDAH. in the said State this NSW day of 9.2.11 before me

S McMinn

Alex Spence
Justice of the peace
for New South Wales
No - 191716

Justice of the Peace

Signature.....

Catalogue No. 45063500

EAST WEST enviroag
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COMMENTS

Project No: EW110492-1 **Location: [redacted]**

Sample Identification: [redacted] Effluent Water

ANALYTE	UNITS	RESULTS	DESIRABLE LEVELS			COMMENTS
			SPRAYS	IRRIGATION	DOMESTIC	
TDS	mg/L	**26720**	*<1000*	*500-1500*	*<900*	*Extremely High*
Conductivity	mS/cm	**42.1**	*<1.5*	*<2.0*	*<4.5*	*Extremely High*
pH	pH units	**9.53**	*6*	*6.0-7.5*	*6.0-8.0*	*Very Alkaline*
Total Alkalinity	mg/L	**7444**	*<50*	*400*	*200*	*Extremely High*
Chlorides	mg/L	**16300**	*<50*	*<350*	*300*	*Extremely High*
Nitrate-N	mg/L	**0.38**	*<5*	*25-125*	*<10*	*Acceptable*
Phosphorus	mg/L	**0.48**	*<0.10*	*<0.8-12.0*	*<0.20*	*Acceptable*
Manganese	mg/L	**0.01**	*<0.25*	*<2.0*	*<0.5*	*Very Low*
Iron	mg/L	**0.18**	*<0.20*	*<1.5*	*<5.0*	*Low*
Potassium	mg/L	**2842**	*<1.0*	*<3.5*	*<2.5*	*Extremely High*
Calcium	mg/L	**0.1**	*<50*	*<200*	*200-400*	*Very Low*
Magnesium	mg/L	**0.1**	*<40*	*<100*	*100-150*	*Very Low*
Sodium	mg/L	**9626**	*<100*	*<150*	*<300*	*Extremely High*
Sodium Adsorption Ratio		**5126**	*<1.5*	*<4.5*	*<9*	*Extremely Toxic*
Total Hardness	mg/L	**0.7**	*<150*	*<350*	*<250*	*Very Soft*
TPH Bands C10-C36	µg/L	**<100**	*<100*	*<100*	*<100*	*Very Low*

SUITABILITY FOR USE

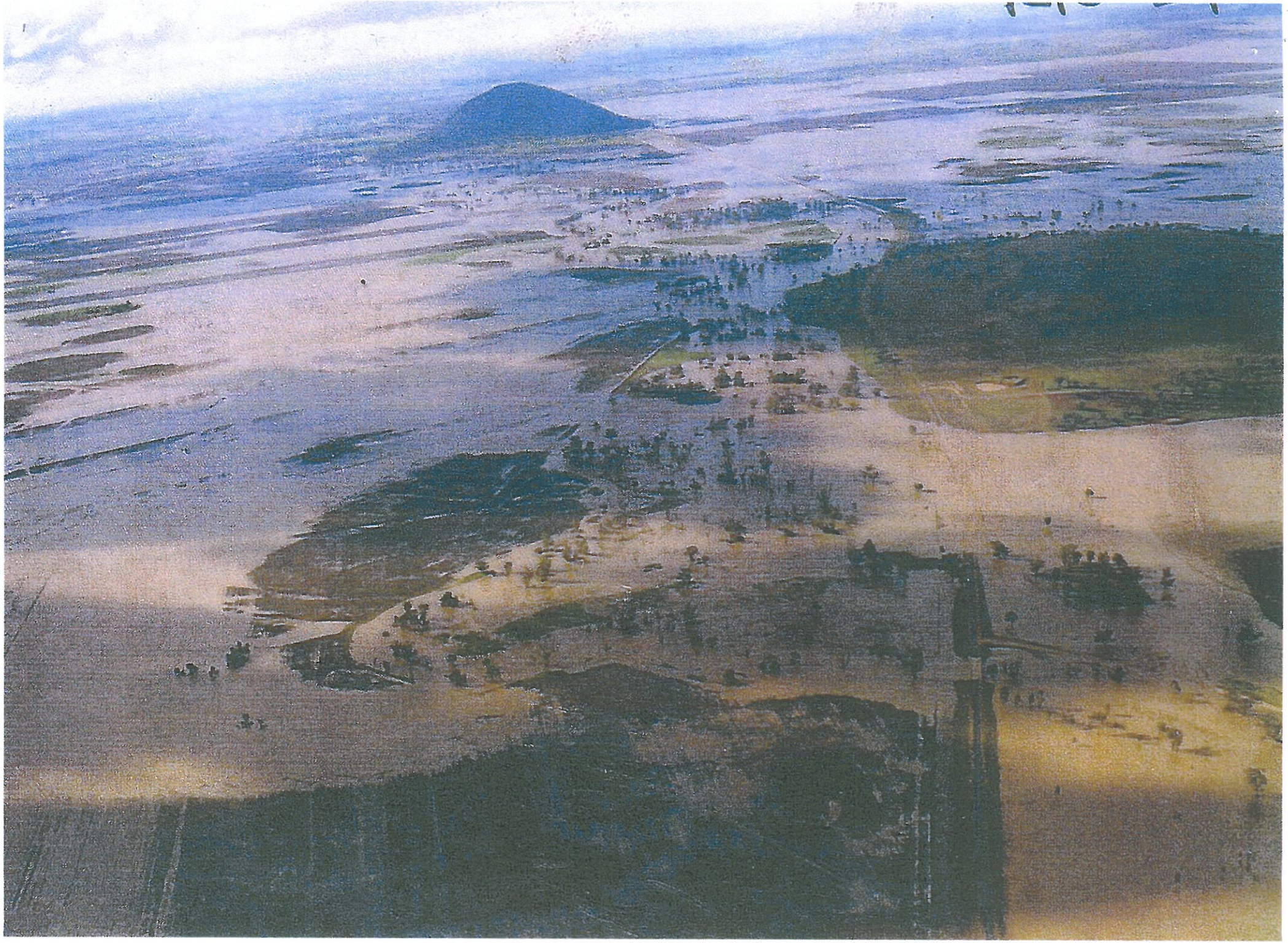
Irrigation:	*This water has an elevated level of total dissolved salts (TDS) sodium, in particular sodium, potassium, chloride and carbonate.* ***This water is totally unsuitable for irrigation.*** *The sodium adsorption Ratio (SAR) is used to predict the danger of sodium (Na) accumulation in the soil. All ornamentals, fruit trees (inc. citrus) and vegetables are sensitive to overhead watering where the sodium absorption ratio (SAR) is between 4 to 8 and chlorides are above 350mg/L. There are no crops or pastures that are tolerant to the high levels of salts in this water. This water should not be applied to soils with restricted drainage. Even with adequate drainage, special management for salinity control would be required.*
Stock:	*Water is the single most important component of any livestock enterprise and* ***this water is not suitable for any livestock*** *to drink. The high level of salts in this water renders it toxic for all stock including sheep.*
Chemical Sprays:	***This water is not suitable for use with chemical sprays.*** *This means it will not be recommended for use with certain pesticide, herbicide or fungicide products because of high alkalinity, sodium, potassium, chloride and pH.*
Domestic:	***This water will be unsuitable for domestic use.*** *Household equipment requires TDS to be less than 500mg/L. In regard to hot water systems, the safe upper limit for salinity is about 1.6 mS/cm and for iron 0.3mg/L and this water exceeds the threshold for salinity. Marginal iron levels can result in staining of domestic pipes (laundry) and plumbing fittings with a rust brown precipitate.*
Drinking:	***In regard to drinking, this water is toxic.*** *The upper limit in drinking water for chloride is 400mg/L, for sodium 180mg/L and TDS 500mg/L. Growths of iron bacteria, which concentrate iron, may cause taste and odour problems and lead to pipe restrictions, blockages and corrosion.*
In General:	***This sample of water is unacceptable for any use.*** *It is reasonably soft water which also contains extreme levels of potassium, sodium, chloride and carbonates. This water should be stored and disposed of according to DECCW guidelines.*

S Cameron

Stephanie Cameron 30/06/2011

Independent consultant for agriculture & the environment

(B.App.Sci Biological & Chemical Technologies)



Report compiled by the Namoi Catchment Management detailing the erosion that occurred following access of Crown Road enclosed within Lot 1 DP 1093884 Mullaley.

The report details erosion that occurred after a short period of access and details the potential for serious erosion with prolonged use of the road.

The report quotes guidelines of the Upper Cox's Creek Floodplain Management Plan.
Gazetted in November 2005 under Part 8 of the Water Act.

The report is consistent with the NSW Governments Flood Prone Land Policy

Report on the flooding and Soil Degradation impacts of the use of Public and Crown Roads that dissect Lot 1 DP1093884 'Inering' Mullaley

By
Glenn Bailey[1], Catchment Services Coordinator,
Namoi Catchment Management Authority
20th April 2009

1. Glenn Bailey, Catchment Coordinator Namoi Catchment Management Authority. 30 years as a practiscing Soil Conservationist of which 25years have been on the Liverpool Plains. Extensive experience with floodplain management, soil conservation and natural resource management. Foundation member of the Upper Coxs Creek Floodplain Management

1. Introduction

This report examines the recent approval of access to 2 roads and their compliance with the Namoi Catchment Management Authority's (Namoi CMA) Catchment Action Plan and the Upper Coxs Creek Floodplain Management Plan.

2. Background

Mendos (Mullaley) Pty Ltd are the owners of Lot 1 DP 1093884. Mr and Mrs King are directors of Mendos (Mullaley) Pty Ltd. Lot 1 DP 1093884 is dissected by the following roads:

- a public road running east west owned and managed by Gunnedah Shire Council, and
- a crown road running north south owned by the crown and currently managed by Mr and Mrs King under enclosure permit 309898.

In 2003, Mr and Mrs King applied to the Department of Lands to close the above roads. Objections were received from a number of surrounding landholders. Following 2 Local Land Board hearings the objections were sustained and approval was given for access to use the roads with numerous conditions (see attachment 1 for Conditions of use).

In May 2007 advice was received from Gunnedah Shire Council that the road access approval was under review by the Minister of Lands.

In January 2008 the following advice was received by Mr and Mrs King from the Department of Lands:

> *'It is considered the decisions from Gunnedah Local Land Board held in 2004 do not deliver good land management outcomes considering the nature of the lands included in the roads.*
>
> *Any use of the crown roads within 'Inering' would impact on your ability to efficiently farm your lands and raises the risk of some environmental damage particularly in wet weather.'*

In June 2008, the roads were used during wet weather in contravention of the 'Conditions of Use' with resulting environmental damage.

In July 2008, Gunnedah Shire Council decided to remove the 'Conditions of Use' for the public road.

Over summer 2008-09, the roads were used on an irregular basis. A rainfall event in February 2009 resulted in minor erosion damage to the crown road. The photos in attachment 4 depict the erosion damage to the crown road.

3. Context

The 2 roads are located:

- on the Coxs Creek floodplain which regularly floods. Flood depths over this section of floodplain can regularly exceed 0.6m

- on land slopes of approximately 0.2%
- on soils that are Vertosols (black earths with high clay contents and high to very high erodibility)
- on areas that have been farmed and cropped for the past 40years
- on areas that are dissected by minor flood channels
- on Land Capability Class II and Land Suitability Class 1

The Public road provides access for the public at any time and for any purpose, whereas the Crown road provides access and movement from 'Bourbah' to 'Bandianna' and vice versa under the following conditions of use:

- Only for the proprietors of 'Bourbah' and 'Bandianna' their agents or contractors
- Only for oversize farming plant and equipment (road vehicles not permitted to use the roads)
- Only in dry weather, and
- Are not to be formed up in any way.

As the roads will not be formed in anyway, then the roads are **not** considered to be 'controlled works' as defined under part 8 of the Water Act 1912 (see attachment 2 for definition of 'Controlled work').

Road vehicle and wet weather access and movement from 'Bourbah' to 'Bandianna' and vice versa is available via the Black Stump Way (MR55) and Bando Road.

The roads are 20m wide with the:

- public road being approximately 1900m long (3.8ha) and perpendicular to flood flows, and
- crown road being approximately 1100m long (2.2ha) and primarily parallel to flood flows.

Advice received from Mr and Mrs King is that the roads will be managed by:

- being mostly cropped
- once sown, wheel tracks will be established the proprietors of 'Bourbah' and 'Bandianna' their agents or contractors when and if required. Observed wheel tracks have been over 1m wide by 50mm deep with 2 tracks approximately 3m apart,
- weeds being adequately controlled
- being **not** fenced.

4. Namoi CMA Catchment Action Plan (Namoi CMA CAP)

The Namoi CMA CAP is a statutory plan approved by the Minister for Natural Resources in January 2007. The Namoi CMA has a statutory role in Natural Resource Management (NRM) through environmental management, achieving viable and productive communities, and considering the impacts of NRM on the social, cultural and economic well-being of the community. The Namoi CMA CAP sets the strategic framework for all stakeholders involved in NRM for the next 10years. The Namoi CMA CAP complies with the NSW and Australian Government's policies on NRM.

The Namoi CMA CAP sets Catchment Targets, Management Targets and Management Actions to manage significant environmental impacts resulting from land use activities. Under the Namoi CMA CAP there are 4 Catchment Targets, 13 Management Targets and 51 Management Actions.

The access to and use of the Public and Crown roads are considered to be land use activities. The appropriateness of accessing and using the roads as a land use activity has been considered against the following Management Targets and Management Actions.

4.1 Best Management Practice

MTL1 – *From 2006, increase the area of land managed according to Best Management Practice.*

This will be achieved by the following management actions:

a) developing and/or extending BMP in partnership with industry; and

b) assisting the adoption of industry based BMPs through technical support and incentives.

The access and use of the roads on the floodplain is not considered to be best management practice from a cropping, flooding, soil conservation or soil management perspective.

Best Management Practice for the black soil floodplains prescribes conservation, sustainability, efficiency and profitability through conservation farming, precision agriculture, improvement of soil structure, fertility and biology, spreading flood flows, prevention of soil erosion, weed and pest animal management, planning and budgeting, and being socially acceptable. The location and use of the roads interrupts the ability of Mr and Mrs King to practice best management and to achieve landscape health.

4.2 Water Management Plans

MTW4 – *From 2006, oversee and review water management planning and other processes under the Water Management Act 2000, so that water management plans, including Water Sharing Plans and Floodplain Management Plans, result in fair and reasonable access to surface and groundwater sources for the environment, economic uses and social values.*

This will be achieved by the following management actions:

a) water sharing plans;

b) consultative processes;

c) adaptive environmental water management;

d) major infrastructure upgrades;

e) operations of major dam; and

f) floodplain management and planning.

The Upper Coxs Creek Floodplain Management Plan (see section 5) prescribes fair and reasonable access, use and distribution of flood waters (surface water) to improve the environment and to reduce adverse economic and social impacts.

The location and use of the roads jeopardises Mr and Mrs King's ability to contribute to reaching this management target.

4.3 Social and Economic Considerations

MTP3 – *From 2006, improve the economic stability and well being of people in the Namoi Catchment.*

This will be achieved by the following management actions:

- *a) delivering programs that support the productive, profitable and sustainable use of natural resources, including new and emerging resource uses;*
- *b) understanding the social and economic environment in the Namoi Catchment;*
- *c) including socio-economic parameters in program and project design, assessment, implementation and evaluation, and*
- *d) mitigating negative socio-economic impacts of CAP programs and activities.*

The access and use of the roads will have an adverse economic and social impact on Mr and Mrs King, the local community and catchment. Mr and Mrs King have lost production potential from the area the roads occupy, will have significant disruption to daily life, opened 'Inering' to threats (weed invasion, theft, vandalism, inappropriate use, wild fire), suffered emotional stress, and consumed local and regional resources.

5. Upper Coxs Creek Floodplain Management Plan (Upper Coxs Creek FMP)

The Upper Coxs Creek FMP was gazetted in November 2005 under Part 8 of the Water Act 1912. It aims to minimise the flood risk faced by occupiers of the floodplain and to support the natural functions of the floodplain environment. It provides a framework for improving the drainage of the floodplain system, as well as resolving landuse management issues. The framework is primarily informed by legislation, floodplain principles and assessment criteria.

The Upper Coxs Creek FMP is also consistent with the NSW Government's *Flood prone Land Policy*. This policy aims to reduce the impacts of flooding on individual owners/ occupiers of flood prone land, and to reduce private and public losses caused by flooding.

The preparation of the Upper Coxs Creek FMP was overseen by the Upper Coxs Creek Floodplain Management Committee which comprised of representatives from the community, various stakeholder groups and government agencies.

The Upper Coxs Creek FMP addresses a number of topics including floodplain management principles, development assessment criteria, management of existing works, environmental assessment, related land management issues and an implementation strategy.

5.1 Floodplain Management Principles

The Upper Coxs Creek Floodplain Management Committee developed a number of floodplain management principles which are listed in attachment 3. The floodplain

management principles inform the criteria used to assess Part 8 applications and to help resolve floodplain land use issues.

Of the 13 floodplain management principles, 3 directly relate to the opening and use of the roads on 'Inering'.

5.1.1 Principle 5

Principle 5 states the following:

> *"The exit of floodwaters from defined flood flow paths should be at rates and depths similar to those that would have been experienced under natural/ historical conditions and should discharge as close as practicable to the location of natural /historical flood flow paths."*

The crown road is approximately 1100m long and runs primarily parallel to flood flows. As advised, the wheel tracks along the crown road, once established, will be left bare. During a flood flow the wheel tracks along the crown road will be predisposed to higher flow velocities and depths because of the following:

- There will be no ground cover on the road wheel tracks once they are established and consequently provide least resistance to flow velocities so they will naturally draw flood flows towards the wheel tracks and crown road,
- The crown road is relatively long and primarily parallel to flood flows, and
- Concentration of flood flows down the crown road and wheel tracks due to the presence of a very old netting fence on the Bandianna and Inering boundary which has now been breached through the erection of mesh gates at the southern end of the crown road where it meets the Bandianna and Inering boundary. The mesh gates will provide less resistance to flood flows when compared to a netting fence.

The public road, on the other hand, will have no ground cover within the wheel tracks, once established, but they are primarily perpendicular to flood flows and relatively narrow (2m), so the area predisposed to higher flow velocities and depths is negligible.

The following table details the expected flow velocities for various flood depths and land use conditions.

Table 1 Assessment of flood flow velocities under various land uses and for various depths of flow.

Land use	**Growing crop 150mm high**	**Standing Stubble**	**Bare soil**
Land slope	0.2%		
Mannings n	0.055	0.04	0.025
Depth of flow	**Velocity of flow m/s**		
0.1	0.16	0.22	0.35
0.2	0.23	0.32	0.51
0.3	0.29	0.39	0.63
0.4	0.33	0.46	0.73
0.5	0.37	0.51	0.82
0.6	0.40	0.56	0.90

Notes:
Land slope has been determined from the 1:50,000 Mullaley Topographic map using noted bench marks.
A channel base width of 1m has been used for the above calculations.
Batter grades of 1H:1V has been used as this will be the area of influence.

A number of interpretations can be made from the above table:

- Under normal conservation farming operations across the floodplain, without the presence of the crown road and wheel tracks, flood flow velocities would range from 0.16 to 0.56m/s (for the range of depths examined)
- With the crown road and wheel tracks in place, flood flow velocities would range from 0.35 to 0.9m/s
- Flood flow velocities will be at increased rates of between 60% and 125%.

Comments

Flow rates are a function of velocity and channel cross sectional area (which is a function of depth of flow). For the same size flood (depth of floodwaters) with wheel tracks present, the rate of discharge will be significantly higher when compared to natural/historical conditions. This is a contravention of Floodplain principle 5.

Furthermore, as the accessed Crown road will provide less resistance to flood flow velocities and as compacted wheel ruts will eventually develop, it is expected that they will carry greater depths of water which will further increase velocities and exacerbate rates of discharge.

Additionally, the point of discharge of these increased rates will be at the northern end of the Crown road, which is at a significantly different location from the natural /historical flood flow paths, especially during low level flood flows.

Backwatering during flood events has not been taken into account in this report. Backwatering primarily occurs during larger floods and closer to the main drainage channels when significant amounts of floodwaters are detained on the flood plain due to limited drainage. The crown road is located well away from the main Coxs Creek drainage channels. However, the wheel tracks result in higher flow rates during all depths of flooding consequently, backwatering has been discounted as having a significant slowing affect during flooding over the crown road.

5.1.2 Principle 7

Principle 7 states the following:

> *"Velocities of flood flow in defined flood flow paths should be minimised and be of an order which would not cause erosion or increased siltation under various land uses."*

The Crown road is a 20m wide easement which is primarily parallel to flood flows and at least the 2m of wheel tracks will be managed under bare earth with significant areas adjacent to the wheel tracks disturbed from farm machinery. Consequently, the wheel tracks and adjacent disturbed area within the Crown road easement would be considered to be a defined flood flow path.

Table 1 lists the velocities of flood flow that would be expected under various land uses and for varying depths of flood flow. As the Crown road is 1100m long, primarily parallel to flood flows, located on highly erodible Black earth soil and the wheel tracks once established, will be left bare, it is expected that flood flow velocities under these conditions would range from 0.35 to 0.9m/s. On highly erodible Black earth, soil erosion is expected to occur when flood flow velocities exceed 0.3m/s.

Furthermore, from table 1, velocities of flood flows down the Crown road are expected to be increased by at least 60% to 125%.

Comments

Flooding over the accessed crown road, once wheel tracks are established will result in floodwaters travelling at erosive velocities. Even at minimum depths of flow, it is expected that soil erosion will occur within the wheel tracks. Furthermore, the velocity of flood flows and the resultant amounts of soil erosion will be exacerbated once wheel ruts are established and soil compaction occurs. This is a contravention of Floodplain principle 7.

These expectations were evidenced in the February 2009 flow event which resulted in minor levels of erosion in the wheel tracks and moderate levels of siltation at the northern end of the road (see photos in attachment 4)

The Upper Coxs Creek FMP states 'As a general rule ....., velocities should not increase by more than 50% from pre-development flow velocities' (p 12 Upper Coxs Creek FMP Nov 2005). Flooding over the accessed Crown road will result in flow velocities which will be much greater than the 50% pre-development flow velocity general rule. This is also in contravention of the Upper Coxs Creek FMP.

The affects of backwatering during flood events on erosive velocities has been discounted for the same reasons as detailed the comments in section 5.1.1.

5.1.3 Principle 8

Principle 8 states the following:

> *"There should be no adverse impact from floodplain development on any individual landholder or community infrastructure including increases in peak flood levels and increased drainage times."*

The Upper Coxs Creek Floodplain Management Committee debated this principle at a number of meetings during the formulation of the Upper Coxs Creek FMP. The phase *"There should no adverse impact....."* was debated and in a draft Upper Coxs Creek FMP the phase was *"There should be minimal impact ...."* with a minority view that *"There should be no impact...."*

Impacts can the physical effects of flooding, environmental effects such as soil erosion, economic effects such as lost income and social effects such as emotional stress. Both the crown road and the public road dissect 'Inering' resulting in adverse impacts.

The crown road has the potential to concentrate and divert floodwaters as detailed in sections 5.1.1 and 5.1.2 with the result being concentrated discharge at the northern end of the road

onto "Inering". This is not only an adverse impact but a divergence from a natural and historical flow path (Floodplain management Principle 3).

Furthermore, as the crown road has the potential to concentrate and divert floodwaters, there is the potential for increased soil erosion along the road and the consequent siltation within 'Inering' when silt laden floodwaters discharging from the road at the northern end. The increased soil erosion levels will also result in increased turbidity and a reduction in water quality.

The presence of the wheel tracks within the crown road also results in a loss of crop production and hence income. Even the limited access and use of the road by the proprietors of 'Bourbah' and 'Bandianna' their agents or contractors results in emotional stress for the King family.

6. Conclusion

This report has examined access and use of the roads on 'Inering' and their compliance with the Namoi CMA CAP and the Upper Coxs Creek FMP, and the potential environmental, economic and social impacts.

This examination has found that access and use of the roads will result in the following impacts:

- It is against Best Management Practice,
- Jeopardises fair and reasonable access, use and distribution of flood waters,
- Floodwaters will exit the Crown road at significantly higher rates and depths
- Floodwaters will leave the crown road at significantly different locations
- Soil erosion will occur within the wheel tracks for all depths of flooding
- Adverse flooding, environmental, economic and social impacts will occur.

The access and use of the crown road is therefore in contravention of some of the Management Targets within the Namoi Catchment Action Plan and the some of the Floodplain Principles within the Upper Coxs Creek Floodplain Management Plan.

From a risk assessment perspective, the contraventions are only minor and the likelihood of the impacts occurring would be at a medium level, while the consequences for Mr and Mrs King would be high, for the local community/floodplain would be low to medium and for the catchment the consequences would be low.

Attachment 1

CONDITIONS OF USE

CROWN ROAD WITHIN "INERING" MULLALEY

1. These conditions relate to the Crown roads marked in red on Diagram '1' only;
2. Any issues pertaining to use of the Council public road marked in green on Diagram '1' is a matter for Gunnedah Shire Council;
3. The proprietors of Lot 11 DP1034199, as holders of Enclosure Permit 309898, are required to erect double gates of minimum width sufficient for oversize farm machinery, to access the Crown road at its juncture with Lot 163 DP 1034199;
4. The provision of access relates to the proprietors of "Bourbah" and "Bandiana' or their agents or contractors whilst ever these holdings are held in the same interest. Upon sale of either of these holdings the requirement for use of the Crown roads within "Inering" will be null and void;
5. The identification of the location of the Crown road is the responsibility of the principal user being the proprietor of "Bourbah" and "Bandiana". As a consequence, they will be required to engage a surveyor to define the location of the road, and to clearly mark the centre line of the road for future access purposes;
6. The provision of access relates only to the movement of oversize farming plant and equipment from "Bourbah" to "Bandiana" and vice versa. Access by road vehicles only is not permitted;
7. Access is only to be made in dry weather. Where it is evident that it is too wet for farm machinery on the black soil plains, no access whatsoever is to be made across the Crown roads;
8. The provision of access is for use of the road in its natural state. No approval is granted for any road construction works of any nature;
9. Any erosion control measures required as a consequence of use of the Crown road will be the responsibility of the user, being the proprietor of "Bourbah" and "Bandiana". Remediation measures will need to be carried out to the satisfaction of the Department of Lands. The Department of Lands may also issue a directive to the user to undertake erosion control measures.
10. The users of the road, being the proprietors and contractors/ agents of "Bourbah" and "Bandiana" indemnifies the Department, the Minister and the Crown against any suits, claims or liabilities that may arise as a result of use of the Crown roads.

CONDITIONS OF USE

PUBLIC ROAD WITHIN "INERING" MULLALEY

1. These conditions relate to the Public Road marked in red on Diagram '1' only;
2. Any issues pertaining to use of the Crown road marked in green on Diagram '1' is a matter for the Department of Lands;

3. The proprietors of Lot 11 DP1034199, as holders of Enclosure Permit 309898, are required to erect double gates of minimum width sufficient for oversize farm machinery, to access the Public road at its juncture with Main Road 55;
4. The provision of access relates to the proprietors of "Bourbah" and 'Bandiana' or their agents or contractors whilst ever these holdings are held in the same interest. Upon sale of either of these holdings the requirement for use of the Public Road within "Inering" will be null and void;
5. The identification of the location of the Public Road is the responsibility of the principal user being the proprietor of "Bourbah" and "Bandiana". As a consequence, they will be required to engage a surveyor to define the location of the road, and to clearly mark the centre line of the road for future access purposes;
6. The provision of access relates only to the movement of oversize farming plant and equipment from "Bourbah" to "Bandiana" and vice versa. Access by road vehicles only is not permitted;
7. Access is only to be made in dry weather. Where it is evident that it is too wet for farm machinery on the black soil plains, no access whatsoever is to be made across the Public Road;
8. The provision of access is for use of the road in its natural state. No approval is granted for any road construction works of any nature;
9. Any erosion control measures required as a consequence of use of the Public Road will be the responsibility of the user, being the proprietor of "Bourbah" and "Bandiana". Remediation measures will need to be carried out to the satisfaction of the Gunnedah Shire Council. Gunnedah Shire Council may also issue a directive to the user to undertake erosion control measures.
10. The users of the road, being the proprietors and contractors/ agents of "Bourbah" and "Bandiana" indemnifies Gunnedah Shire Council against any suits, claims or liabilities that may arise as a result of use of the Public Road.

Attachment 2

Definition of Controlled Works

Works referred to as flood control works are defined under the part 8 of Water Act 1912 as 'Controlled works'. 'Controlled works' require approval under the Act and are defined as follows:

165A Controlled work—meaning

(1) In this Part, a ***controlled work*** means:

(a) an earthwork, embankment or levee that is situated, or proposed to be constructed, on land that:
  (i) is, or forms part of, the bank of a river or lake, or
  (ii) is within a floodplain, or

(b) any work that is situated, or proposed to be constructed, on land that:
  (i) is, or forms part of, the bank of a river or lake, or
  (ii) is within a floodplain,
  and that is declared by order of the Ministerial Corporation published in the Gazette to be a controlled work, or

(c) an earthwork, embankment or levee, wherever situated or proposed to be constructed, that:
  (i) affects or is reasonably likely to affect the flow of water to or from a river or lake, and
  (ii) is used or is to be used for, or has the effect or likely effect of, preventing land from being flooded by water, or

(d) any work, wherever situated or proposed to be constructed, that:
  (i) affects or is reasonably likely to affect the flow of water to or from a river or lake, and
  (ii) is used or is to be used for, or has the effect or likely effect of, preventing land from being flooded by water, and
  (iii) is declared by order of the Ministerial Corporation published in the Gazette to be a controlled work.

Attachment 3

3.0 FLOODPLAIN MANAGEMENT PRINCIPLES

A Floodplain Management Plan typically aims to cater for flows, provide flood mitigation, foster ecologically sustainable development and ensure that flooding for floodplain ecosystems is maintained. It needs to adhere to an overall set of management principles. The principles adopted by the Upper Coxs Creek FMC are listed below:

1. Defined flood flow paths must possess adequate hydraulic capacity and continuity to enable the orderly passage of floodwaters through the floodplain;
2. Any system of Flood flow paths should conform as closely as is reasonable to the natural drainage pattern.
3. Floodway areas should be equitably allocated (between adjacent landholders) consistent with natural/historical flow paths;
4. Environmental issues related to the floodplain management plan need to be identified and investigated including developing strategies for flood dependent ecosystems such as wetlands, riparian vegetation, and any other environmentally sensitive areas;
5. The exit of floodwaters from defined flood flow paths should be at rates and depths similar to those that would have been experienced under natural/historical conditions and should discharge as close as practicable to the location of natural/historical flood flow paths;
6. Sufficient pondage must be retained on the developed floodplain so that the flood peak travel time is not unduly accelerated to downstream users or its height increased;
7. Velocities of flood flow in defined flood flow paths should be minimised and be of an order which would not cause erosion or increased siltation under various land uses;
8. There should be no adverse impact from floodplain development on any individual landholder or community infrastructure including increases in peak flood levels and increased drainage times;
9. Floodplain development should not cause significant redistribution of floodwater;
10. Should the community agree, there might be scope to depart from the natural/historical drainage pattern, provided it is hydraulically and environmentally feasible;
11. Have due regard for government policy and legislation;
12. All distribution of flows affected by earthwork development should be considered and reconciled in volumetric terms across the entire cross-section of the floodplain, and not just in the region where localised effects are expected; and
13. Provision should be made for local drainage

These principles are adhered to and reflected within the FMP through adopted assessment criteria and will be applied by DNR when considering Part 8 applications under the *Water Act.*

Attachment 4

Erosion damage to the crown road following a minor runoff event. Looking south from junction of Crown and Public Road. February 2009

Siltation at the northern end of the crown road following a minor runoff event. Looking north at the junction of Crown and Public Road. February 2009

Erosion Photos January 2009

A result of accessing Crown Roads through black soils at Mullaley.

Crown Roads "Paper Roads" accessed in June 2008.

The dramatic photos reveal the significant silt runoff.
This erosion occurred after only six months and one rainfall event.

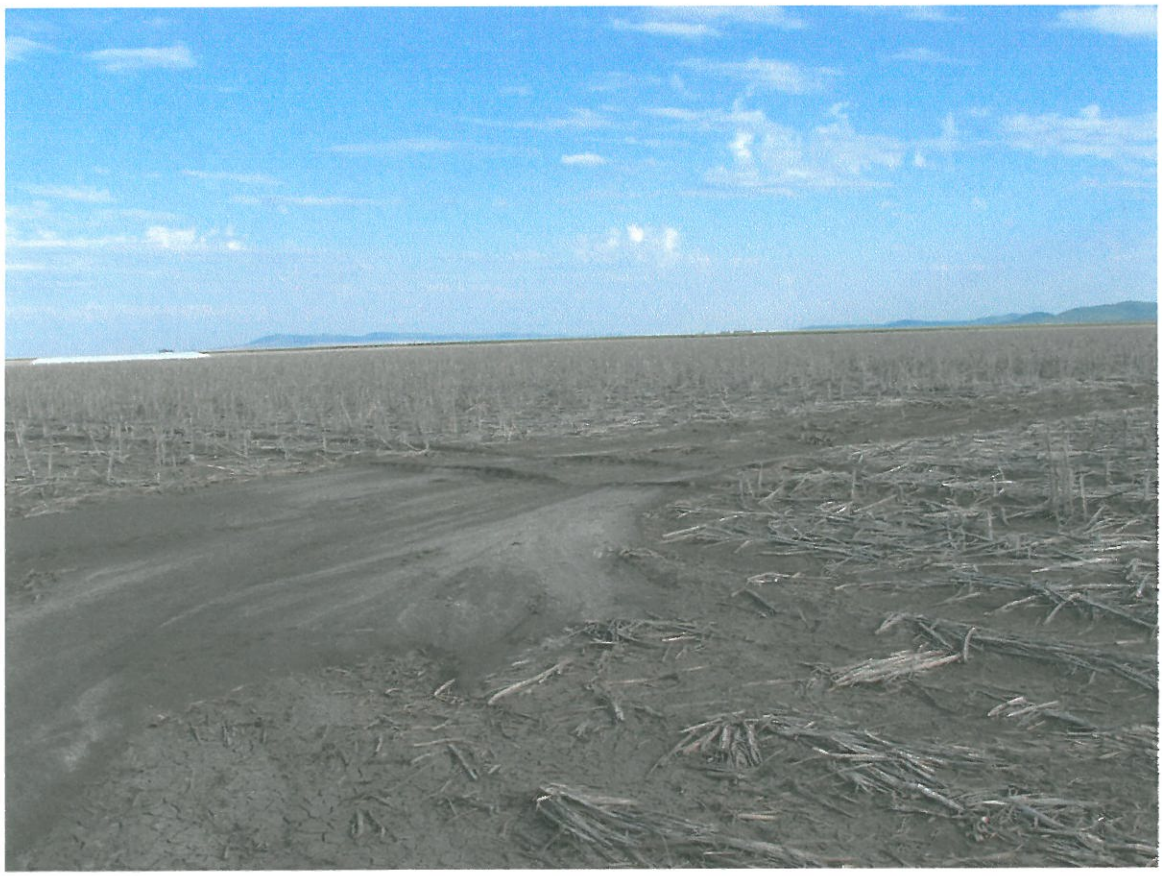
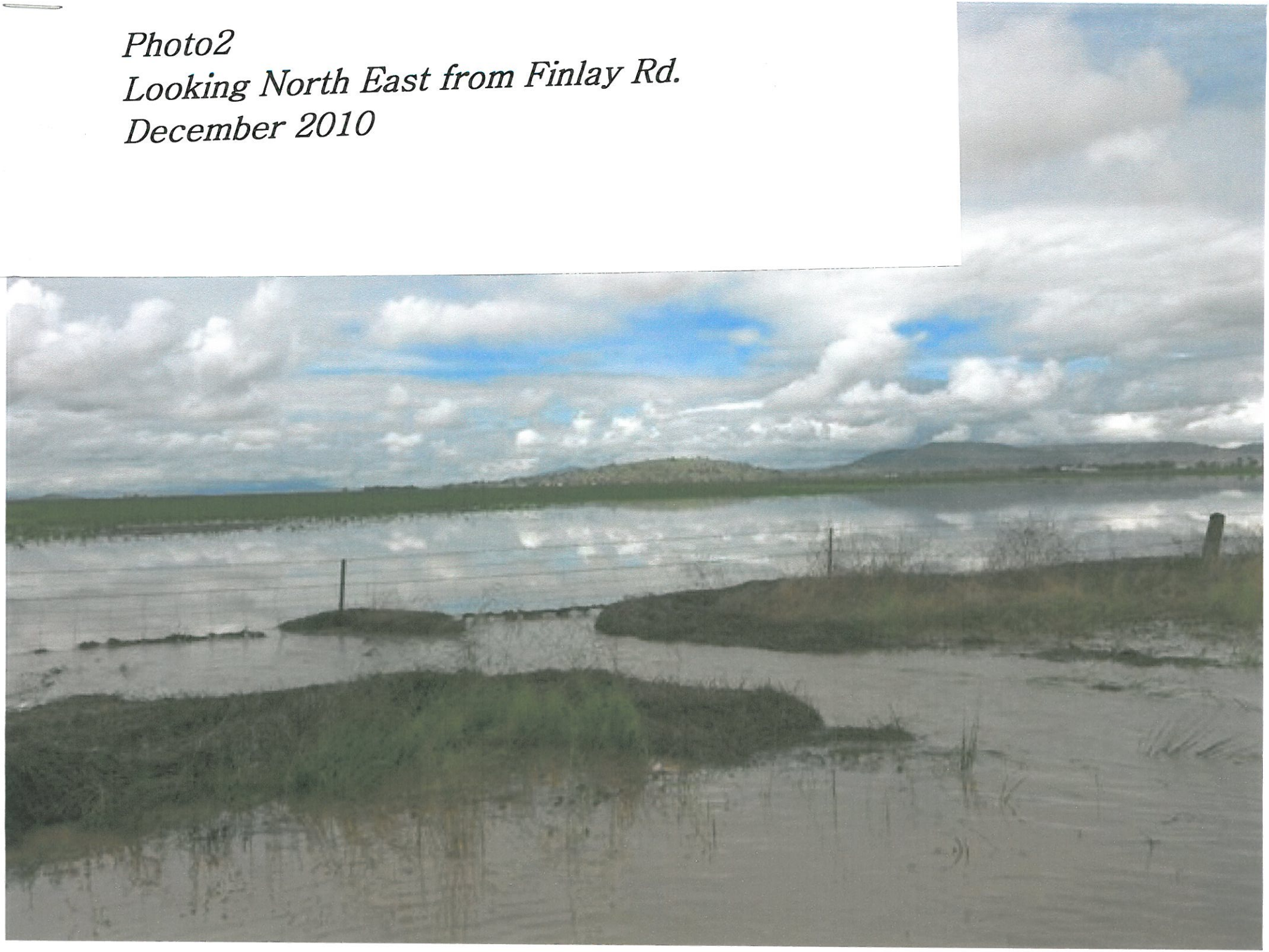


Photo 1
Flooding South of Mullaley
December 2010
Looking North from Finlay Rd.
Mullaley Mountain in background.

Photo2
Looking North East from Finlay Rd.
December 2010



UNDER THE RADAR

HOW COAL SEAM GAS MINING IN THE PILLIGA IS IMPACTING MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

THE WILDERNESS SOCIETY

Nature Conservation Council of NSW
The voice for the environment since 1955

NORTHERN INLAND COUNCIL for the ENVIRONMENT

Under the Radar:
How Coal Seam Gas mining in the Pilliga is impacting matters of national environmental significance

June 2011

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Dewhurst 8. Photo: T.Pickard.

EXECUTIVE SUMMARY

Eastern Star Gas (ESG) is currently conducting coal seam gas exploration and production activities in Petroleum Exploration Licence 238 (PEL238) and Petroleum Assessment Lease 2 (PAL2). These two titles cover an area of approximately 819,234 hectares in north-western NSW around Narrabri[1]. The petroleum titles are centred over the area of forest known as the Pilliga Scrub, or Pilliga Forest. They encompass a number of tenures, including State Forest, State Conservation Areas, other Crown Lands, and private land.

Eastern Star Gas acquired a controlling interest in conventional gas reserves in PEL238 in 2002[2], and acquired an interest in coal seam gas in the PEL in 2004[3]. PAL2 was issued to Eastern Star Gas in October 2007. There were a number of companies with an interest in PEL238 prior to, and concurrently with, Eastern Star Gas, some of whom conducted exploration activities.

ESG and it's predecessors have undertaken a considerable number of exploration and production activities in the petroleum titles, including the drilling of coreholes and pilot production wells; seismic surveys; the construction of gas production and water treatment infrastructure; construction of water impoundments, the discharge of produced water, the creation of access roads, and land clearance for pipeline and production infrastructure construction.

There are at least 24 matters of national environmental significance, as defined by the *Environment Protection and Biodiversity Conservation Act* 1999, which occur within the Pilliga Forest section of PEL 238 and PAL2. These include known, likely, and potential habitat for 15 nationally threatened species (4 endangered, 11 vulnerable), and known or potential habitat for 9 migratory birds listed under international conventions[4].

The EPBC Act 1999 makes it illegal to undertake an activity that has, or is likely to have, a significant impact on these matters of national environment significance. These prohibitions are set down in Part 3 of the EPBC Act 1999, in s16, s18 and s20 respectively.

The Action

The Significant Impact Guidelines (DEH 2006) require that *"The proposed action should be considered at its broadest possible scope.....If the action consists of a series of activities or a number of related activities, you should consider the impacts of each activity, and then consider the combined impacts of those activities".*

In accordance with this requirement, the coal seam gas exploration and production activities undertaken by Eastern Star Gas as one work program in PEL238 and PAL2 should constitute a single action under the EPBC Act 1999.

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1 Derived from data obtained under licence from http://www.dpi.nsw.gov.au/minerals/geological/online-services/minview
2 Eastern Star Gas, n.d: http://www.easternstar.com.au/about.html, (accessed 22.6.11).
3 Eastern Star Gas 2008
4 Tolley (2011)

The scope of the action within PEL238 and PAL2 at its broadest includes:

1. The drilling and on-going management of more than 92 coal seam gas bores and coreholes
2. The conduct of 482km of seismic surveys
3. The construction and management of 56.6km of gas and water gathering pipelines
4. The development and management of five production fields, encompassing 35 production bores
5. The construction and management of a gas-fired power station at Wilga Park, including an upgrade of the station from 10MW to 40MW
6. The construction and operation of 1 reverse osmosis unit
7. The construction and management of 13 major water treatment dams/impoundments and numerous drill ponds
8. The discharge of treated produced water into the Bohena Ck, part of the Murray-Darling Basin.
9. The bull-dozing of numerous roads and tracks to facilitate the construction and operation of works listed above.

However, there is no evidence that the combined impacts of these activities on matters of national environmental significance have ever been considered by Eastern Star Gas. On the contrary, a review of it's considerations as contained in numerous Reviews of Environmental Factors conducted under s111 of the NSW Environmental Planning and Assessment Act 1979, indicates that each small activity has only ever been considered in isolation and the entire action has never been addressed in accordance with the Guidelines.

The entire work program of exploration and production that has been undertaken by Eastern Star Gas and it's predecessors over the last decade or more in PEL238 and PAL 2 is hereafter referred to in this document as 'the action'.

Exemptions

The prohibitions relating to matters of national environmental significance (MNES) in s16, 18 & 20 described above do not apply if:

(a) “an approval of the taking of the action by the person is in operation under Part 9 for the purposes of this section; or

(b) Part 4 lets the person take the action without an approval under Part9 for the purposes of this section; or

(c) there is in force a decision of the Minister under Division 2 of Part 7 that this section is not a controlling provision for the action and, if the decision was made because the Minister believed the action would be taken in a manner specified in the notice of the decision under section77, the action is taken in that manner; or

(d) The action is an action described in subsection 160(2) (which describes actions whose authorisation is subject to a special environmental assessment process)”.

In relation to coal seam gas exploration, production and associated activities in PEL238 and PAL2, it is found that none of these exemptions apply, because:

(a) there is no approval under Part 9
(b) Part 4 does not allow the action to be taken without an approval
(c) no decision has been made by the Commonwealth Minister that the proposed action is not a controlled action
(d) section 160 is not relevant.

The relevant cases set down in Part 4 for which environmental approvals are not needed, are:

i Actions declared by agreement not to need approval (s29)
ii Actions covered by Ministerial declarations and accredited management arrangements or accredited authorisation processes (s32)
iii Actions covered by Ministerial declarations and bioregional plans (s37A)
iv Actions declared by conservation agreement not to need approval (s37M)
v Certain forestry operations in regions covered by a Regional Forest Agreement (s38) or regions subject to the process of negotiating a Regional Forest Agreement (s40)
vi Actions with prior authorisations (s43A); and
vii Actions which are lawful continuations of use of land etc (s43B)

In relation to coal seam gas, exploration, production and associated activities in PEL238 and PAL2 are not covered by any of the agreements set down in -vii above.

Furthermore, the PEL238 and PAL2 coal seam gas operations are not exempt under the prior authorisation provision because prior to the commencement of the EPBC Act 1999, there was not a specific environmental authorisation in the form of an approval under the NSW Environment Planning and Assessment Act 1979 for either coal seam gas exploration or production in PEL238.

Referral

Eastern Star Gas does not have an approval under Part 9 of the Act for any part of 'the action', and as shown above, it is not exempt from requiring an approval under any of the provisions of Part 4. However, it has failed to refer the action in its entirety or even in any of its parts to the Federal Government, despite the identification of known or likely habitat for nationally-listed species within the areas where activities have been undertaken.

Notably, Eastern Star Gas has recently referred a proposal for a large new coal seam gas production project within PEL238 and PAL2 to the Federal Government, identifying a number of MNES that will be affected. This new production proposal encompasses many of the same areas in which the existing actions have occurred within the Pilliga Forest, and affects the same MNES. There is no logical reason as to why the new project should have been referred as one action, when the existing works have not been referred in the same manner.

Eastern Star Gas has previously obtained a small Part 3A approval for the operation of the Wilga Park Power Station and the associated gas flowline and 12 pilot production bores, but it did not refer that development to the Federal Government under the EPBC Act 1999.

We allege that the failure of Eastern Star Gas and it's predecessors to refer the program of coal seam gas exploration and production in the Pilliga Forest in it's broadest sense represents a breach of the EPBC Act 1999, and provides sufficient impetus for the Commonwealth to call-in the action immediately.

Current impacts

Environment groups have conducted a detailed quantitative assessment of the impacts of 'the action' on the environment. It is apparent that 'the action' has resulted in:

- Increased disturbance footprint across an area of approx 44,700 ha of native vegetation
- Increased ignition sources from multiple infrastructure and vehicle movements, and introduction of a flammable gas into an already fire prone environment leading to increased frequency and intensity of fires
- Heavy fragmentation of an area of 1,700 ha of native vegetation, leading to direct impacts on fauna and flora populations and indirect impacts through the spread of invasive species
- Direct destruction of at least 150 ha of native vegetation that is likely habitat for matters of NES.
- Creation of artificial watering points (water impoundments) at more than 13 different locations, plus numerous drill ponds, representing a risk to wildlife
- Introduction of numerous sources of pollution through the use of chemicals and the handling and disposal of produced water (i.e. diesel spills, poor mitigation of flood events)
- Direct alteration of the ecology of a creek system for up to 22km

Bibblewindi 9 complex. Photo: T.Pickard

We have conducted a general assessment of the likely impacts of 'the action' on matters of National Environmental Significance, following the *Guidelines for Significant Impact* set down by DEH (2006). These are the guidelines that were in operation when the majority of the impacts were incurred in PEL238 and PAL2, and that should have been applied by Eastern Star Gas to assess the impacts. These guidelines are near identical in all relevant clauses to the current guidelines, which are also addressed in this document.

These are the same guidelines that should be applied by Eastern Star Gas to assess the impacts. The assessment has involved a substantial literature review, direct analysis of Eastern Star Gas approvals and licences and assessment of all available data in a Geographic Information System.

In relation to the matters set down in the Guidelines (DEH 2006), we have concluded that 'the action' is likely to have a significant impact on matters of National Environmental Significance because of it's intensity, the extraordinary national and international conservation significance of the environment in which it is occurring, the sensitivity of the ecosystem given the scale of extinctions that have already occurred in the mammalian fauna and the scale of decline now evident in the bird fauna, the substantial geographic area affected, the high cumulative impact in the context of other threats (other mining and gas developments, background clearing rates, climate change, invasive species, logging, and high intensity and frequent fires), the low level of confidence with which the impacts are understood, and the context in which they occur of a heavily cleared and highly fragmented landscape with very low levels of reservation.

We have also conducted a more detailed assessment of impact on specific nationally threatened species, and concluded that there is sufficient evidence to conclude that the action is likely to have a significant impact on the Pilliga Mouse, South-eastern Long-eared Bat, Regent Honeyeater and several plant species.

Furthermore, we conclude that the measures put in place by Eastern Star Gas to avoid or mitigate impacts are inadequate to prevent such impacts, and their effectiveness is uncertain and not scientifically established. Most notably, remediation and rehabilitation of sites such as well-heads has not been successful, weed invasions of cleared areas are common, pollution events have occurred and wildlife have been found dead at saline ponds.

Comparison with other referred actions

In order to gauge how the impact of 'the action' compares with other referred actions under the EPBC Act 1999 with regard to both scale and the number of MNES that are affected, we have conducted a review of a random sample of referred actions that are currently on the EPBC referrals website. The results indicate that actions which affect far fewer MNES and which have far fewer impacts in terms of scale and intensity, are routinely referred to the Federal Government under the EPBC Act 1999.

Conclusion

The coal seam gas exploration and production project that has been conducted by Eastern Star Gas and it's predecessors over the last decade in PEL238 and PAL2 is likely to be having a

significant impact on MNES. We believe it should constitute a single action for the purposes of the EPBC Act 1999 and in accordance with the Guidelines for assessing significance. However, neither the action in its entirety nor any of its components has ever been referred to the Federal Government under the EPBC Act 1999.

In this context, the Federal Government must urgently:

1. Call-in the activity to determine whether it is a controlled action,
2. Prevent any further impacts on matters of national environmental significance by exploration or production until the impact has been assessed and a decision made by the Federal Government on the activity.
3. Take immediate compliance action against Eastern Star Gas for the allegedly illegal exploration and production activities undertaken to date.

THE EPBC ACT 1999 AND EASTERN STAR GAS OPERATIONS IN THE PILLIGA

The Action

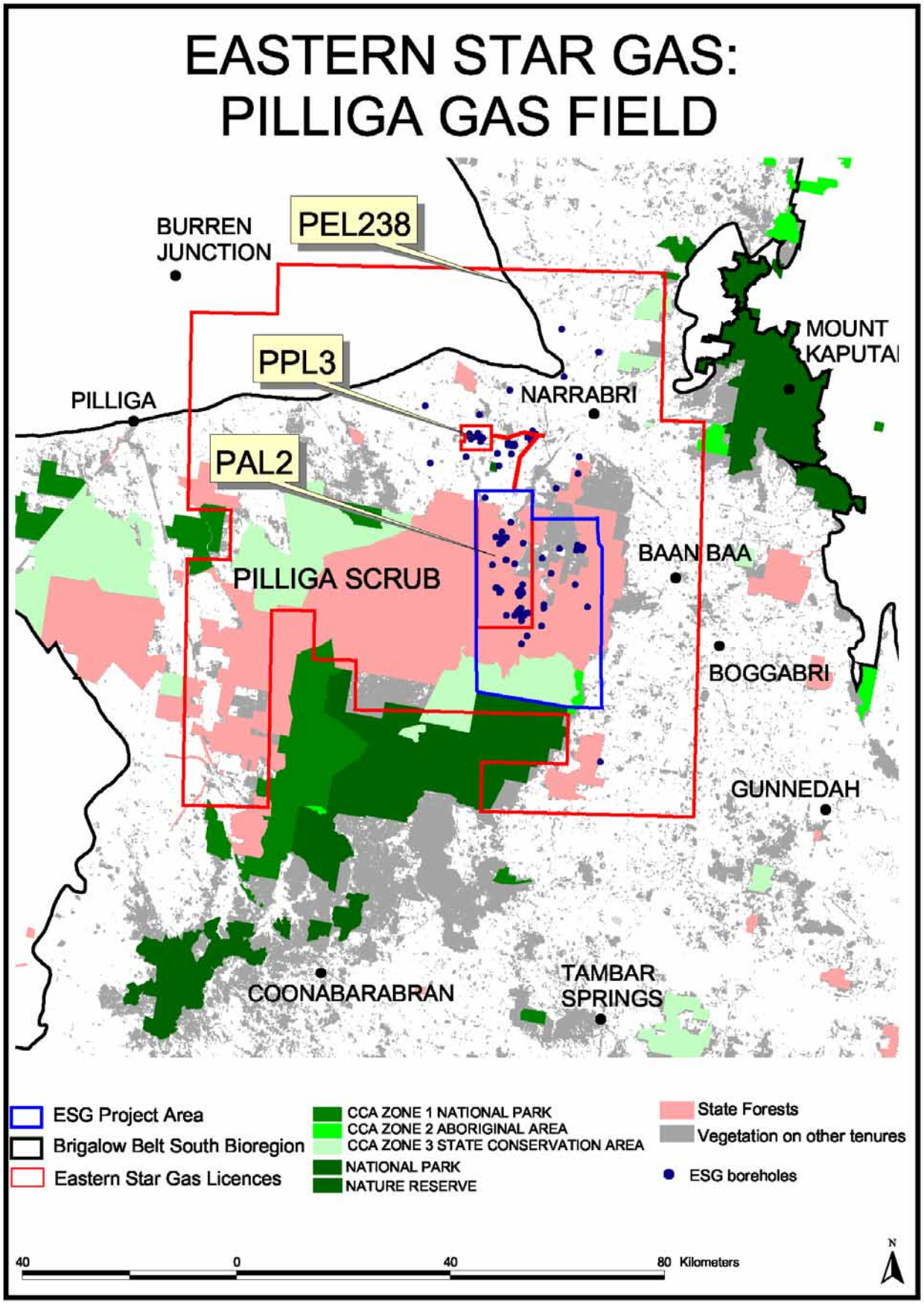
The Significant Impact Guidelines (DEH 2006) require that *"The proposed action should be considered at its broadest possible scope. This includes all stage and components of the action, all related activities, and all related infrastructure such as roads and powerlines, if applicable. If the action consists of a series of activities or a number of related activities, you should consider the impacts of each activity, and then consider the combined impacts of those activities".*

In accordance with this requirement, we contend that the coal seam gas exploration and production activities undertaken by Eastern Star Gas as one work program in PEL238 and PAL2 should constitute a single action under the EPBC Act 1999.

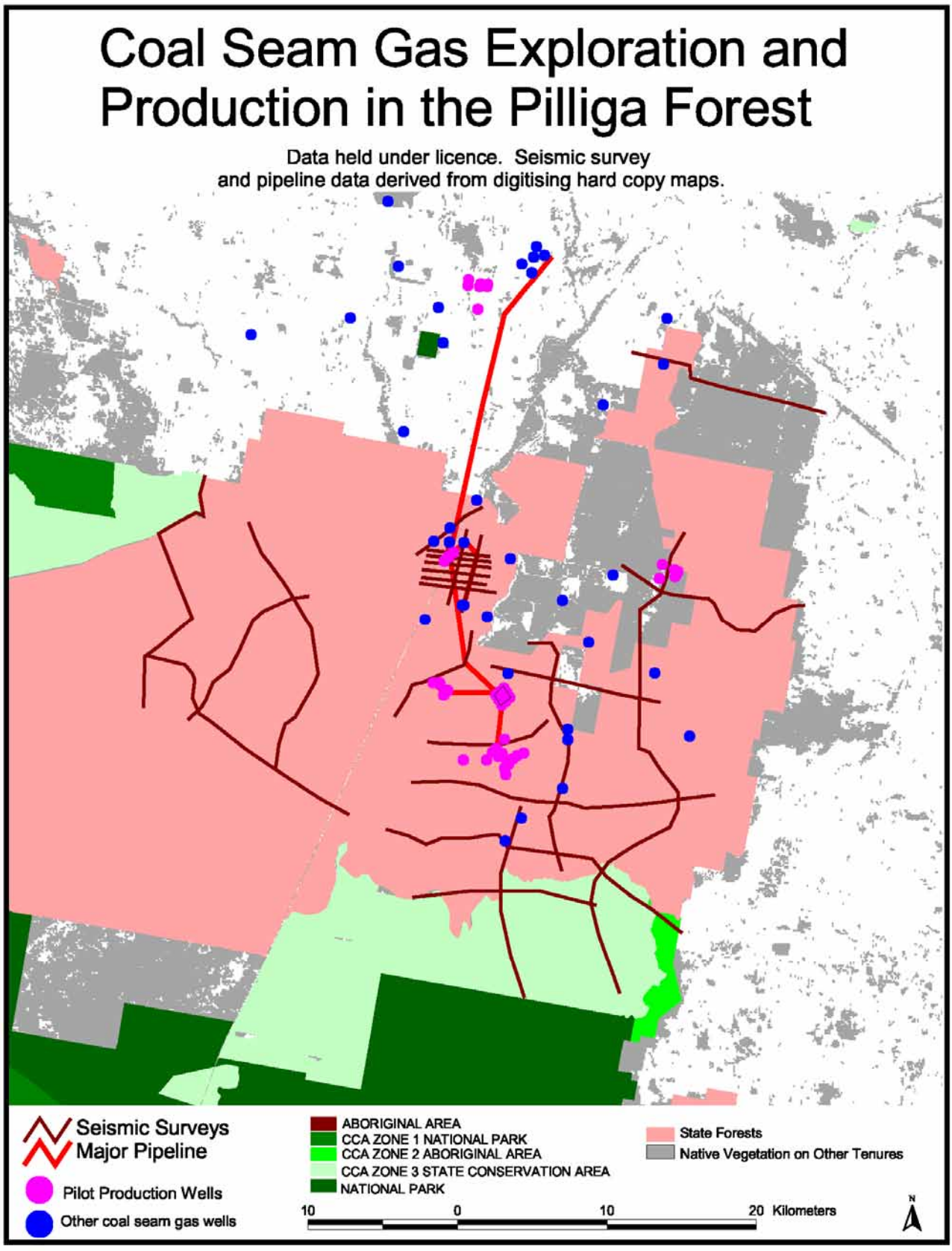
In order to ascertain the true scope of the program, environment groups have conducted a detailed audit and analysis of the scope of the 'action' that has been undertaken by Eastern Star Gas and its immediate predecessor in these two titles in relation to coal seam gas. This analysis has included a literature review of all available consents, licences and instruments under which Eastern Star Gas conduct their operations, a thorough interrogation of publicly available data available from the Department of Trade and Investment in relation to titles and boreholes, and a map-based analysis using a Geographic Information System.

The analysis has led to the conclusion that 'the action' within PEL238 and PAL2 at its broadest scope includes:

1. The drilling and on-going management of more than 92 coal seam gas bores and coreholes
2. The conduct of 482km of seismic surveys
3. The construction and management of 56.6km of gas and water gathering pipelines
4. The development and management of five production fields, encompassing 35 pilot production bores
5. The construction and management of a gas-fired power station at Wilga Park, including an upgrade of the station from 10MW to 40MW
6. The construction and operation of 1 reverse osmosis unit
7. The construction and management of 13 major water treatment impoundments and numerous small drill ponds.
8. The discharge of treated produced water into the Bohena Ck, part of the Murray-Darling Basin.
9. The bull-dozing of numerous roads and tracks to facilitate the construction and operation of works listed above.


EASTERN STAR GAS:
PILLIGA GAS FIELD
BURREN JUNCTION
PEL238
PPL3
PILLIGA
NARRABRI
MOUNT KAPUTAI
PAL2
PILLIGA SCRUB
BAAN BAA
BOGGABRI
GUNNEDAH
COONABARABRAN
TAMBAR SPRINGS
ESG Project Area
Brigalow Belt South Bioregion
Eastern Star Gas Licences
CCA ZONE 1 NATIONAL PARK
CCA ZONE 2 ABORIGINAL AREA
CCA ZONE 3 STATE CONSERVATION AREA
NATIONAL PARK
NATURE RESERVE
State Forests
Vegetation on other tenures
ESG boreholes
40
0
40
80 Kilometers
N

Map 1.


Coal Seam Gas Exploration and Production in the Pilliga Forest
Data held under licence. Seismic survey and pipeline data derived from digitising hard copy maps.
Seismic Surveys
Major Pipeline
Pilot Production Wells
Other coal seam gas wells
ABORIGINAL AREA
CCA ZONE 1 NATIONAL PARK
CCA ZONE 2 ABORIGINAL AREA
CCA ZONE 3 STATE CONSERVATION AREA
NATIONAL PARK
State Forests
Native Vegetation on Other Tenures
10 0 10 20 Kilometers
N

Map 2.

Map 1 depicts the extent of the PEL238 and PAL2 and their location in relation to the Pilliga Forest and Map 2 depicts the extent of 'the action' within the Pilliga Forest, as derived by environment groups using available data sources. It is notable that the majority of the impacts that have occurred are the result of coal seam gas production to supply the Wilga Park Power Station for commercial gain, and have not been incurred through purely exploratory activities.

There is no evidence that the combined impacts of these activities on matters of national environmental significance have ever been considered by Eastern Star Gas. On the contrary, a review of it's considerations as contained in numerous Reviews of Environmental Factors conducted under s111 of the NSW Environmental Planning and Assessment Act 1979, indicates that each small activity has only ever been considered in isolation and the entire 'action' has never been addressed in accordance with the Guidelines.

Attachment 1 provides a fully referenced list of each component of the 'action', and more detail as to their location and characteristics.

Furthermore, there is nothing in the Significant Impact Guidelines that provide any special exemption or apply any lesser considerations to the activity of petroleum exploration. In fact, the Guidelines specifically state that that an action includes petroleum resource exploration and extraction, as follows:

'Action' is defined broadly in the EPBC Act and includes: a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. Actions include, but are not limited to: construction, expansion, alteration or demolition of buildings, structures, infrastructure or facilities; industrial processes; mineral and ***petroleum resource exploration and extraction****; storage or transport of hazardous materials; waste disposal; earthworks; impoundment, extraction and diversion of water; agricultural activities; aquaculture; research activities; vegetation clearance; culling of animals; and dealings with land. Actions encompass site preparation and construction, operation and maintenance, and closure and completion stages of a project, as well as alterations or modifications to existing infrastructure.* [Emphasis added]

An appendix to the Guidelines provides some more detailed advice to proponents in terms of determining in what circumstances, some selected sectoral activity is likely to have a significant impact on a matter of national environmental significance. This includes the provision of additional advice for the mineral exploration sector.

This appendix is not considered relevant for a number of reasons:

1) There is no reference in the appendix to the petroleum exploration sector.
2) It relates only to exploration, and the majority of Eastern Star Gas impacts in the Pilliga forest area are related to commercial production of petroleum for use in the Wilga Park power station.
3) The appendix itself states that '*it should not be taken to be conclusive*' and that '*it should be read in conjunction with the significant impact criteria in the guidelines*'.

Therefore, in this report 'the action', which includes commercial production of coal seam gas and exploration, is assessed in relation to the significant impact guidelines.

Matters of National Environmental Significance

There are 24 matters of national environmental significance, as defined by the *Environment Protection and Biodiversity Conservation Act* 1999, which occur within PEL 238 and PAL2 . These include known, likely, and potential habitat for 15 nationally threatened species (4 endangered, 11 vulnerable), and known or potential habitat for 9 migratory birds listed under the CAMBA and JAMBA conventions.

The EPBC Act 1999 makes it illegal to undertake an activity that has, or is likely to have, a significant impact on these matters of national environment significance. These prohibitions are set down in Part 3 of the EPBC Act 1999, in s16, s18 and s20 respectively, which read as follows:

"Subdivision C—Listed threatened species and communities

18 Actions with significant impact on listed threatened species or endangered community prohibited without approval

(3) A person must not take an action that:
  (a) has or will have a significant impact on a listed threatened species included in the endangered category; or
  (b) is likely to have a significant impact on a listed threatened species included in the endangered category.

(4) A person must not take an action that:
  (a) has or will have a significant impact on a listed threatened species included in the vulnerable category; or
  (b) is likely to have a significant impact on a listed threatened species included in the vulnerable category."

"Subdivision D—Listed migratory species

20 Requirement for approval of activities with a significant impact on a listed migratory species

(1) A person must not take an action that:
  (a) has or will have a significant impact on a listed migratory species; or
  (b) is likely to have a significant impact on a listed migratory species."

Likely significant impact

The meaning of 'significant impact' under the EPBC Act 1999 is not defined in the Act or Regulations. However, SEWPaC (then DEH) has published *Significant Impact Guidelines for Matters of National Environmental Significance*. These guidelines provide the following advice in relation to the 'significance' of an impact:

> *"A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant*

impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. You should consider all of these factors when determining whether an action is likely to have a significant impact on matters of national environmental significance" (DEH 2006).

This report will establish that coal seam gas exploration, production and associated activities in PEL238 and PAL2 are having, or are likely to have, a significant impact on matters of national environmental significance, and that as such, it should be called-in by the Minister for the Environment (if not immediately referred by Eastern Star Gas).

In relation to deciding whether an impact is 'likely', the DEH Guidelines (DEH 2006) specify that:

> *To be 'likely', it is **not** necessary for a significant impact to have a greater than 50% chance of happening; it is sufficient if a significant impact on the environment is a **real or not remote** chance or possibility. If there is scientific uncertainty about the impacts of your action and potential impacts are serious or irreversible, the precautionary principle is applicable. Accordingly, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on the environment.*

The report will show that there is a real chance or possibility of significant impacts from that coal seam gas exploration, production and associated activities in the Pilliga Forest. The potential impacts of the action are both serious and irreversible, and given the lack of scientific certainty about the potential impacts of that coal seam gas exploration, production and associated activities in the Pilliga Forest, the precautionary principle must be applied, and the matter urgently referred to the Commonwealth or 'called-in'.

Exemptions

There are a number of potential 'exemptions' to the provisions of the EPBC Act 1999 in relation to matters of national environment significance and to the determination of a matter as a 'controlled action'.

The prohibitions relating to matters of national environmental significance in s16, 18 & 20 described above do not apply if:

(e) "an approval of the taking of the action by the person is in operation under Part 9 for the purposes of this section; or

(f) Part 4 lets the person take the action without an approval under Part 9 for the purposes of this section; or

(g) there is in force a decision of the Minister under Division 2 of Part 7 that this section is not a controlling provision for the action and, if the decision was made because the Minister believed the action would be taken in a manner specified in the notice of the decision under section 77, the action is taken in that manner; or

(h) the action is an action described in subsection 160(2) (which describes actions whose authorisation is subject to a special environmental assessment process)".

In relation to that coal seam gas exploration, production and associated activities in PEL 238, it is found that none of these exemptions apply, because:

(a) there is no approval under Part 9

(b) Part 4 does not allow the action to be taken without an approval

(c) no decision has been made by the Commonwealth Minister that the proposed action is not a controlled action

(d) section 160 is not relevant.

Part 4 sets out a number of cases in which a Part 9 approval is not required. We have addressed each of the relevant cases below to show that none of these circumstances apply to that coal seam gas exploration, production and associated activities in PEL 238, and thus that it is not exempt under that Part.

The relevant cases set down in Part 4 for which environmental approvals are not needed, are:

i Actions declared by agreement not to need approval (s29)
ii Actions covered by Ministerial declarations and accredited management arrangements or accredited authorisation processes (s32)
iii Actions covered by Ministerial declarations and bioregional plans (s37A)
iv Actions declared by conservation agreement not to need approval (s37M)
v Certain forestry operations in regions covered by a Regional Forest Agreement (s38) or regions subject to the process of negotiating a Regional Forest Agreement (s40)
vi Actions with prior authorisations (s43A); and
vii Actions which are lawful continuations of use of land etc (s43B)

Each of these is addressed in turn below, with regard to how they relate to coal seam gas exploration, production and associated activities in PEL 238.

i In January 2007, the Commonwealth and NSW governments signed a Bilateral Agreement which allows the assessment regimes under the Environmental Planning and Assessment Act 1979 (Parts 3A, 4 and 5 of the EP&A Act) to be automatically accredited under the EPBC Act (http://www.planning.nsw.gov.au/environmentalassessment/comm.asp). This means that separate assessment processes are not required. The Bilateral Agreement only covers matters that are determined to be 'controlled actions' by the Commonwealth Government.

However, the 2007 Commonwealth/NSW Bilateral Agreement relates only to assessment regimes, and there is no Bilateral Agreement (nor any clause in the current Bilateral Agreement) which declares that coal seam gas exploration, production and associated activities in PEL 238 is an action, or one of a class of actions, that does not require approval under Part 9 for the purposes of the provision.

ii Coal seam gas exploration, production and associated activities in PEL 238 are not subject to a bilaterally accredited management arrangement or a bilaterally accredited authorisation process exempting them from a need for approval under Part 9.

iii There is no bioregional plan in place and no Ministerial declaration exempting coal seam gas exploration, production and associated activities in PEL 238 from a need for approval under Part 9 with reference to any such plan.

iv There is no conservation agreement in place that exempts coal seam gas exploration, production and associated activities in PEL 238 form the need for approval under Part 9.

v RFAs are not relevant to coal seam gas.

vi The definition of actions with prior authorisation, is set out in section 43A as follows:

"(1) A person may take an action described in a provision of Part 3 without an approval under Part 9 for the purposes of the provision if:

a) the action consists of a use of land, sea or seabed; and

b) before the commencement of this Act, the action was authorised by a specific environmental authorisation; and

c) immediately before the commencement of this Act, no further specific environmental authorisation was necessary to allow the action to be taken lawfully; and

d) at the time the action is taken, the specific environmental authorisation continues to be in force.

(1A) For the purposes of paragraphs (1)(c) and (d), a renewal or extension of a specific environmental authorisation is taken to be a new specific environmental authorisation unless:

a) the action that is authorised by the authorisation following the renewal or extension is the same as the action that was authorised by the authorisation before the commencement of this Act; and

b) the renewal or extension could properly be made or given without any further consideration of the environmental impacts of the action.

Note: If a renewal or extension of a specific environmental authorisation is taken to be a new specific environmental authorisation, the condition in paragraph (1)(c) or (d) would not be met.

(2) In this Act:

***environmental authorisation** means an authorisation under a law of the Commonwealth, a State or a self-governing Territory that has either or both of the following objects (whether express or implied):*

(a) to protect the environment;

(b) to promote the conservation and ecologically sustainable use of natural resources.

***specific environmental authorisation** means an environmental authorisation that:*

(a) identifies the particular action by reference to acts and matters uniquely

associated with that action; or

(b) was issued or granted following a consideration of the particular action by reference to acts and matters uniquely associated with that action".

There was no specific environmental authorisation for coal seam gas exploration, production and associated activities in PEL 238 and PAL2 that was in place before the commencement of the EPBC Act in 2000.

vii The definition of actions which are lawful continuations of use of land are set out in s43B as follows:

"43B Actions which are lawful continuations of use of land etc.

(1) A person may take an action described in a provision of Part 3 without an approval under Part 9 for the purposes of the provision if the action is a lawful continuation of a use of land, sea or seabed that was occurring immediately before the commencement of this Act.

(2) However, subsection (1) does not apply to an action if:

(a) before the commencement of this Act, the action was authorised by a specific environmental authorisation; and

(b) at the time the action is taken, the specific environmental authorisation continues to be in force.

Note: In that case, section 43A applies instead.

(3) For the purposes of this section, neither of the following is a ***continuation*** *of a use of land, sea or seabed:*

(a) an enlargement, expansion or intensification of use;

(b) either:

(i) any change in the location of where the use of the land, sea or seabed is occurring;

or

(ii) any change in the nature of the activities comprising the use;

that results in a substantial increase in the impact of the use on the land, sea or seabed".

Although one or two coal seam gas wells may have been drilled by a predecessor of Eastern Star Gas just prior to the commencement of the EPBC Act in 2000, the actions of each company including Eastern Star Gas since that time represents an enlargement, expansion and intensification of use, and therefore does not constitute a lawful continuation.

Referral

Part 7 of the EPBC Act 1999 designates actions as 'controlled actions' if they are prohibited by Part 3 of the Act (because they have, or are likely to have, a significant impact on matters of national environmental significance). In relation to 'controlled actions', s 67A of the Act states that:

> "A person must not take a controlled action unless an approval of the taking of the action by the person is in operation under Part 9 for the purposes of the relevant provision of Part3".

Furthermore, s68 of the Act requires that:

> "A person proposing to take an action that the person thinks may be or is a controlled action must refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action".

Eastern Star does not have an approval under Part 9 of the Act, and as shown above, it is not exempt from requiring an approval under any of the provisions of Part 4.

Conclusion

Therefore, we believe the Commonwealth Minister for the Environment must urgently call in existing exploration and pilot production activities being undertaken by Eastern Star Gas in PEL238 and PAL2 as controlled actions under the EPBC Act 1999 (s70).

GENERAL ASSESSMENT OF THE ACTION

The *Significant Impact Guidelines for Matters of National Environmental Significance* (DEH 2006) specify four major elements that should be considered when making a decision about referral of an action to the Minister by a proponent, and provide guidance on how they should be considered.

These are as follows:

> *"1. Are there any matters of national environmental significance located in the area of the proposed action (noting that 'the area of the proposed action' is broader than the immediate location where the action is undertaken; consider also whether there are any matters of national environmental significance adjacent to or downstream from the immediate location that may potentially be impacted)?*
>
> *2. Considering the proposed action at its broadest scope, is there potential for impacts on matters of national environmental significance?*
>
> *If there are matters of national environmental significance in the vicinity of your proposed action, you need to consider whether there is potential for your proposed action to impact upon those matters.*
> *The proposed action should be considered at its broadest possible scope. This includes all stages and components of the action, all related activities, and all related infrastructure such as roads and powerlines, if applicable.*
> *If the action consists of a series of activities or a number of related activities, you should consider the impacts of each activity, and then consider the combined impacts of those activities.*
> *It is also necessary and important to consider off-site and indirect impacts of your proposed action on matters of national environmental significance.*
>
> *3. Are there any proposed measures to avoid or reduce impacts on matters of national environmental significance?*
>
> *It is important to consider the environmental impacts of the proposed action early in the planning of the proposal. Careful planning of the action can avoid, or reduce, the likelihood of a significant impact on matters of national environmental significance. Where possible and practicable it is best to avoid impacts. If impacts cannot be avoided then they should be minimised or mitigated as much as possible.*
> *You should consider impacts on matters of national environmental significance in relation to the following:*
> - *site selection and the location of buildings or activities on the selected site;*
> - *the timing of the action or its component activities; and*
> - *the design of any buildings, or other structures or infrastructure.*
>
> *However you should not conclude that a significant impact is not likely to occur because of management or mitigation measures unless the effectiveness of those measures is well-established (for example through demonstrated application, studies or surveys) and there is*

a high degree of certainty about the avoidance of impacts or the extent to which impacts will be reduced.

4. Are any impacts of the proposed action on matters of national environmental significance likely to be significant impacts?

In order to decide whether an action is likely to have a significant impact, it is necessary to take into account the nature and magnitude of potential impacts. In determining the nature and magnitude of an action's impacts, it is important to consider matters such as:

10. *the sensitivity of the environment which will be impacted;*
11. *the timing, duration and frequency of the action and its impacts;*
12. *all on-site and off-site impacts;*
13. *all direct and indirect impacts;*
14. *the total impact which can be attributed to the action over the entire geographic area affected, and over time;*
15. *existing levels of impact from other sources; and*
16. *the degree of confidence with which the impacts of the action are known and understood."*

This report aims to undertake an assessment of whether coal seam gas exploration, production and associated activities in PEL 238 and PAL2 require referral under the EPBC Act 1999, in accordance with the DEH guidelines quoted above. It will show, in relation to these activities and the EPBC Act 1999, that:

1. There are 24 matters of national environmental significance in the area of the action.
2. There is potential for the action to impact on these matters – especially when it is properly considered in terms of the combined impact of a number of related activities including disturbance footprint, area subject to fragmentation, increased fire risk, well-pad clearance, corehole clearance, access track clearance, pipeline clearance, seismic survey clearance, water treatment clearance, produced water disposal, and the creation of impoundments.
3. The measures in place to avoid or reduce impacts are not adequate to prevent such impacts, and their effectiveness is uncertain and not scientifically established.
4. The impacts are likely to be significant impacts because of their intensity, the extraordinary national and international conservation significance of the environment in which they are occurring, the sensitivity of the ecosystem given the scale of extinctions that have already occurred in the regional mammalian fauna and the scale of decline now evident in the bird fauna, the substantial geographic area affected, the high cumulative impact in the context of other threats (other mining and gas developments, background clearing rates, climate change, invasive species, logging, and high intensity and frequent fires), the low level of confidence with which the impacts are understood, and the context in which they occur of a heavily cleared and highly fragmented landscape with very low levels of reservation.

Each of these four considerations is addressed generally below, and where appropriate more specific detail is provided in the following sections on each matter of national environmental significance. The aim has been to replicate the process that Eastern Star should have undertaken to determine whether a referral is necessary under the EPBC Act 1999, and to thus make an

objective determination of the need for referral in accordance with DEWHA Guidelines (DEH 2006).

Matters of national environmental significance

A review of the Atlas of NSW Wildlife, available literature, and Eastern Star Gas documents indicates that there are 24 matters of national environmental significance, as defined by the *Environment Protection and Biodiversity Conservation Act* 1999, for which known or likely habitat occurs within the Pilliga Forest section of PEL 238 and PAL2[5] or, in the case of the Murray Cod, which occurs downstream from the Pilliga Forest and is likely to be affected by the action.

These include:

Regent Honeyeater – Endangered
Malleefowl – Vulnerable
Swift Parrot – Endangered
Superb Parrot - Vulnerable
Pilliga Mouse - Vulnerable
South-eastern Long-eared Bat – Vulnerable
Spotted-tailed Quoll – Endangered
Large-eared Pied Bat – Vulnerable
Grey-headed Flying Fox – Vulnerable
Murray Cod - Vulnerable
Tylophora linearis - Endangered
Collabah Bertya (*Bertya opponens*) - Vulnerable
Philotheca ericifolia - Vulnerable
Cobar Greenhood Orchid (*Pterostylis cobarensis*) - Vulnerable
Rulingia procumbens - Vulnerable

Migratory species

Migratory species that are known or likely to occur within the Pilliga Forest include the following:
Regent Honeyeater (*Xanthomyza Phrygia*)
Swift Parrot (*Lathamus discolour*)
Cattle Egret (*Ardea ibis*)
Fork-tailed Swift (*Apus pacificus*)
Great Egret (*Ardea alba*)
Rainbow Bee-eater (*Merops omatus*)
White-Bellied Sea Eagle (*Haliaeetus leuccogaster*)
Satin Flycatcher (*Myiagra cyanoleuca*)
White-Throated Needletail (*Hirundapus caudacutus*).

5 Eastern Star Gas 2011

Significance of Impacts

Intensity, Magnitude and Geographic Extent

Environment groups have utilised the results of the audit of 'the action' conducted previously in this document to conduct an analysis of the impacts on native vegetation, and thence on MNES. 'The action' has largely taken place in the eastern section of the Pilliga Forest, although there are also components of it that have occurred on cleared land to the north and east.

Map 2 depicts the full extent of 'the action' within the Pilliga forest to date, according to the best available data. This map delineates all of the coreholes that have been drilled, the pilot production wells that are in operation, the gas and water gathering pipelines that have been constructed and the seismic survey lines that have been run.

Utilising this map-based data, the action has been assessed as having the following impacts on the environment:

- Increased disturbance footprint across an area of approx 44,700 ha of native vegetation
- Increased ignition sources from multiple infrastructure and vehicle movements, and introduction of a flammable gas into an already fire prone environment leading to increased frequency and intensity of fires
- Heavy fragmentation of an area of 1,700 ha of native vegetation, leading to direct impacts on fauna and flora populations and indirect impacts through the spread of invasive species
- Direct destruction of at least 150 ha of native vegetation that is likely habitat for matters of NES.
- Creation of 13 major artificial watering points which are predominantly saline, plus numerous additional small drill ponds, representing a risk to wildlife
- Introduction of numerous sources of pollution through the use of chemicals and the handling and disposal of produced water (ie diesel spills, flood overflow events)
- Direct alteration of the ecology of a creek system for up to 22km

Attachment 2 sets out in detail as to how those impacts were quantified.

Bibblewindi Treatment Plant. Photo: T.Pickard.

Sensitivity, value and quality

The Pilliga Forest has outstanding conservation significance. It is the largest temperate woodland left in eastern Australia, and it forms the southern recharge area of the Great Artesian Basin and contributes surface water flows to the Murray-Darling Basin.

The Pilliga Forest is the largest remnant left in the heavily cleared Wheat-Sheep Belt of NSW. It covers an area of approximately 500,000 hectares in size. It is the major biodiversity refuge area for flora and fauna in western NSW and is a critical asset for adaptation to human-induced climate change.

Eastern Star Gas themselves have described the importance of the Pilliga as follows "*The remnant has national, state and regional conservation significance for the protection of biodiversity and threatened species due to its large size (> 500 000 hectares), high threatened species diversity and high quality habitat*"[6].

The Pilliga is recognised internationally as an Important Bird Area under the BirdLife International scheme. The Pilliga Forest is described as follows in the Important Bird Area site fact sheet "*This large block of woodland supports strong populations of the vulnerable Painted Honeyeater and near threatened Diamond Firetail, irregular numbers of the endangered Swift Parrot and Regent*

6 Eastern Star Gas. July 2009. Review of Environmental Factors: 2009 Narrabri Coal Seam Gas Program Dewhurst 8 Lateral Production Pilot.

Honeyeater and the near-threatened Bush Thick-knee, and good numbers of other declining woodland birds"[7].

It goes on to say that "*The woodlands support the largest population of Barking Owls and other declining woodland species in NSW. One hundred and seventy bird species were recorded in the IBA during surveys in 1991-1993 (Date et al. 2002) and in 1999-2000 (NSW NPWS 2000) and over 200 bird species recorded for the Pilliga (D. Johnston pers. comm.)*".

The area has recognised wilderness values, and more than 117,698 hectares have been recognised as meeting the criteria for the National Wilderness Inventory[8] including large areas of the Pilliga East State Forest. The area was nominated close to a decade ago for wilderness identification under the NSW Wilderness Act 1987. However, Legal exemptions and changes have since made it impossible for that nomination to proceed, but the wilderness significance of the area remains.

The area provides habitat for at least 24 matters of national environmental significance, 48 threatened plants and animals under the NSW Threatened Species Conservation Act 1995[9] and at least 5 endangered ecological communities under state or federal legislation as well as numerous regionally significant species.

It provides habitat for the only known population of the endemic Pilliga Mouse, the largest Koala population in NSW west of the Great Divide and one of only two known Black-striped Wallaby populations in NSW. It is recognised as the national stronghold for the South-eastern Long-eared Bat.

Context

The Brigalow Belt South bioregion is recognised by the Federal Government as one of only 15 national biodiversity hotspots within Australia[10]. The bioregion has the highest number of resident bird species of any bioregion in Australia, and it is also one of the top ten bioregions for richness and levels of endemism of the original mammal fauna[11]. It is located in an overlap zone with temperate, semi-arid and sub-tropical influences resulting in high species diversity[12].

The Brigalow Belt South bioregion is very poorly reserved. The bioregion has less than 5% of it's land area within the National Reserve System, and is a recognised high priority nationally for large new reserves[13].

The environment in the BBS region is in severe decline. The region is well recognised as one of the most endangered and heavily cleared bioregions in Australia, with reliable estimates that 70% of the original woody vegetation in the bioregion has been cleared. It is vegetated by temperate

7 http://www.birdlife.org/datazone/sitefactsheet.php?id=23856
8 RACD 2002b
9 Eastern Star Gas 2010. Preliminary Environmental Assessment.
10 http://www.environment.gov.au/biodiversity/hotspots/national-hotspots.html
11 NHT 2002
12 RACD 2002a
13 http://www.environment.gov.au/parks/nrs/science/pubs/ibra_regions.pdf

woodlands that as a broad vegetation formation have had more than 90% of their original distribution cleared across the continent[14].

More than 14 mammal species are already believed to be extinct in the region, which represents one of the highest extinction rates in Australia. Species that are now presumed extinct include the Western Quoll, Red-tailed Phascogale, Western Barred Bandicoot, Bilby, White-footed Rabbit-Rat, Greater Stick-Nest Rat, Brush-tailed Bettong, Burrowing Bettong, Eastern Hare-wallaby, Bridled Nailtail Wallaby, Plains Mouse, Gould's Mouse, Eastern Chestnut Mouse, and Hopping Mouse[15].

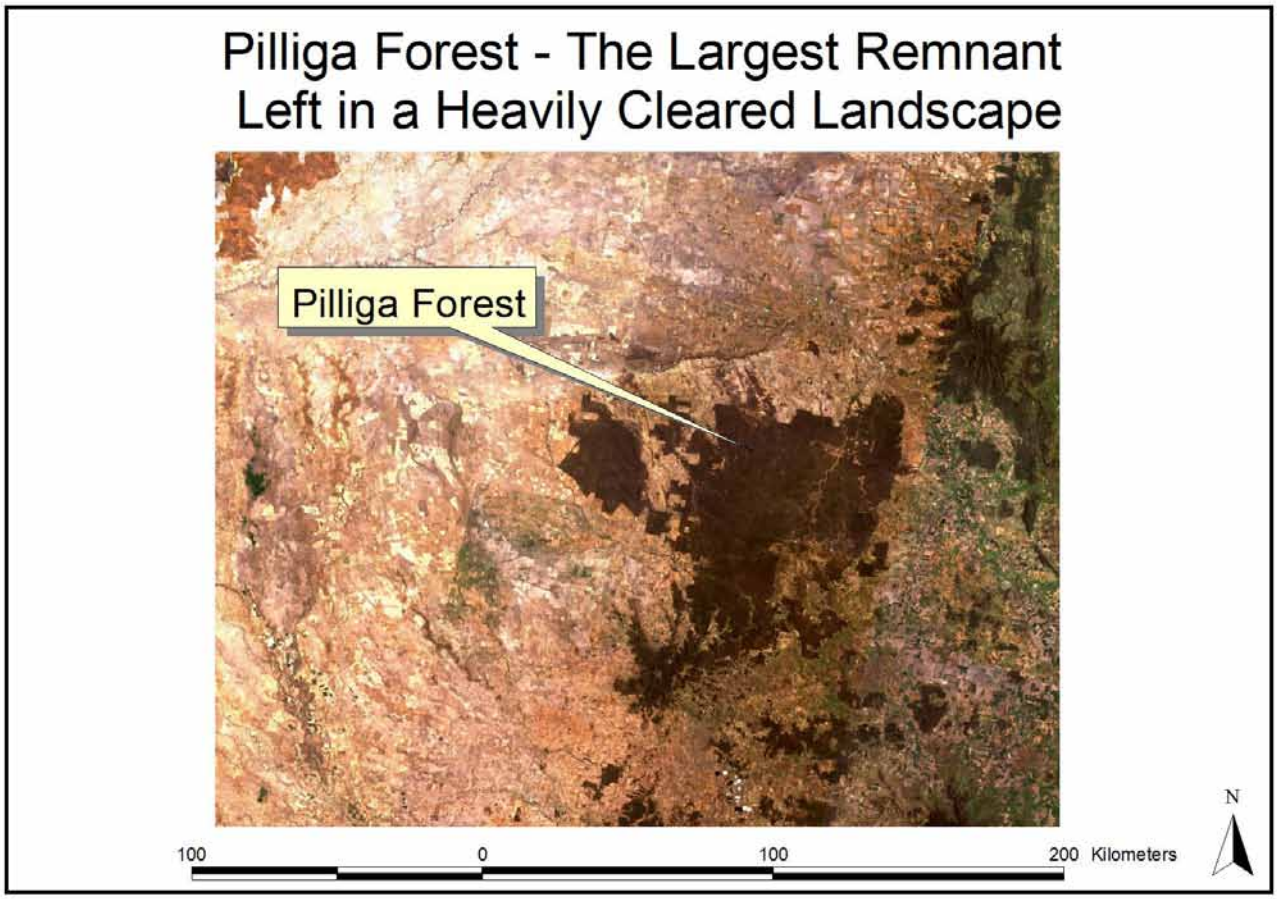
Furthermore, even common mammal species such as the Common Ring-tailed and Common Brush-tailed Possums are thought to have declined and are now uncommon to rare in the BBS study area[16].

Similarly, many woodland birds of the Sheep-Wheat belt are experiencing a wave of local and regional extinctions across their ranges with more than 60 species, or 25% of all woodland bird species, recognised as threatened or declining[17].

Therefore, the Pilliga Forest is located in a landscape which is incredibly diverse and significant, but which is severely threatened and has experienced extreme extinction rates in the past and now faces on-going and protracted declines in fauna and flora. The ecological importance of the 500,000 ha refuge which the Pilliga Forest provides in that context is enormous.

14 http://www.abs.gov.au/ausstats/abs@.nsf/0/9A0C82D0F59158DCCA256BDC0012240D?opendocument
15 RACD 2002a
16 NPWS 2000b, Milledge 2002

17 Reid 1999, Reid 2000, Traill and Robinson 1996



Existing impacts from other sources

The Brigalow Belt South bioregion and the Pilliga Forest both face a number of very serious and on-going threats, which had to a substantial cumulative impact on the environment and matters of NES.

There are four open-cut coal mines currently proposed or approved just east of Narrabri, which will collectively clear at least 5,500 hectares of native vegetation, and there is an estimated background rate of agricultural clearing in the Namoi Catchment of 1-5% of vegetation each year. The Pilliga Forest is also subject to logging for cypress and some limited volumes of ironbark timber and utilised for domestic firewood collection. Climate change is expected to represent a serious and on-going threat to the vegetation of the region. Invasive species and inappropriate fire regimes also represent a grave threat to the future of the Pilliga Forest, with numerous new weed species currently spreading rapidly through the Namoi Catchment and with frequent intense, hot fires having caused considerable degradation already over the last decade.

Confidence levels

The Guidelines require consideration of "*the degree of confidence with which the impacts of the action are known and understood".*

The impacts of the action are very poorly understood. Firstly, the entire action and it's cumulative impact has never been considered. Secondly, the level of knowledge and assessment of the areas

affected by the action are markedly inadequate. Eastern Star Gas themselves acknowledge that the eastern section of the Pilliga Forest where they are undertaking these activities is poorly surveyed.

Eastern Star Gas state that[18]:

"The Pilliga East State Forests have received little detailed attention in terms of botanical surveying to assess the type and quality of floral composition or the presence of threatened floral species, populations or ecological communities and potential habitat for faunal species.

The Pilliga East State Forest has received little detailed attention in terms of systematic fauna surveying to assess the presence of threatened faunal species, populations or ecological communities and potential/actual habitat."

Despite this recognised paucity of knowledge, Eastern Star Gas repeatedly rely on the existing 'knowledge base' as the only grounds for undertaking impact assessments. For example, in relation to the Dewhurst-8 Lateral Production Pilot, they state that:

"The basis for the assessment of impacts on the native flora species and vegetation communities posed by the ongoing exploration activities has been formed from the knowledge base developed from flora impact assessments carried out to date. The following survey reports make up the knowledge base and are considered sufficient to provide an understanding of the actual, likely and potential impacts associated with the proposed activity:
• Clements, A & Moore, R. (2002). Review of Existing Flora Data: PEL238 Pilliga East Seismic Survey, Anne Clements & Associates Pty Ltd, North Sydney, NSW
• Elks, G.N. (2005). PEL238 Coal Seam Gas Flora Survey – Bibblewindi Nine Spot, Idyll Spaces Environmental Consultants, Bonville NSW
• Elks, G.N. (2006). PEL238 Coal Seam Gas Flora Survey – Water Management Facility, Idyll Spaces Environmental Consultants, Bonville NSW
• Elks, G.N. (2007). PEL238 Narrabri Coal Seam Gas Project Pipeline Flora Survey, Idyll Spaces Environmental Consultants, Bonville NSW

The assessment of impacts on the native fauna posed by the Dewhurst-8 pilot relies on the existing knowledge base on fauna impact assessments carried out to date. Survey reports from the following field surveys have been consulted and are considered sufficient to provide an understanding of the actual, likely and potential impacts associated with the proposed activity:
*• **Kendall, K. (2005).** Fauna Study PEL238 Coal Seam Gas Project - Bibblewindi Nine Spot, Kendall & Kendall Ecological Consultants, West Kempsey NSW*
*• **Kendall, K. (2006).** Fauna Study PEL238 Coal Seam Gas Project - Water Management Facility, Kendall & Kendall Ecological Consultants, West Kempsey NSW*
*• **Kendall, K. (2007).** Fauna Study PEL238 Narrabri Coal Seam Gas Project Pipeline, Kendall & Kendall Ecological Consultants, West Kempsey NSW*
*• **Smith, A. 2002.** PEL238 Pilliga East Seismic Survey: Fauna Review, AUSTECO Environmental Consultants, Armidale, NSW."*

18 Eastern Star Gas. July 2009. Review of Environmental Factors: 2009 Narrabri Coal Seam Gas Program Dewhurst 8 Lateral Production Pilot.

However, on closer inspection, it is apparent that the four surveys to which they refer were confined to a very limited geographic area, and were not undertaken anywhere in the vicinity of the Dewhurst-8 Lateral Production Pilot. The same is the case for most, if not all, of the other gas wells, infrastructure and pipelines/gathering systems that have been constructed as part of the action.

It is apparent from all available Reviews of Environmental Factors and other information, that the extent of survey undertaken for the entire extent of 'the action' within the Pilliga forest is extremely restricted to:

- An area of approximately 72 hectares in a single location near the Bibblewindi Nine Vertical Production Pilot
- Along a single pipeline length of approximately 15km
- In relation to one seismic survey conducted in 2002.

This is vastly inadequate, given that an area of 1,700 hectares has been fragmented, a disturbance footprint of 44,700 ha applied, pipelines and seismic surveys covering over 538.6km have been undertaken, and 150ha of native vegetation destroyed.

The level of knowledge on which 'the action' has been taken is demonstrably inadequate to properly assess the impacts with any confidence. The information is clearly an inadequate basis on which to conduct a valid impact assessment.

Measures put in place to avoid or reduce impacts

A review of the operation of Eastern Star Gas operations indicates that the measures that have been put in place to avoid or reduce impacts are inadequate.

In particular, field assessment of Eastern Star Gas operations and advice from local landholders have confirmed that remediation and rehabilitation of sites such as well-heads has been unsuccessful on most occasions, weed invasions of cleared areas are common, pollution events have been recorded and wildlife have been found dead at saline ponds. There have been very significant tree deaths from saline water spillage/leakage at a number of coal seam gas wells in the Pilliga. The worst events occurred in 2001/2002, but there are also contemporary examples. These areas have, to date, not been rehabilitated. Further information can be provided on these specific problems with operation of the exploration and pilot production program. A number of photos of some of these problems are provided in this document.

There has little or no successful rehabilitation of abandoned drill holes and there are numerous serious weed incursions at almost every corehole that has been drilled in the Pilliga forest. This is despite the fact that REFs require 'the removal of imported materials and the rehabilitation of the site',

The standard conditions contained in REFs compiled by ESG for rehabilitation are as follows (ESG 2008):

"*At the completion of the drilling and core collection activities, well logging and the plug and abandonment procedures, rehabilitation activity can commence. The process includes the removal of all imported soil materials, the replacement of sub and topsoils and the return of natural contours to assist with erosion control. The strategy to enhance the natural regeneration of the site involves the retention of all vegetative material removed from the site in addition to the stripping and stockpiling of topsoils. This material is stockpiled during site preparations and re-spread across the site after the topsoils have been replaced; the strategy is designed to provide a physical barrier to the incidental losses of topsoils and seed stock from site during the regeneration period. The encouragement of seed germination and providing additional topsoil stability during regeneration has proven to be an effective method of rehabilitating sites within shorter timeframes where climatic conditions are conducive to regeneration i.e. mild temperatures, average rainfall during summer and when foraging resources are plentiful*".

The fact is that rehabilitation of well sites is not occurring as required within the Pilliga forest and numerous photos are available to confirm this.

We conclude that the measures put in place by Eastern Star Gas to avoid or mitigate impacts are inadequate to prevent such impacts, and their effectiveness is uncertain and not scientifically established.

Dewhust 6c Photo: T.Pickard.

Nationally Threatened Species

Bird Species

The area of Pilliga Forest within PEL238 and PAL2, is likely to contain habitat for the Endangered Regent Honeyeater (*Xanthomyza phrygia*). There is also likely habitat for the Endangered Swift Parrot (*Lathamus discolour*) and Vulnerable Superb Parrot (*Polytelis swainsonii*) to occur in the area. The vulnerable Malleefowl has been known to previously occur in the area, but it has not been recorded for at least a decade. Nevertheless, the area must still be considered as suitable, known habitat for this species which may expand it's range now that the recent drought has broken.

Regent Honeyeater

The Atlas of NSW Wildlife identifies two records of the Regent Honeyeater in the vicinity of the areas where 'the action' has occurred. These records are located in the Pilliga Nature Reserve, and the Pilliga East State Forest.

There exist recorded breeding events for the Regent Honeyeater within Pilliga Nature Reserve. This is significant given that breeding is generally concentrated around a small number of other areas.

The Regent Honeyeater is know to be a nomadic species, and suitable foraging habitat occurs within the area of the Pilliga where 'the action' has been undertaken. The recent EPBC referral for future production projects in PEL238 and PAL2, produced for Eastern Star Gas, state that it is "considered likely that the species occurs" within that area[19].

The direct vegetation clearance, heavy vegetation fragmentation, and extended disturbance footprint that has occurred as a result of 'the action' has all occurred in areas that are likely habitat, and also potentially breeding habitat, for the Regent Honeyeater.

The species is identified in the Regent Honeyeater *(Xanthomyza phrygia)* Recovery Plan 1999-2003[20] as having:

- specialised habitat requirements
- significant reductions in extent of habitat
- demonstrable reduction in habitat quality throughout its range
- apparent reliance on a small number of favoured sites
- clear reduction in range in recent decades (probably on-going in central Victoria)
- low population level
- low population densities over a large proportion of the range with aggregations occurring for breeding

19 Trolley 2011
20 Menkhorst, P., Schedvin, N., Geering, D. (1999)

- [and as having]… no obvious, straightforward or quick solutions to the postulated causes of the population decline. Only long-term changes to land management, on both public and private land, will lead to a significant improvement.

There is a strong possibility that the actions conducted in the PEL238 and PAL 2 area to-date may have impacted and may impact significantly on the Regent Honeyeater.

As likely foraging and potentially breeding habitat for a species that has specialised habitat requirements, and has suffered both quality and extent reductions of its habitat, any impact that reduces the quality of available habitat may impact the viability of the species in the area. As noted in the National Recovery Plan for the Regent Honeyeater:

> *Regent Honeyeaters opportunistically utilise patches of habitat. Therefore, it is essential to maintain adequate patches of suitable habitat to provide for the needs of the species under all contingencies of climate and land use.*

Additionally, as the activities undertaken, particularly in regards to clearing for infrastructure such as well pads, ponds, and water treatment infrastructure, are permanent, or will at least persist over periods of years to decades, the duration of impact is considerable.

There has been no effort made to quantify the overall area of impact or the likelihood of cumulative impacts of multiple projects.

The Pilliga, whilst containing large areas of habitat, is already impacted by a considerable degree of fragmentation due to logging roads, and logging itself. Additional clearance adds to the cumulative impact of previous actions on habitat quality.

There appears to have been limited or in some cases no assessment of the impacts of the various coal seam gas infrastructure projects on the Regent Honeyeater in the area. There also appears to have been limited or in some cases no assessment of the species' use of the area.

Dewhurst Complex. Photo: T.Pickard.

Bibblewind 23 Drill Pond. Photo: T.Pickard.

Mammal Species

Nationally threatened mammal species that are known to occur in the Pilliga Forest within which 'the action' has occurred, include the vulnerable South-eastern Long-eared Bat (*Nyctophilus corbeni*) and the Vulnerable Pilliga Mouse (*Pseudomys pilligaensis*). Other species that are likely to occur include the endangered Spotted-tailed Quoll (*Dasyrus maculates*), the vulnerable Grey-headed Flying Fox (*Pteropus poliocephalus*) and the vulnerable Large-eared Pied Bat (*Chalinolobus dwyeri*).

Pilliga Mouse

The Pilliga Mouse is endemic to the Pilliga Forest, and relies on habitats with a high species richness, moderate to low shrub cover, and a moist groundcover of plants, litter and fungi. A recent EPBC referral document for the new Narrabri Coal Seam Gas production project identified that "*it is likely that the Project area [*which encompasses the same area as 'the action*'] supports part of an important population of Pilliga Mouse given that the population within the project area is near the north eastern limit of the species population range, and the species is restricted to the Pilliga region of NSW*"[21].

21 Tolley 2011

Map 4 shows the modelled distribution of Pilliga Mouse habitat in the Brigalow Belt South, revealing that there are large areas of modelled high probability habitat in the eastern Pilliga Forest where 'the action' has occurred.

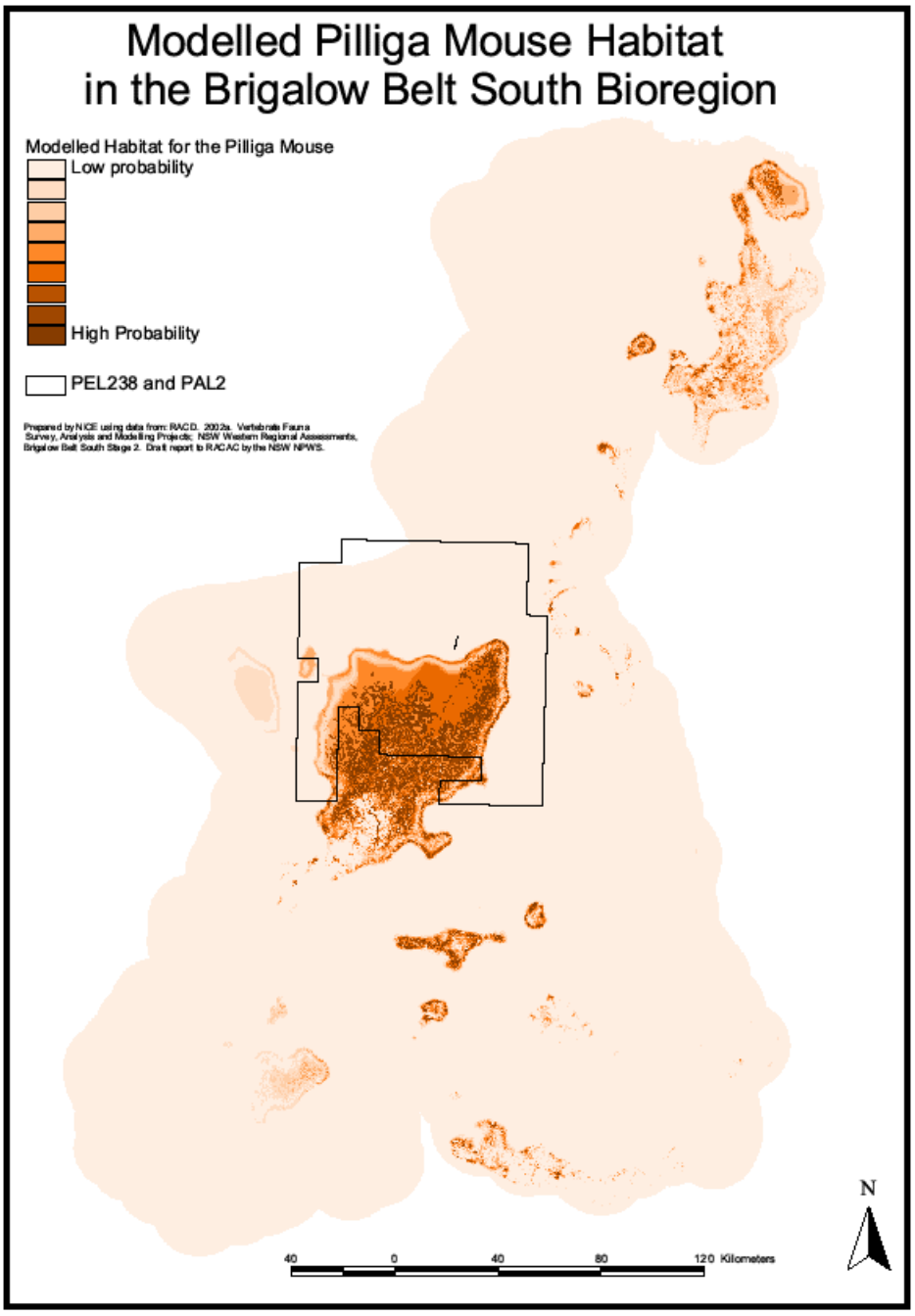
Tolley (2011) identifies a number of potential impacts from the proposed production pilot which apply equally to 'the action' that is already occurring. This includes the potential to increase the spread of invasive predator species, and consequent increased rates of predation; the increased fragmentation from access tracks and dispersed clearance potentially creating unfavourable microclimates, open space, and traffic disturbances (in addition to existing tracks). The loss of habitat would also appear significant.

The susceptibility of the species to clearance, alteration to preferred habitat, and the impacts of fragmentation indicate sensitivity of the species to the action already conducted by Eastern Star Gas. The duration of the impacts (in the order of years to decades for clearance) would also indicate significant impacts.

The species appears to be particularly susceptible to alterations in fire regimes, and any understanding of impacts should require an assessment of the potential for increased or altered fire regimes as a result of developments. The impacts of increased traffic on dispersal should also be addressed.

There is limited knowledge of the species, and little to no assessment of the impacts on the species as a result of individual and cumulative projects undertaken by Eastern Star Gas to date.

The recent assessment by Tolley (2011), in regards to the 2011 Narrabri Coal Seam Gas Project referral, concluded that "*given the population of Pilliga Mouse in the project area is considered an important population and the potential for impacts described above, the development may have a significant impact on the species*". We contend that 'the action' as undertaken to date in a program of exploration and pilot production is likely to have a similarly significant impact, given that it has cast a disturbance footprint of 44,700 hectares, and heavily fragmented 1,700 hectares of vegetation and directly cleared 150 ha, whilst increasing fire risks.



South-eastern Long-eared Bat

The Pilliga, including the Pilliga East State Forest, is the recognised national stronghold of the South-eastern Long-eared Bat *N. timoriensis*[22]. Breeding occurs in tree hollows, and the species forages close to vegetation and around tree trunks, and within a limited range (several kilometres) of roosting sites[23]. Map 5 shows the modelled distribution of South-eastern Long-eared Bat habitat in the Brigalow Belt South, revealing that there are large areas of modelled high probability habitat in the eastern Pilliga Forest where 'the action' has occurred.

22 Turbill and Ellis 2006
23 Ibid

There is strong evidence to show that larger, intact forest remnants are important to the species, with surveys in central western NSW showing '*a tenfold difference in relative abundance between trapping sites within large continuous forest remnants compared to small forest areas*'[24]. In particular, Turbill & Ellis (2006) found that '*While previously captured infrequently and in low numbers, recent surveys have revealed that the large remnants of woodland in the Goonoo, Pilliga West and Pilliga East study areas are a distinct stronghold in the distribution of the south-eastern form of N.timorensis*'. They concluded that "*these larger remnants of box/ironbark/cypress woodland are needed to support high densities of N. timoriensis"*. Other factors that have been implicated in describing its distribution within the scientific literature include warmer over-wintering areas, highly drained soils, and oldgrowth vegetation[5].

It is estimated that within NSW, 75% of the eastern part of this species' range has already been cleared[25]. As noted in the Draft Recovery Plan[26]: *'Habitat loss may have not only removed Southeastern Long-eared Bat habitat such as roosting sites, but also potentially threatens the viability of remaining populations by fragmentation of remaining habitat (see below) and the impacts of dryland salinity.*

While clearing for agriculture has been the greatest reason for clearing mallee and woodland habitat, additional threats are emerging that are targeting remaining areas of habitat, such as various open cut coal, natural gas and mineral sand mining proposals".

Therefore, gas developments have already been recognised as a threat to this species, and the associated habitat fragmentation that the Eastern Star Gas exploration and pilot production program has caused must pose a similarly major threat.

The Draft Recovery Plan states that:

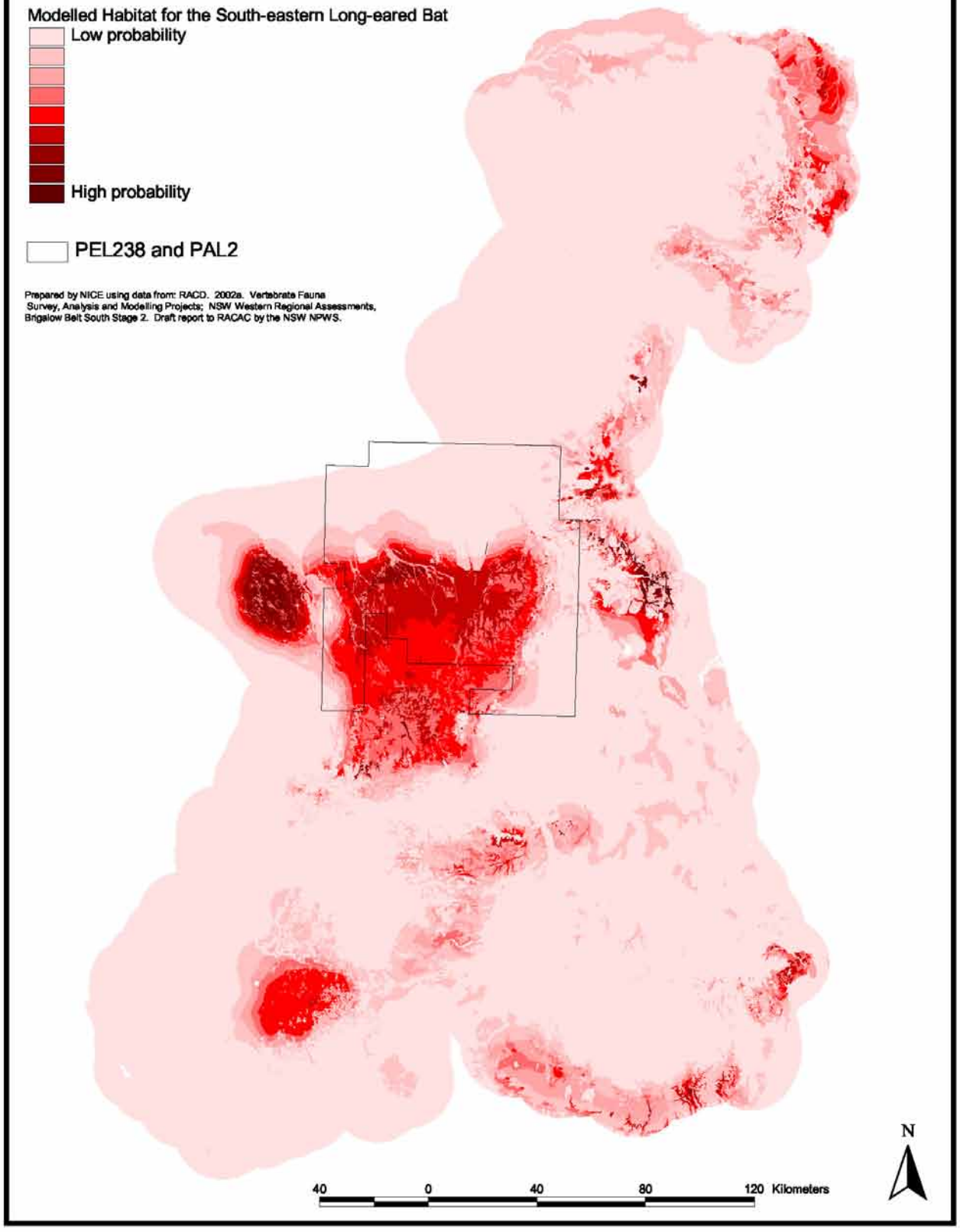
"Before European settlement, mallee and woodland habitats were extensive and nearly contiguous across inland eastern Australia (Specht 1981). However, clearing for agriculture has resulted in fragmentation of suitable habitat for this species. Trapping results and initial modelling strongly suggest this species is affected by fragmentation, with it displaying a preference for larger forest remnants (Pennay 2002; Turbill & Ellis 2006). Small isolated populations may be especially vulnerable to local extinction by a range of processes that may deplete the number of individuals or degrade the overall fitness of each population (Denniston 1978; Shaffer 1981). Fragmentation of South-eastern Long-eared Bat habitats may also exacerbate other threats. For example, foxes and feral cats are probably more abundant near cleared land (Saunders et al. 1995); habitat fragments may be completely burnt by wildfire or control burns, potentially leading to local extinction where sources for recolonisation no longer exist; and fragmentation may increase the exposure of this bat to agrichemicals....."

In addition, the reliance on tree hollows for breeding and roosting, and the limited range of individuals, would suggest that the species may be particularly sensitive to clearing in particular areas and to increased fire risk, with this being exacerbated given the long-term to permanent clearance of areas for infrastructure.

24 Schulz & Lumsden, 2010.
25 Schulz & Lumsden, 2010.
26 Ibid

There is sufficient evidence available on the threats to the South-eastern Long-eared Bat to conclude that the action is likely to have a significant impact on it.

Modelled South-eastern Long-eared Bat Habitat in the Brigalow Belt South Bioregion



Spotted-tailed Quoll

The Spotted-tailed Quoll was recorded in the Pilliga in the 1990s[27]. Whilst there is no recent evidence of the species, the rarity of this species would indicate a need for more substantive surveys.

The NSW Government threatened species profile recognizes the following threatening processes that can be considered likely to have a significant impact on the species[28]:

- Loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development, logging and frequent fire (Edgar & Belcher 1995; Dickman & Read 1992; NPWS in prep.)
- Loss of large hollow logs and other potential den sites (Scotts 1992)
- Competition for food and predation by foxes and cats (Edgar & Belcher 1995; Dickman & Read 1992).

It is very difficult to make an informed assessmnt of the likely impact of coal seam gas operations on this species. The fragmentation of habitat, and the creation of access roads and cleared areas is likely to increase the accessibility of the area to competing predators.

Threatened Plants

The following nationally threatened plant species have been identified as known or likely to occur in the Pilliga Forest within PEL238 and PAL2.

Tylophora linearis - endangered
Collabah Bertya (*Bertya opponens*) - vulnerable
Philotheca ericifolia - vulnerable
Cobar Greenhood Orchid (*Pterostylis cobarensis*) - vulnerable
Rulingia procumbens - vulnerable

The endangered *Tylophora linearis* is known to occur in dry woodlands consisting of *Eucalyptus fibrosa, Callitris endlicheri, C. glaucophylla* and *Allocasuarine leuhmannii*, as occurs in the area where 'the action' is occuring. Although there are no records of this species in the area, there is high potential for it to occur.

The largest population of *Bertya opponens* occurs in the Jack's Creek State Forest, just to the north of the PAL 2 area, and it has been observed recently just outside the PAL 2 area[29]. *Philotheca ericifolia* has also been recorded within the Pilliga East State Forest, and *Rulingia procumbens* is known from within the PAL 2 area. No meaningful consideration appears to have been given to the impacts of clearance, fragmentation, increased weed invasion and increased fire risk on these species.

27 Paull, D.C., and Date, E.M. (1999).
28 www.environment.nsw.gov.au/resources/nature/tsprofileSpottedtailedQuoll.pdf
29 Tolley 2011

Comparison with other referred actions

In order to gauge how the impact of 'the action' compares with other referred actions with regard to both scale and the number of MNES that are affected, we have conducted a review of a random sample of five referred actions that are currently on the EPBC referrals website. The results are presented below in Table 1.

Table 1. Profile of a random sample of five referred actions

Project	**Referral Number**	**Disturbance Footprint**	**MNES**
Monomeath Development Pty Ltd, Residential Development	2011/5972	44.8ha mostly cleared	6
Auralandia NL 3 dimension marine seismic survey	2011/5961	1,600km	20
North Tuncurry Mixed Use Development	2011/5954	625 vegetated	19
Mitchell Line to Muswellbrook Power Line Project	2011/5930	39ha	6
Tarrawonga Coal Project	2011/5923	517ha of which 312ha is vegetated	16
Eastern Star Gas Coal Seam Exploration and Pilot Production Program	**Not referred**	**44,700ha disturbance footprint, 1,700 heavy fragmentation, 150 ha direct clearance**	**24**

The results of the comparison indicate that actions which affect far fewer MNES and which have far fewer impacts in terms of scale and intensity are routinely referred to the Federal Government under the EPBC Act 1999.

Conclusion

To restate the Guidelines in relation to assessing a significant impact:

"*A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends*

upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts".

It appears that significant impacts may have occurred, or are likely to occur, on several matters of national environment significance as a result of coal seam gas exploration and pilot production projects in PEL 238 and PAL 2 within the Pilliga Forest.

Detailed review of a number of species conducted above indicates that the threatened species that are most likely to be negatively impacted by 'the action' as it has been undertaken to date are the Pilliga Mouse, South-eastern Long-eared Bat, Regent Honeyeater, Spotted-tailed Quoll and several threatened plant species.

REVISED SIGNIFICANT IMPACT GUIDELINES

This report has primarily assessed 'the action' in relation to the 2006 Significant Impact Guidelines (DEH) because they are the guidelines that were in operation when the majority of the impacts were incurred in PEL238 and PAL2.

However, new guidelines have more recently been released. These 2009 Significant Impact Guidelines Matters of National Environment Significance contain near identical provisions to all of the relevant clauses in the 2006 Guidelines that have been addressed throughout this document. The key clauses from the 2009 Guidelines are provided in full below.

It is apparent from these clauses that applying the 2009 Guidelines to 'the action' leads to the exact same conclusion as does application of the 2006 Guidelines - that it is likely to have a significant impact on MNES, and that it should be referred to the Federal Government immediately, or called-in.

'Action' is defined broadly in the EPBC Act and includes: a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. Actions include, but are not limited to: construction, expansion, alteration or demolition of buildings, structures, infrastructure or facilities; industrial processes; mineral and petroleum resource exploration and extraction; storage or transport of hazardous materials; waste disposal; earthworks; impoundment, extraction and diversion of water; agricultural activities; aquaculture; research activities; vegetation clearance; culling of animals; and dealings with land. Actions encompass site preparation and construction, operation and maintenance, and closure and completion stages of a project, as well as alterations or modifications to existing infrastructure.

A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts. You should consider all of these factors when determining whether an action is likely to have a significant impact on matters of national environmental significance.

To be 'likely', it is not necessary for a significant impact to have a greater than 50% chance of happening; it is sufficient if a significant impact on the environment is a real or not remote chance or possibility. If there is scientific uncertainty about the impacts of your action and potential impacts are serious or irreversible, the precautionary principle is applicable. Accordingly, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on the environment.

To make a decision as to whether or not to refer an action to the Minister, you should consider the following:
1. Are there any matters of national environmental significance located in the area of the proposed action (noting that 'the area of the proposed action' is broader than the immediate location where the action is undertaken; consider also whether there are any matters of national environmental significance adjacent to or downstream from the immediate location that may potentially be impacted)?

2. Considering the proposed action at its broadest scope (that is, considering all stages and components of the action, and all related activities and infrastructure), is there potential for impacts, including indirect impacts, on matters of national environmental significance?
3. Are there any proposed measures to avoid or reduce impacts on matters of national environmental significance (and if so, is the effectiveness of these measures certain enough to reduce the level of impact below the 'significant impact' threshold)?
4. Are any impacts of the proposed action on matters of national environmental significance likely to be significant impacts (important, notable, or of consequence, having regard to their context or intensity)?

REFERENCES

The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA);

The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Eastern Star Gas. 2004. 2002 Pilliga East Seismic Survey Report, PEL238 Gunnedah Basin NSW.

Eastern Star Gas. December 2006. Bohena Coal Seam Gas Project Review of Environmental Factors: Water Treatment and Disposal Project. PEL238 Gunnedah Basin NSW.

Eastern Star Gas. May 2008a. Review of Environmental Factors: 2008 Narrabri CSG Seismic Survey. PEL238, Gunnedah Basin NSW.

Eastern Star Gas. May 2008b. Narrabri Coal Seam Gas Utilisation Project: Part 3A Environmental Assessment. PEL238 Gunnedah Basin NSW.

Eastern Star Gas. July 2008. Review of Environmental Factors: Narrabri Coal Seam Gas Lateral Program, Lateral Production Pilot A. PAL2 Gunnedah Basin NSW.

Eastern Star Gas. March 2009a. Narrabri Coal Seam Gas Project Review of Environmental Factors: Bibblewindi West Lateral Pilot Gas and Water Gathering System. PAL2 Gunnedah Basin NSW.

Eastern Star Gas. March 2009b. Narrabri Coal Seam Gas Project Review of Environmental Factors: Bibblewindi West Lateral Pilot Gas and Water Gathering System. PAL2 Gunnedah Basin NSW.

Eastern Star Gas. July 2009. Review of Environmental Factors: 2009 Narrabri Coal Seam Gas Program Dewhurst 8 Lateral Production Pilot.

Eastern Star Gas. November 2009. Review of Environmental Factors: 2009 PEL238 Seismic Survey - Coghill, Denison, Dewhurst South, and Edgeroi Prospects. PEL238, Gunnedah Basin NSW.

Eastern Star Gas. February 2010. Tintsfield Water Management Plan. Narrabri Coal Seam Gas Project PEL 238 Gunnedah Basin NSW.

Eastern Star Gas. February 2010. Modification to the Tintsfield CSG Pilot, Supplementary Information. Narrabri Coal Seam Gas Project. PEL238 Gunnedah Basin NSW.

Eastern Star Gas. 2011. Review of Environmental Factors: 2011 Seismic Survey. PEL 6, 238, 427 &428.

Natural Heritage Trust. 2002. *Australian Terrestrial Biodiversity Assessment 2001.* National Land and Water Resources Audit. Commonwealth Government, Canberra.

Menkhorst, P., Schedvin, N., Geering, D. (1999) Regent Honeyeater (Xanthomyza phrygia) Recovery Plan 1999-2003, Department of Natural Resources and Environment, May 1999 <*http://155.187.2.69/biodiversity/threatened/publications/recovery/regent-h-eater/#16*>, accessed 18.6.11

Milledge, D.R. 2002. A survey of large owls in the cypress pine-ironbark forests and woodlands of central western NSW. Unpubl. report to Western Directorate NSW National Parks and Wildlife Service. Landmark Ecological Services, Suffolk Park,NSW.

NSW NPWS 2000b. Brigalow Belt South: Regional assessment (Stage 1) - report on preliminary fauna assessment of Pilliga and Goonoo forests, November 1999 to January 2000. Unpubl. Report. NSW National Parks and Wildlife Service, Dubbo.

Paull, D.C., and Date, E.M. (1999). Patterns of Decline in the Native Mammal Fauna of the North-west slopes of New South Wales. *Australian Zoologist*. **31**: 210 – 224.

RACD. 2002a. Vertebrate Fauna Survey, Analysis and Modelling Projects; NSW Western Regional Assessments, Brigalow Belt South Stage 2. Draft report to RACAC by the NSW NPWS.

RACD 2002b. Summary of Scoping of Wilderness Values: NSW Western Regional Assessments – BBS Stage 2. A report prepared for the Resource and Conservation Assessment Council.

Reid, Julian. 1999. Threatened and Declining Birds in the NSW Sheep-Wheat Belt I: Diagnosis, Characteristics and Management. Unpubl. report. NSW National Parks and Wildlife Service, Sydney.

Reid, Julian. 2000. Threatened and Declining Birds in the NSW Sheep-Wheat Belt II: Landscape relations – modelling bird atlas data against vegetation cover. Unpubl. report. NSW National Parks and Wildlife Service, Sydney.

Robinson, D. and B.J. Traill. 1996. Conserving Woodland Birds in the Wheat and Sheep Belts of Southern Australia. Supplement to Wingspan Vol. 6, No. 2 June 1996.

Tolley (2011) *Referral of proposed action, Narrabri Gas Field Development, April 2011,* Ecological Australia.

Turbill, C. and and Ellis M. (2006) Distribution and Abundance of the South-eastern form of the Greater Long-eared Bat *Nyctophilus Timoriensis*, *Australian Mammalogy*, **28**:1-6.

Attachment 1: Audit of Eastern Star Gas activities in PEL238 and PAL2

Component	Details	Reference
Coal seam gas wells	92 coal seam gas wells mapped in PEL238 & PAL2	From data held on MinView, sourced April 2011 http://www.dpi.nsw.gov.au/minerals/geological/online-services/minview
Seismic surveys	94.5km seismic survey, all within the Pilliga Forest	Eastern Star Gas. 2004. 2002 Pilliga East Seismic Survey Report, PEL238 Gunnedah Basin NSW
	180km seismic survey, all within the Pilliga Forest	Eastern Star Gas. May 2008. Review of Environmental Factors: 2008 Narrabri CSG Seismic Survey. PEL238, Gunnedah Basin NSW.
	120km seismic survey	Eastern Star Gas. November 2009. Review of Environmental Factors: 2009 PEL238 Seismic Survey - Coghill, Denison, Dewhurst South, and Edgeroi Prospects. PEL238, Gunnedah Basin NSW.
	87.6km seismic survey	Eastern Star Gas. 2011. Review of Environmental Factors: 2011 Seismic Survey. PEL 6, 238, 427 &428.
Gas and water gathering pipelines	32km buried gas flowline from Bibblewindi/Bohena to Wilga Park power station (20m wide)	Eastern Star Gas. May 2008. Narrabri Coal Seam Gas Utilisation Project: Part 3A Environmental Assessment. PEL238 Gunnedah Basin NSW.
	5.5km gas and water gathering system at the Bibblewindi West lateral pilot (12m wide)	Eastern Star Gas. March 2009. Narrabri Coal Seam Gas Project Review of Environmental Factors: Bibblewindi West Lateral Pilot Gas and Water Gathering System. PAL2 Gunnedah Basin NSW.
	3.5km gas and water gathering system at the Bibblewindi Nine pilot	Eastern Star Gas. May 2008. Narrabri Coal Seam Gas Utilisation Project: Part 3A Environmental Assessment. PEL238 Gunnedah Basin NSW.
	Estimated 5.7km gas and water gathering at the Bibblewindi lateral pilot	Based on maps provided in: Eastern Star Gas. March 2009. Narrabri Coal Seam Gas Project Review of Environmental Factors: Bibblewindi West Lateral Pilot Gas and Water Gathering System. PAL2 Gunnedah Basin NSW.
	1km gas gathering system at the Bohena production pilot	Eastern Star Gas. May 2008. Narrabri Coal Seam Gas Utilisation Project: Part 3A Environmental Assessment. PEL238

		Gunnedah Basin NSW.
	Estimated 7.4km water gathering system at Bohena	Based on maps provided in: Eastern Star Gas. March 2009. Narrabri Coal Seam Gas Project Review of Environmental Factors: Bibblewindi West Lateral Pilot Gas and Water Gathering System. PAL2 Gunnedah Basin NSW.
	1.7km Dewhurst gas and water gathering (10m)	Eastern Star Gas. July 2009. Review of Environmental Factors: 2009 Narrabri Coal Seam Gas Program Dewhurst 8 Lateral Production Pilot.
	Estimated 1.5km Tintsfield gas and water gathering (10m wide)	Eastern Star Gas. February 2010. Tintsfield Water Management Plan. Narrabri Coal Seam Gas Project PEL 238 Gunnedah Basin NSW.
Infrastructure	Wilga Park Power Station	Eastern Star Gas. May 2008. Narrabri Coal Seam Gas Utilisation Project: Part 3A Environmental Assessment. PEL238 Gunnedah Basin NSW.
	Reverse Osmosis Unit at Bibblewindi Treatment Works	Eastern Star Gas. December 2006. Bohena Coal Seam Gas Project Review of Environmental Factors: Water Treatment and Disposal Project. PEL238 Gunnedah Basin NSW.
	Proposed Reverse Osmosis Unit at Wilga Park Water Management Facility	Eastern Star Gas. February 2010. Tintsfield Water Management Plan. Narrabri Coal Seam Gas Project PEL 238 Gunnedah Basin NSW.
	Gas Compression Station at Bibblewindi Nine Vertical Production Pilot	Eastern Star Gas. December 2006. Bohena Coal Seam Gas Project Review of Environmental Factors: Water Treatment and Disposal Project. PEL238 Gunnedah Basin NSW.
	Proposed gas compression station at Bohena CSG Pilot	Eastern Star Gas. December 2006. Bohena Coal Seam Gas Project Review of Environmental Factors: Water Treatment and Disposal Project. PEL238 Gunnedah Basin NSW.
Water Impoundments	Estimated 2.5ha at three water impoundments at Bibblewindi Water Treatment Works	Eastern Star Gas. December 2006. Bohena Coal Seam Gas Project Review of Environmental Factors: Water Treatment and Disposal Project. PEL238 Gunnedah Basin NSW.
	Estimated 2ha across four evaporation ponds at Bohena 3, 6 and Bohena	Eastern Star Gas. March 2009. Narrabri Coal Seam Gas Project Review of Environmental Factors: Bibblewindi West Lateral Pilot Gas

	South 1 (x2)	and Water Gathering System. PAL2 Gunnedah Basin NSW.
	Estimated 2ha at two water impoundments at Dewhurst 8 Lateral Pilot	Eastern Star Gas. July 2009. Review of Environmental Factors: 2009 Narrabri Coal Seam Gas Program Dewhurst 8 Lateral Production Pilot.
	Four water impoundments at Wilga Park Water Management Facility: Production water 3.5ha Concentrate and buffer 3ha Treated water tank dam	Eastern Star Gas. February 2010. Tintsfield Water Management Plan. Narrabri Coal Seam Gas Project PEL 238 Gunnedah Basin NSW.
Pilot Production Fields	Bohena Production Pilot – Bohena 3, 7, 9	Eastern Star Gas. May 2008. Narrabri Coal Seam Gas Utilisation Project: Part 3A Environmental Assessment. PEL238 Gunnedah Basin NSW.
	Bibblewindi Nine Spot Vertical Production Pilot - Bibblewindi 1, 2, 3, 4, 5, 6, 7, 8, 9	Eastern Star Gas. May 2008. Narrabri Coal Seam Gas Utilisation Project: Part 3A Environmental Assessment. PEL238 Gunnedah Basin NSW.
	Bibblewindi Lateral Pilot or Lateral Production Pilot A - Bibblewindi 12, 13, 14, 15, 16, 17, 18H, 19H, 21H, 27H, 28H, 29H	Eastern Star Gas. July 2008. Review of Environmental Factors: Narrabri Coal Seam Gas Lateral Program, Lateral Production Pilot A. PAL2 Gunnedah Basin NSW.
	Bibblewindi West Trilateral Pilot - Bibblewindi 22, 23, 24, 25, 26H	Eastern Star Gas. March 2009. Narrabri Coal Seam Gas Project Review of Environmental Factors: Bibblewindi West Lateral Pilot Gas and Water Gathering System. PAL2 Gunnedah Basin NSW.
	Tintsfield CSG Pilot - Tintsfield 2H, 3H, 4H, 5, 6, 7	Eastern Star Gas. February 2010. Modification to the Tintsfield CSG Pilot, Supplementary Information. Narrabri Coal Seam Gas Project. PEL238 Gunnedah Basin NSW.
	Proposed Dewhurst 8 Lateral Production Pilot* - Dewhurst 13, 14, 15, 16H, 17H, 18H	Eastern Star Gas. July 2009. Review of Environmental Factors: 2009 Narrabri Coal Seam Gas Program Dewhurst 8 Lateral Production Pilot.
Water Discharge	Discharge of up to 1ML per day into Bohena Creek	Eastern Star Gas. December 2006. Bohena Coal Seam Gas Project Review of Environmental Factors: Water Treatment and Disposal Project. PEL238 Gunnedah Basin NSW.

		Eastern Star Gas. March 2009. Narrabri Coal Seam Gas Project Review of Environmental Factors: Bibblewindi West Lateral Pilot Gas and Water Gathering System. PAL2 Gunnedah Basin NSW.
Roads and tracks	Extensive roads and tracks to service all of the above	Generally not explicitly addressed or quantified as part of REFs or other instruments.

*These wells have been drilled but they are not as yet producing gas for consumption.

ATTACHMENT 2: Impacts of 'the action' on the environment

Overall footprint of disturbance on native vegetation

In order to derive an estimate of the total area of native vegetation that has been subject to disturbance as a result of 'the action', we have utilised a GIS to digitise a polygon around the outer extent of all components (apart from stand alone seismic surveys) within the forested area. This indicated that a total area of 44,700 hectares is the overall footprint for disturbance from 'the action'.

Escalation of fire risk

The presence of approximately 29 pilot production wells in the Pilliga Forest represents a major increase in vehicle use and traffic in the area, dramatically increasing ignition sources. Pilot production wells are checked regularly, and additional drilling frequently occurs for pressure control wells and build wells. The extraction of coal seam gas results in a highly flammable gas being brought to the surface, and experience throughout Australia has shown that coal seam gas production is prone to methane leakage from pipes, joints and wellheads. Local landholders have recently recorded a pipeline in the Pilliga Forest leaking methane. Therefore, we estimate that there has been a manifold increase in fire risk in the Pilliga Forest as a result of the 'the action'.

Heavy fragmentation of native vegetation

In order to derive an estimate of the total area of native vegetation that has been subject to heavy fragmentation as a result of 'the action', we have utilised a GIS to digitise a polygon around the outer extent of the five major pilot production fields in the forested area. This indicated that a total area of 1,700ha of vegetation has been heavily fragmented by 'the action' to date.

Weed and feral animal invasions

Local botanists have advised that there are numerous weeds that have taken over areas that have been disturbed by 'the action', particularly well-heads. Feral animal invasions will undoubtedly also be facilitated by increased fragmentation.

Direct clearing of native vegetation

A detailed analysis of the impacts of 'the action' on native vegetation, indicates that it has led to the estimated direct destruction of approximately 151ha in total within the Pilliga forest. The analysis on which this estimate is based is provided below, with each figure sourced directly from the relevant approval or from a Geographic Information System.

Clearing for production wells and coreholes

There are 66 coal seam gas wells within the core forested area of the Pilliga. We have extracted the dimensions of the well-heads from each relevant REF or approval for each well-head, where available. For wells where information is not available, we have utilised a default dimension of 80mx80m. The result of this analysis is as follows:

12 wellheads 0.8ha in size = 9.6ha
15 coreholes 0.25ha in size = 4ha
38 wellheads 0.64ha in size = 24.32ha
Total coal seam gas well clearing = 37.92ha

Clearing for pipelines, water and gas gathering systems

20m wide,15km gas flowline passing through vegetated areas to Wilga Park = 30ha
12m wide, 5.5km gas and water gathering at Bibblewindi West Pilot = 6.6ha
12m wide, 3.5km gas and water gathering at Bibblewindi Nine Pilot = 4.2ha
12m wide, 5.7km gas and water gathering at Bibblewindi Lateral Pilot = 6.8ha
12m wide, 1km gas and water gathering at Bohena Pilot = 1.2ha
10m wide, 1.7km gas and water gathering at Dewhurst Pilot = 1.7ha
Total pipelines and gathering systems = 50.5ha

Clearing for water impoundments

Three Bibblewindi impoundments = 2.5ha
Four Bohena impoundments = 2ha
Two Dewhurst impoundments = 2ha
Total water impoundments = 6.5 ha

Clearing for seismic surveys

2002 seismic survey, 4m width, estimated 32.5km vegetated[30] = 13ha
2008 seismic survey, 4m width, 27.5km vegetated = 11ha
2009 seismic survey, 4m width, 6km vegetated = 2.4ha
Total seismic survey clearance = 26.4ha

Additional vegetation destruction

Tree deaths due to saline water spillage/leadage = estimated from visual inspection 10 hectares
Excess clearing at Dewhurst 8 Lateral Pilot above the 10ha permitted in the REF = estimated from aerial photographs at least 5 hectares
Estimated additional roads and tracks = 15 hectares
Total additional direct vegetation impacts = 30 hectares

Artificial saline watering points and drill ponds

There are 13 major water impoundments, many of which occur within the Pilliga Forest. Creek systems in the Pilliga are ephemeral, and wildlife are known to flock to artificial surface watering points to drink due to the paucity of natural surface during most seasons. There have been records by local landholders of dead kangaroos adjacent to saline ponds in the Pilliga Forest. The water impoundments are not covered, and are not therefore protected from use by bats and

30 Based on analysis of digitised map in GIS, and comparison with road data, it is estimated that 36.6km out of a total of 94.5km required vegetation clearance and was not located along roads.

birds. There are also drill ponds in the Pilliga Forest from which wildlife are not adequately excluded by fences.

Introduction of sources of pollution

The action has introduced numerous sources of pollution through the extensive use of chemicals and the handling and disposal of produced water

There have been recorded overflows of drill ponds in the Pilliga Forest during flood events and recorded chemical spills, as well as extensive saline water leakage leading to tree deaths.

Direct alteration of the ecology of a creek system for up to 22km

The discharge of treated produced water into the Bohena Creek was estimated in 2006 as amounting to up to 1ML per day[31]. Since that time substantially more pilot production wells have come on line, but there is no updated figure available on the volume of water that is being discharged into the creek.

The original modelling and sensitivity analysis conducted by Eastern Star Gas in 2006[32] indicated that 1ML per day of treated water discharge per day could lead to up to 22km of the creek system being subject to changed flow regimes (ie permanent saturation).

31 Eastern Star Gas 2006
32 Ibid

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Narrabri Project - June 2011

Peter Fox, GM Stakeholder Relations

Corporate Overview

Narrabri Gas Project – June 2011

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Corporate Overview

Prime, well-located CSG Resource

- 1520 PJ 2P reserves (ESG 65%), upgrades to come
- Access to two industrial ports for LNG export
- Proximate to large domestic energy market
- Primary focus Narrabri Gas Project (NGP) in PEL 238

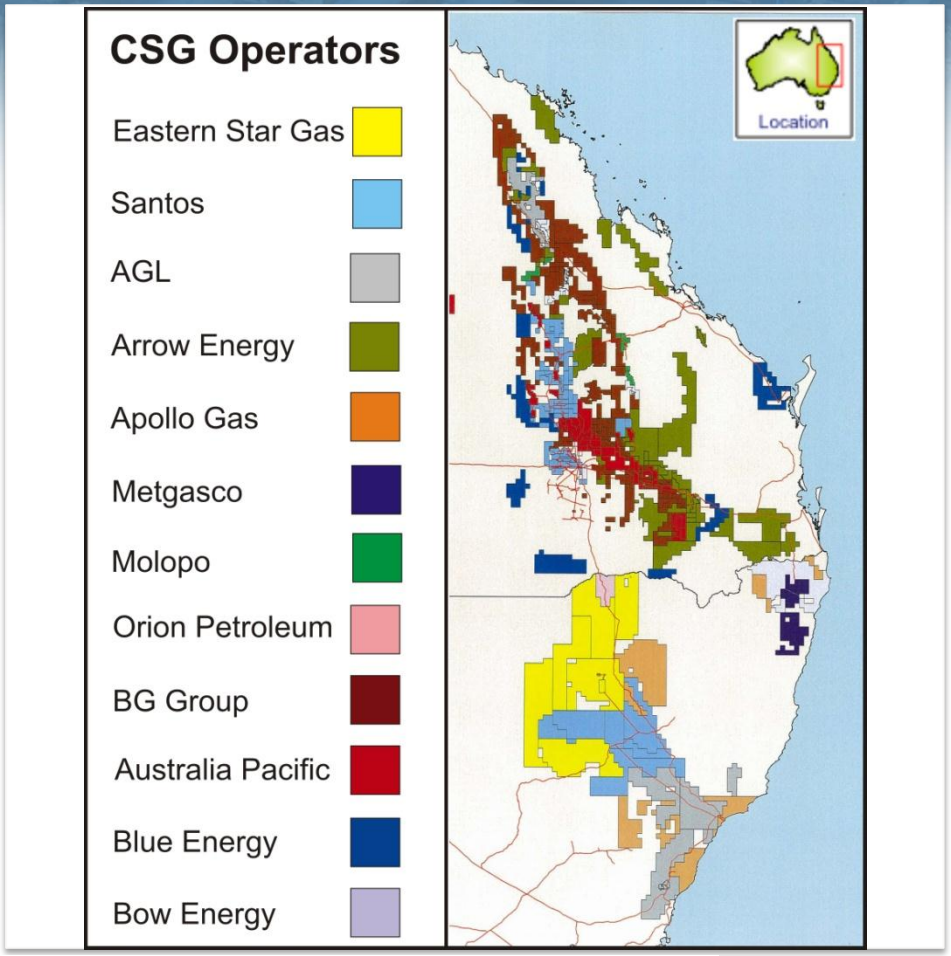
Financially robust

- ASX Top 200
- Stable shareholder base

Proven execution capability

- Management team with deep technical, commercial, financial and project execution experience
- Quality strategic partners

Market Cap. (1 June 2011)	$722 million
Cash (31 March 2011)	$92.4 million
Daily Volume (52 week average)	3.6 million



Positioned to be NSW's leading producer of natural gas and LNG

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The Road to FID...

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Reserves

Narrabri Gas Project – June 2011

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Certified Gas Reserves & Resources

Already sufficient for LNG Newcastle…

Current PEL 238 2P Reserves sufficient for:

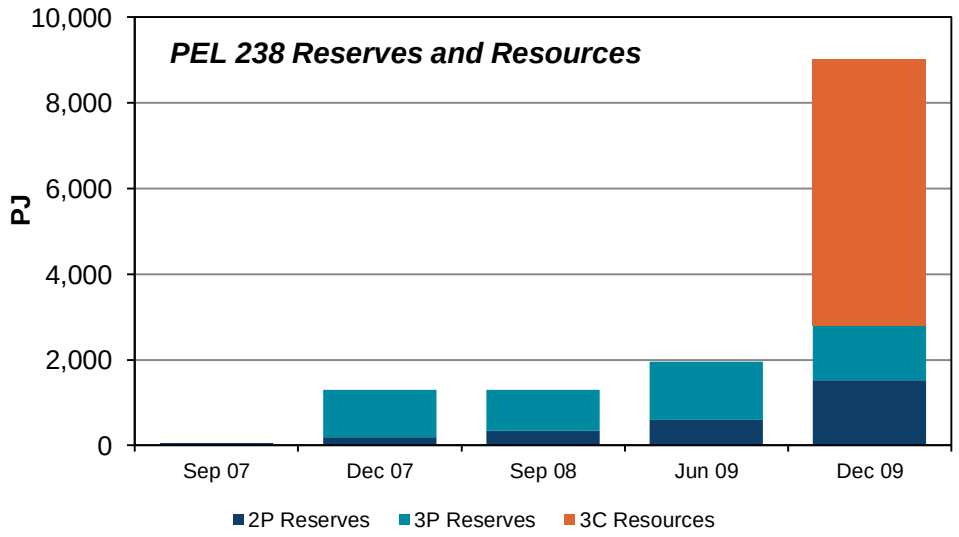
- 1.5 Mtpa LNG export; or
- 2,000 MW domestic power plant @ 60% C.F.

Reserves upgrade due

- Pending results of Tintsfield pilot, delayed due to extended wet weather impacts on water holding facility

PEL 238 Certified Gas Reserves (as at Dec 2009)		
1P	2P	3P
115 PJ	1,520 PJ	2,797 PJ

PEL 238 Certified Contingent Resources (as at Dec 2009)		
1C	2C	3C
1,243 PJ	3,515 PJ	6,215 PJ



Area	Southern PEL 427	PEL 6/427/428
Contingent Resource	475 PJ	536 PJ
Prospective Resource		4,637 PJ
ESG Interest	50%	40-80%

Significant, independently certified reserves base

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Field Development

What makes the Narrabri Gas Project different…

Unique geology

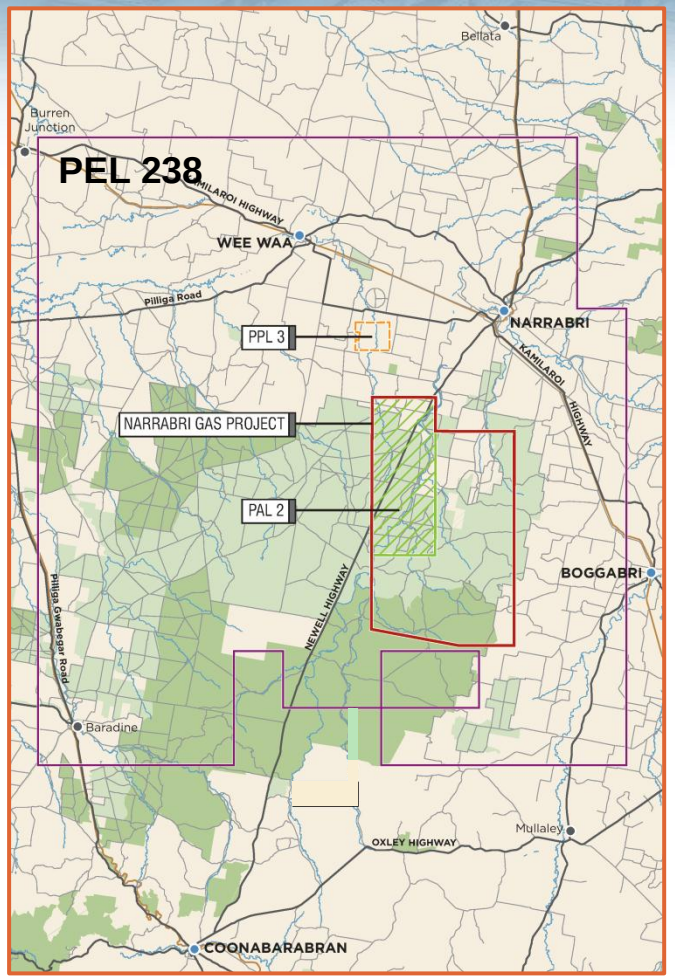
- Deep seams (500m – 1100m) result in high gas contents
- High reserves per hectare – typically thick seams & up to five coal horizons
- Vertical fracturing yields high, directional permeability
- No impact on groundwater resource

Completion technology defined

- High capital efficiency relative to vertical wells
- Lower surface impact
- No fraccing required

Chief landholder is NSW State Government

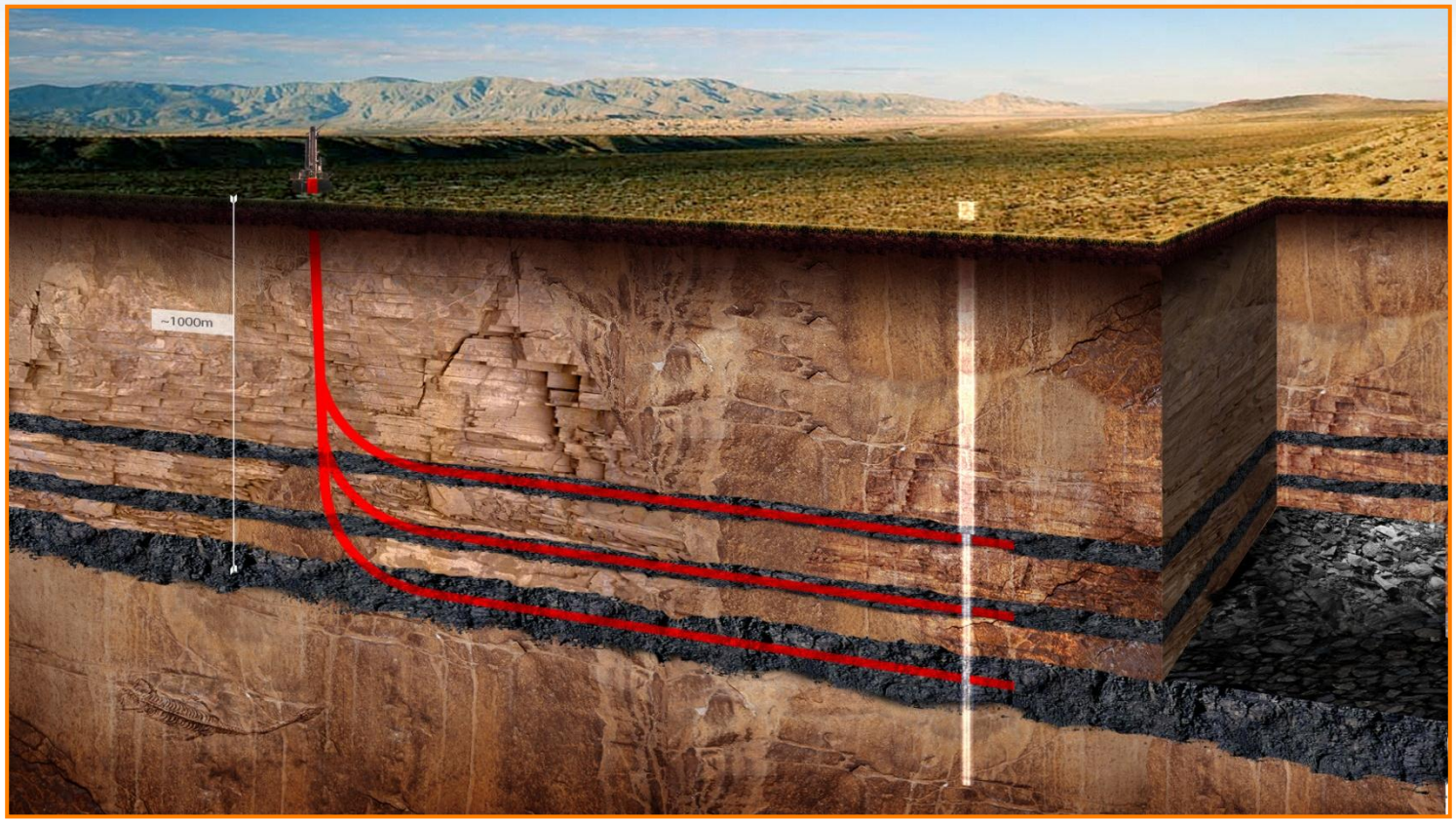
- Long-term land access secured



Unique characteristics make Narrabri Gas Project distinctive

Stacked Laterals

Further enhancing each well set's production…



To date, to assist with reservoir characterisation, each pilot has targeted specific coal horizons.

- None have targeted drilling into all key seams

Horizontal wells can be drilled in multiple seams

- Taps additional reserves and production at only incremental cost
- More reserves and production per well means land use further reduced
- To be tested in current drilling programme

Application of lateral drilling technology can be applied to multiple seams

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Gas Markets

Narrabri Gas Project – June 2011

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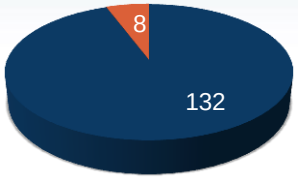
Gas Markets

A Different Proposition to Most…

Domestic Market

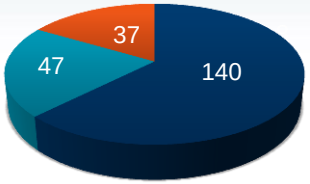
Significant domestic power generation growth

- ESG located close to NSW brownfields sites



Gas Mix (PJ/a)

- Imported (Other Australian states)
- Indigenous



NSW Demand (PJ/a)

- Existing Demand
- Growth 10 years
- Growth 20 years

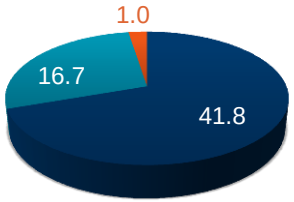
LNG Export Market

ESG is developing mid-scale LNG in Newcastle

- Multiple modular 1 Mtpa trains
- 24 hA Kooragang Island site acquired – sufficient for 4 Mtpa
- Third parties likely to be introduced closer to FID

Plant capacity not large in an Australian (or Asia-Pacific) context

- Potentially different market base



Total Aust LNG (Mtpa)

- Increments to 2020
- Production 2009
- ESG Proposed

Source: APPEA

Image courtesy Toyo Engineering Corporation

Discrete market opportunities can be matched by staged development

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LNG Newcastle

Why a different approach…

Benefits of Mid-scale LNG

- Ideally matched to upstream CSG project
- Low reserves requirement to reach FID
- High-efficiency with operational flexibility
- Ease of ramp-gas management
- Modular design gives cost and time benefits
- $1B for first stage 1 Mtpa development

Aligned with Hitachi and Toyo Engineering

- Strong Japanese partners using Chart IPSMR™
- Front end engineering and design underway
- Project scale suits Japanese market opportunities
- Robust market outlook, focused on Japan

Image courtesy Toyo Engineering Corporation

Potential to achieve first LNG export by 2015

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Infrastructure

Narrabri Gas Project – June 2011

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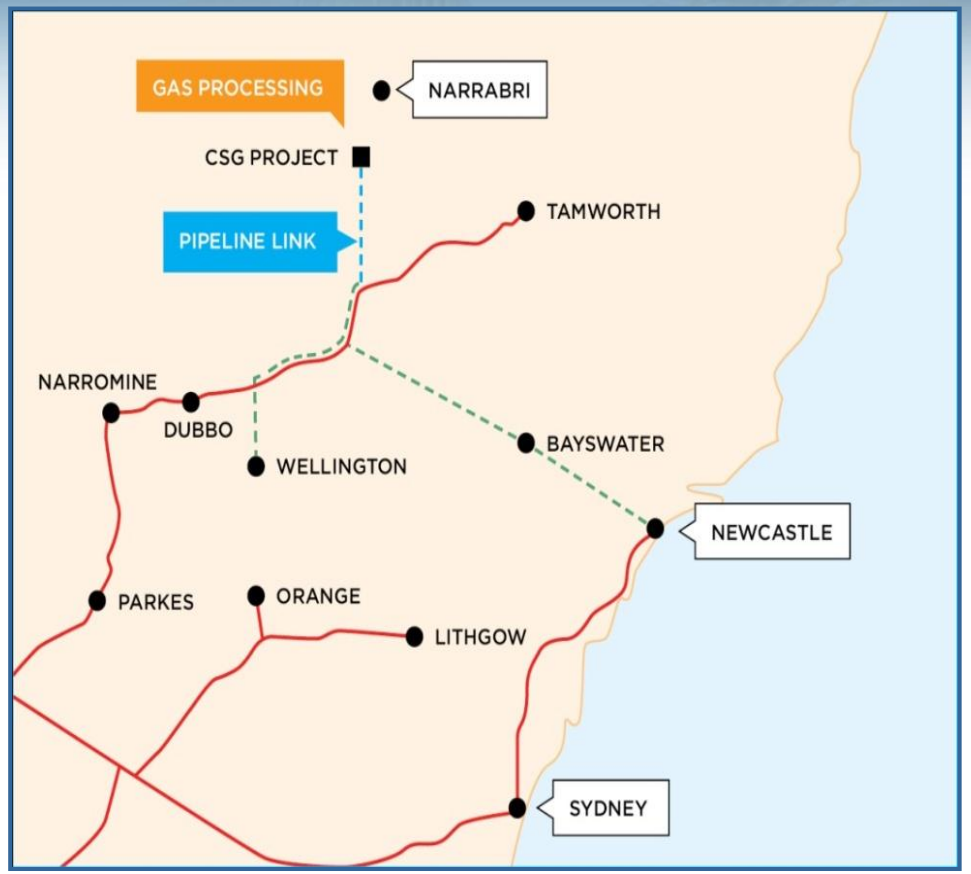
Connecting to the market

ESG is driving pipeline development…



Domestic sales: connect to existing pipelines

- Direct connection to local Narrabri-area sales and potentially large power stations en-route to Newcastle.
- Broader NSW markets accessible via connection to existing gas transmission network.

State-wide markets are in reach

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Sorry Chelsea! I didn't expect you to write about yourself!!!!! I thought perhaps you could put a couple of quick tips in and then I can promote "the tour" around t

Connecting to the market

ESG is driving pipeline development…

LNG sales: new large diameter pipelines

- LNG markets supplied by new large-diameter transmission pipeline.
- Newcastle (new ESG plant) and Gladstone (existing 3rd party plants).

Two LNG export locations accessible

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Approvals

Narrabri Gas Project – June 2011

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Project Status

Regulatory Approvals…

NSW APPROVALS Project Component	PEA Submitted	Major Project Status Awarded	Planning Focus Meeting	Director General's Requirements Issued
Gas Field	7 Sep 2010	23 Sep 2010	7 Oct 2010	7 Dec 2010
Narrabri to Wellington Pipeline	3 Aug 2010	31 Aug 2010	7 Oct 2010	10 Nov 2010
Coolah to Newcastle Pipeline	7 Oct 2010	26 Nov 2010	21 Dec 2010	11 Feb 2010
LNG Newcastle	8 Mar 2011	Pending	Pending	Pending

COMMONWEALTH APPROVALS Project Component	Referral Submitted	Declaration on whether a "Controlled Action"
Gas Field	12 April 2011	Received
Narrabri to Wellington Pipeline	11 April 2011	Received
Coolah to Newcastle Pipeline	14 April 2011	Received
LNG Newcastle	12 April 2011	Received

Each component of the overall project is being progressed in parallel.

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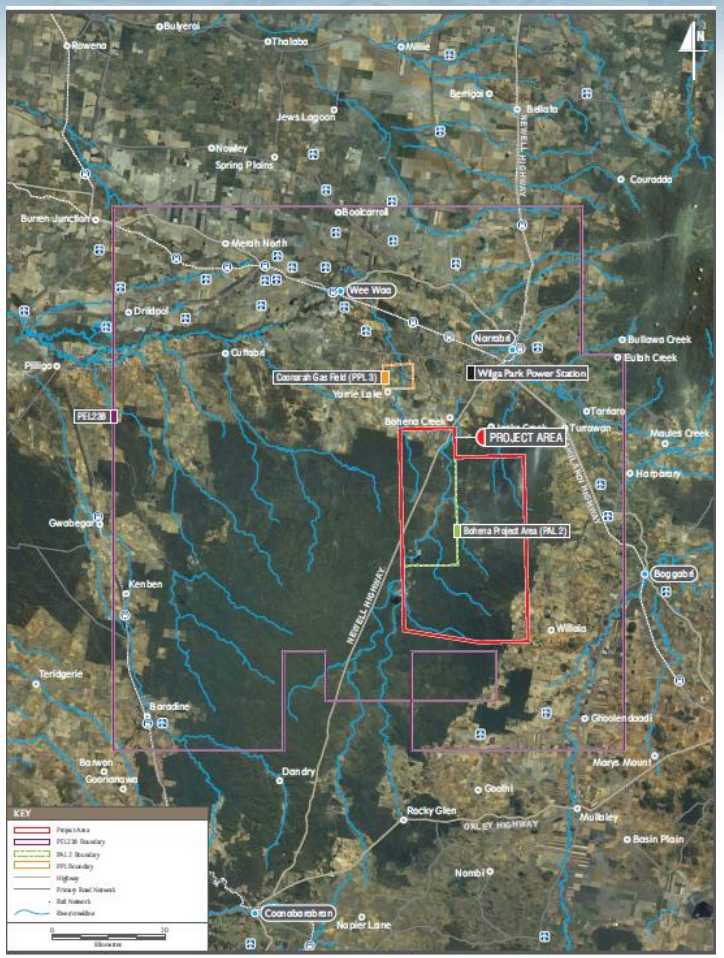
Scale of Field Development

Proposed development outlined…

- The total Project area approximates 85,000 ha and is predominantly within the Pilliga East State Forest.
- Approval sought for:
  - Maximum of 550 well sets;
  - Approx 1000km of gathering systems;
  - Centralised gas processing, compression and water management facilities; and
  - Camp facilities, site offices, workshops, access roads, materials laydown areas etc.
- This development is over 20 years:
  - Some activity predominantly early (eg construction of central facilities);
  - Wells, in particular, will be drilled in a profile over time.



Field development envelope defined for approval process.

Scale of Field Development

Clearing and rehabilitation…

- Estimated initial footprint within the broader project site is approximately 0.5% of the Pilliga.
- Post construction rehab of around half of this area to minimise cumulative impact.
- After all gas is produced, 100% rehab is possible.
- Each well pad requires approximately 1.2 ha to be cleared initially (ie post-rehab area is smaller).
- Wells generally spaced in a grid arrangement with laterals oriented NW-SE.
- Initial wells spaced approx 500m apart, later wells 750m to 1km apart.

Field development envelope defined for approval process.

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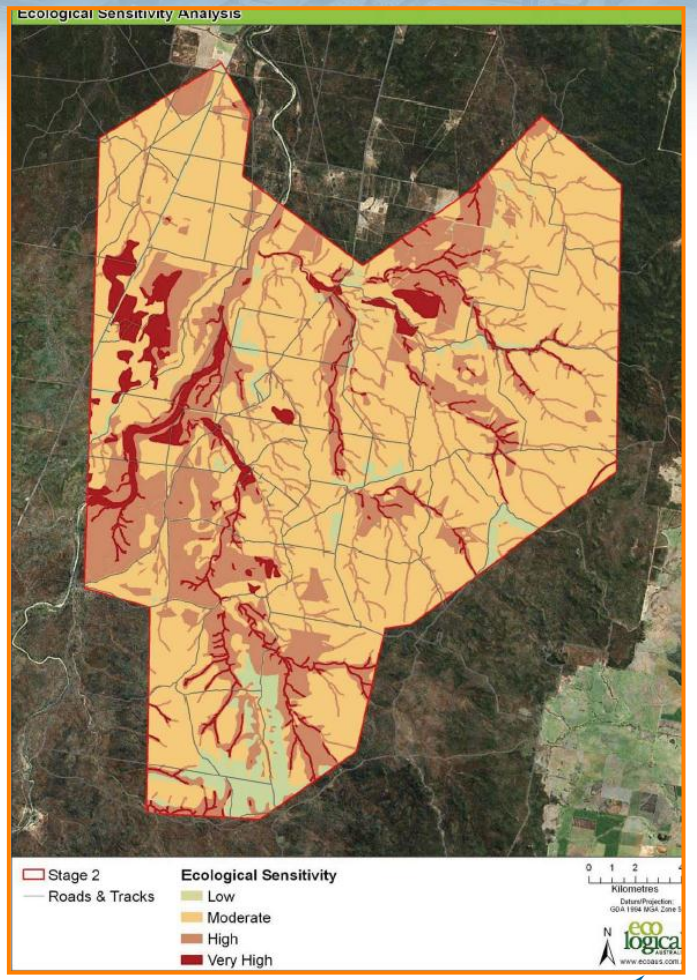
Scale of Field Development

Process for rollout of wells…

- Surface constraints model developed from:
  - high resolution aerial photography;
  - terrain elevation;
  - canopy height model; and
  - existing roads, tracks and trails.
- Final location of gas wells will be determined on a well-by-well basis. Location selection is dependent on geology, resource availability, environment and land access.
  - A process of “micro-siting” wells and infrastructure is proposed to be undertaken for each well site.
- All reasonable and feasible options for reducing surface footprint are being considered:
  - 2 wells per pad;
  - ‘Plough in’ versus ‘clear and trench’ for reduced gathering system corridors; and
  - Partial rehabilitation.



Precise well locations will take account of local conditions.

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Scale of Field Development

Employment and expenditure…

- Employment during construction: 500+.
- Long term employment (operations phase): 200+.

- Indicative capital expenditure: $2.3 billion (20 year investment in today's dollars).
- Initial spend approx $1.3 billion in 2012 – 2013.

- Estimates based on present planning but subject to refinement. Precise ramp up of construction phase is dependent on:
  - Timing and profile of when ESG's customers want gas; and
  - Optimisation and availability of:
    - Materials;
    - Equipment (especially drilling rigs); and
    - People.

Large in scale during construction and operations.

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Some Relevant Legislation, Policies & Guidelines

- Environment Protection and Biodiversity Conservation Act
- National Greenhouse and Energy Reporting Act 2007
- Environmental Planning and Assessment Act 1979
- Petroleum (Onshore) Act 1991
- Pipelines Act 1967
- Water Management Act 2000
- Protection of the Environment Operations Act 1997
- Forestry Act 1916
- Native Vegetation Act 2003
- Threatened Species Conservation Act 1995
- Roads Act 1993
- National Parks and Wildlife Act 1974

- Rural Fires Act 1997
- Catchment Management Act 1989
- Noxious Weeds Act 1993
- State Environment Protection Plans
  - Infrastructure 2007 – SEPP Infrastructure
  - Koala Habitat Protection – SEPP 44
  - Major Projects, 2005 – SEPP Major Projects
- State Environment Planning Policies
  - Mining, Petroleum Production and Extractive Industries, 2007
  - Hazardous and Offensive Industries – SEPP 33
- NSW Biodiversity Strategy 1999
- Narrabri Council Local Environment Plan No 2

The project is subject to a large number of regulatory instruments.

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The Way Forward

Narrabri Gas Project – June 2011

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The Way Forward

2011 through early 2012

- Tintsfield production pilot now online, producing from Hoskissons coal seam
- Determine single go-forward option for upstream (gas field) development
- Stacked lateral production pilot - drilling underway
- Gas reserves upgrade
- Complete FEED for upstream development and LNGN Project
- LNG sales agreements in place
- Project financing arrangements established
- Project development approvals secured
- Commitment to Project development (FID)

Clear pathway to Project commercialisation

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Disclaimer

This presentation may contain forward looking statements that are subject to risk factors associated with oil and gas businesses. It is believed that the expectations reflected in these statements are reasonable but they may be affected by a variety of variables and changes in underlying assumptions which could cause actual results or trends to differ materially, including but not limited to: price fluctuations, actual demand, currency fluctuations, drilling and production results, reserve estimates, loss of market, industry competition, environmental risks, physical risks, legislative, fiscal and regulatory developments, economic and financial market conditions in various countries and regions, political risks, project delay or advancement, approvals and cost estimates.

Investors should undertake their own analysis and obtain independent advice before investing in ESG shares.

All references to dollars, cents or $ in this presentation are to Australian currency, unless otherwise stated.

More information on ESG can be found at www.easternstar.com.au

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Appendix

2011

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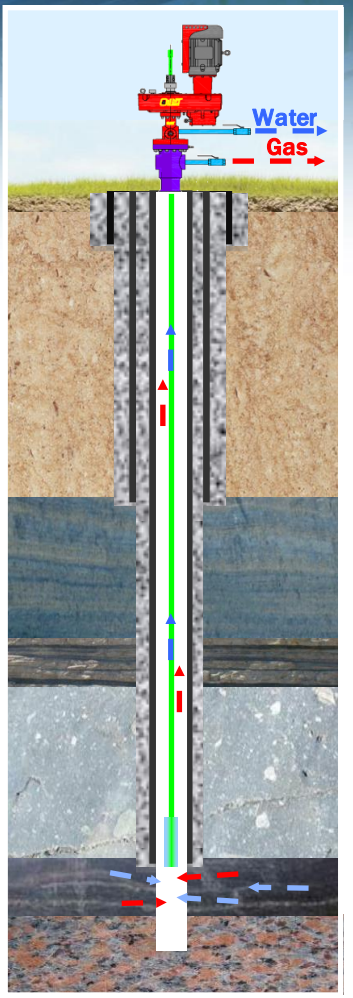
Coal Seam Gas - What is it?

Description	**Natural gas** Comprising mainly methane.
Gas Formation	Formed during coalification.
Gas Storage Mechanism	Adsorbed to coal. Held in place by water pressure.
Reservoir Depth	Typically between 250 and 1,000 metres.
Gas Production Mechanism	Wells are drilled into the coal. Water is extracted to release CSG.
Observations	*Petroleum Act* applies. Coal is not mined. Low environmental impact.



Coal Seam Gas is one form of natural gas

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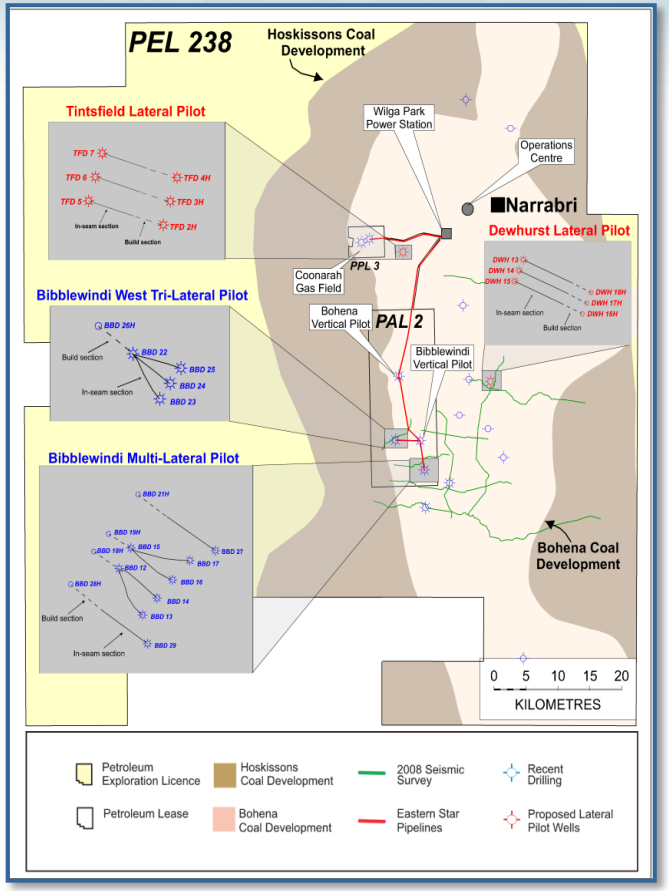
Narrabri CSG Project - Technical Status

Project Infrastructure and Production Pilots



Outstanding Success to Date

Resource potential demonstrated

- Multiple, thick coal seams
- High gas content
- Good permeability – directional

Lateral wells successfully utilised

- Effective communication with reservoir
- High flow rates (consistent with expectations)

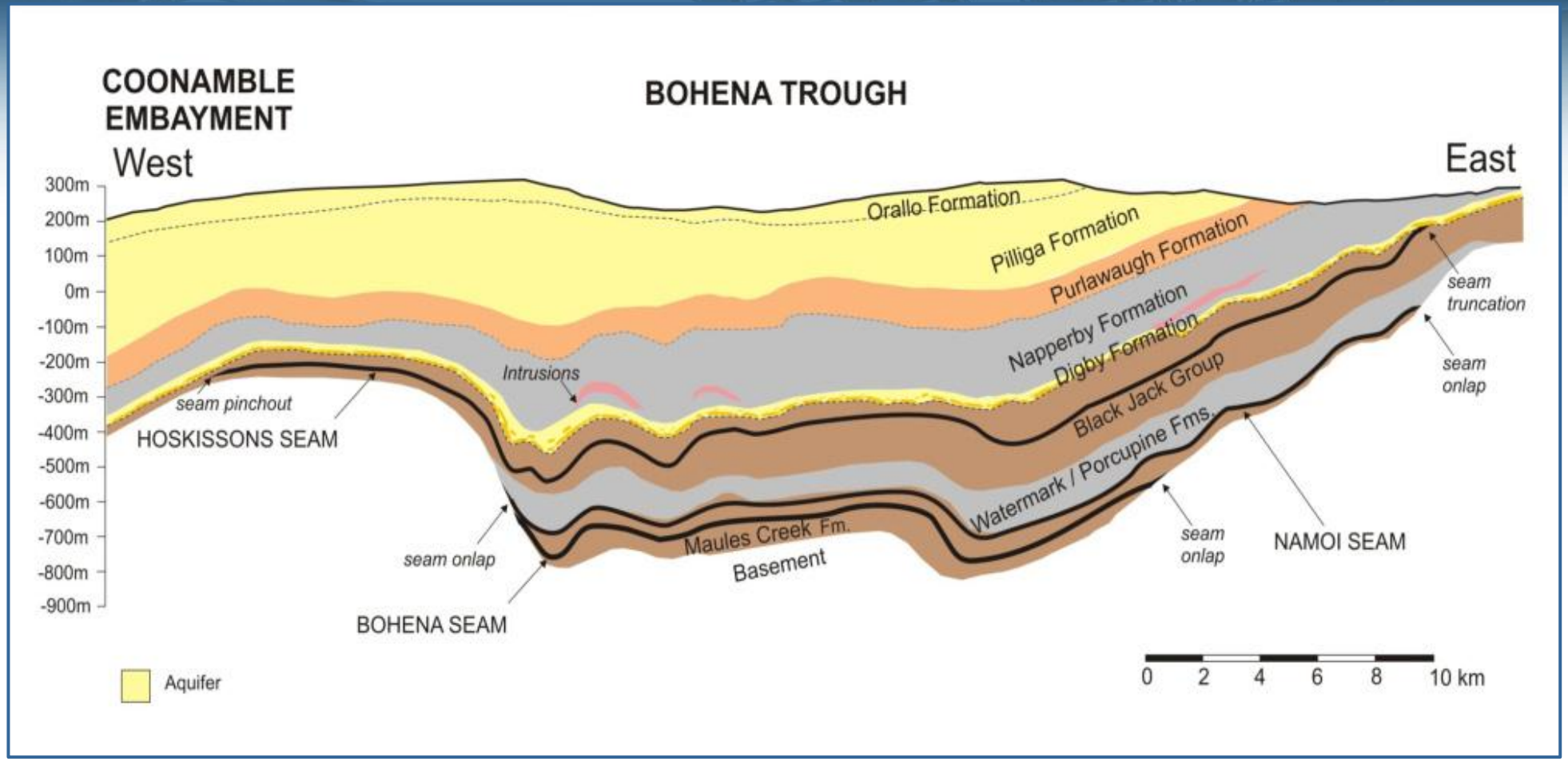
Reverse osmosis water processing

Independently certified gas reserves (project)

- 1P: 115 PJ
- 2P: 1,520 PJ

Compelling technical evidence of commercial resource

Protecting Regional Water Resources



Valuable Pilliga aquifers are separated from target coals by impervious rock layers (or Aquitards)

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Narrabri CSG Project - Technical Status

Favourable Geology with Industry Best Practices

Subsurface

- Shallow Pilliga aquifers are geologically separate from much deeper, target coal seams.
- Fraccing (in any case a safe practice) is not required with ESG's lateral well design.
- Wells have double casing (steel plus concrete) through upper strata preventing cross-flow.

Above Ground

- Reverse Osmosis (super fine filtration) used, reducing TDS of discharge to ~50 ppm.
- Concentrate is evaporated in lined ponds.

Water Discharge is Potable Quality

Narrabri CSG Project will not impact Ground or Surface Water Resources

LNG Newcastle – What is Liquefied Natural Gas?

- LNG is natural gas that is liquefied by cooling to -162^{o}C. Liquefaction is a physical (not chemical) process.
- LNG occupies 1/600 of the space taken up in gaseous form; 1 tonne of LNG contains ~50 GJ of energy. LNG lends itself to ocean-borne transport. The liquefaction process amounts to 'cargo assembly'.
- LNG is stored in insulated, cryogenic tanks at atmospheric pressure.
- LNG is not explosive and is not 'persistent' - should spillage occur it will quickly dissipate into the atmosphere.
- World-scale LNG carriers are more manoeuvrable than coal carriers and can safely traverse Newcastle Harbour.

LNG is widely traded on world commodity markets

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About Eastern Star Gas

Eastern Star Gas Limited (ESG) is a public company developing the coal seam gas (CSG) resource of the Narrabri CSG Project, centred on Petroleum Exploration Licence (PEL) 238. ESG owns 65% and is operator of the Project.

PEL 238 is estimated to contain a staggering 17 TCF (trillion cubic feet) of coal seam gas. To put this in perspective, NSW, which imports almost all of its gas requirements from other states, uses around just 0.14 TCF of natural gas per year.

This Project will supply the NSW gas market and, potentially, the Eastern Australian and international markets with gas.

ESG has Memorandums of Understanding to supply gas for NSW-based electricity generation and is also investigating major new gas market opportunities.

The Narrabri CSG Project's first independently certified coal seam gas reserves were booked in 2007. Since then, they have been increased so the project now has the following reserves and resources:

- 1P (Proven) 115PJ
- 2P (Proven & Probable) 1,520PJ
- 3P (Proven/Probable/Possible) 2,797PJ
- 3C Contingent Resources 6,215PJ

The Company is undertaking a major exploration and appraisal programme in the region, which is expected to generate additional reserves. The Project already provides gas to the ESG/Santos owned Wilga Park Power Station at Narrabri.

The power station uses coal seam gas produced as part of ESG's commercialisation of gas reserves. Wilga Park provides electricity to Country Energy which distributes it to residents and businesses in the region.

Since listing on the stock exchange in 2001, ESG has grown to be one of the top 10 ASX-listed oil and gas companies.

Eastern Star Gas in Narrabri

ESG is proud to be a local company, directly employing twenty people at its purpose-built Operations Centre on Yarrie Lake Road. Wherever possible, ESG also uses local contractors, suppliers and services.

Last year ESG injected approximately $15 million into the local economy.

Longer term Eastern Star's work in the region is likely to spur major new investment, create job opportunities and deliver a new energy source to many businesses and individuals.

ESG is proud to support a wide range of organisations, events and community groups within the Shire, including Rotary and Lions, the Narrabri Blue Boars, the lawn bowls teams, the Narrabri Education Fund, and the Narrabri and Wee Waa Shows. ESG is also principal supporter of the Nosh on the Namoi Festival and provides sponsorship to the Westpac Rescue Helicopter's Hunter service, which covers Narrabri and surrounds.

What is Coal Seam Gas?

Coal seam gas was formed millions of years ago as part of the burial of organic plant and animal matter

Wilga Park Power Station

Schematic of LNG Newcastle Project at Kooragang Island

(Image courtesy of Toyo Engineering Corporation)

that created coal. It contains mostly methane, which is a colourless and odourless gas.

CSG is an environmentally-friendly fuel, and like other forms of natural gas can be transported by pipeline and used for residential, commercial or industrial purposes.

Producing Coal Seam Gas

Production of CSG involves drilling wells into a coal seam. Water pressure holding the gas onto the surface of the coal is then reduced, releasing the gas and allowing it to flow up the wells to the surface. The gas is then collected and transported for use.

While the gas is extracted the coal itself is left in the ground.

Because of the fractured nature of the coal found in the Narrabri area, ESG has used innovative lateral drilling to extract the CSG.

This type of drilling has produced great results for ESG with the Company's lateral pilot wells delivering extremely impressive gas flow rates.

Eastern Star Gas' Leadership Team

Eastern Star Gas is led by a highly experienced and reputable team of professionals with deep technical knowledge of Australia's coal seam gas industry.

The Company's Board is led by Non-Executive Chairman The Hon John Anderson, the former Deputy Prime Minister of Australia.

Managing Director David Casey is a key figure in the establishment of the Australian coal seam gas industry. He has been active in the industry for almost 20 years, gaining technical and management experience locally and overseas.

The Future

ESG has signed an MoU with ERM Power to supply gas to a power station approved for construction at Wellington, NSW. As a result, project approval processes for construction of a gas pipeline to Wellington have been initiated.

ESG has also signed an MoU with Japanese firms Hitachi and Toyo Engineering to conduct a feasibility study into development of a mid-scale LNG (Liquid Natural Gas) facility at Newcastle, A parcel of land on Kooragang Island, in Newcastle, has been acquired by ESG for this purpose.

Marubeni Corporation has also entered into an MoU with ESG to expedite commercialisation of the proposed LNG Newcastle Project. Marubeni has wide-ranging expertise in all aspects of the LNG industry.

The enormous promise of the Narrabri CSG Project means ESG is well on the way to transitioning from a gas exploration company, to a major gas producer. The Company's vision to be NSW's leading supplier of natural gas is looking more attainable than ever.

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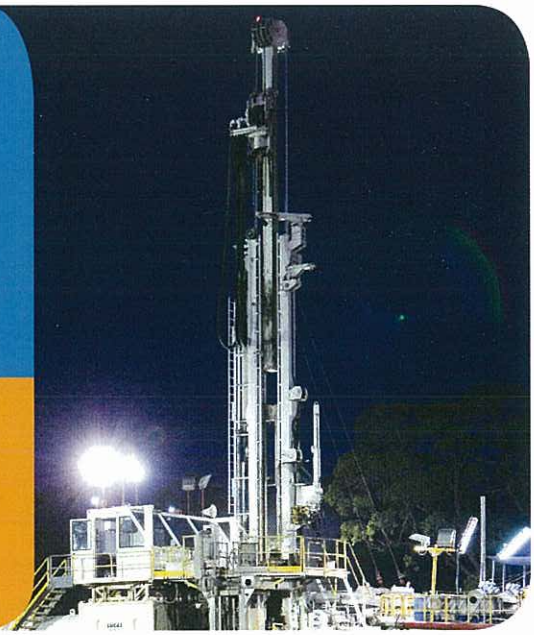


Drilling of Coal Seam Gas Production Wells

What is a Coal Seam Gas Production Well

A coal seam gas production well is a well, or sometimes an interconnected set of wells, drilled into a coal seam to allow water to be removed and gas produced from the coal. Water is removed from the coal by means of a pump installed in the well. Removal of the water is necessary to allow gas to be released from the coal for production.

Production Well Design at Narrabri

Coal seams targeted for coal seam gas production at Narrabri have a unique, vertically-fractured structure. Eastern Star Gas has determined the optimal production well design for these coals involves lateral wells, drilled down to and then along through the coal seam perpendicular to the natural fracture system.

From one location it is possible to drill laterals through multiple coal seams. Each lateral well intersects a vertical well through which water and gas production takes place. The combination of lateral and vertical wells may be referred to as a production well set.

Drilling of Production Well Sets

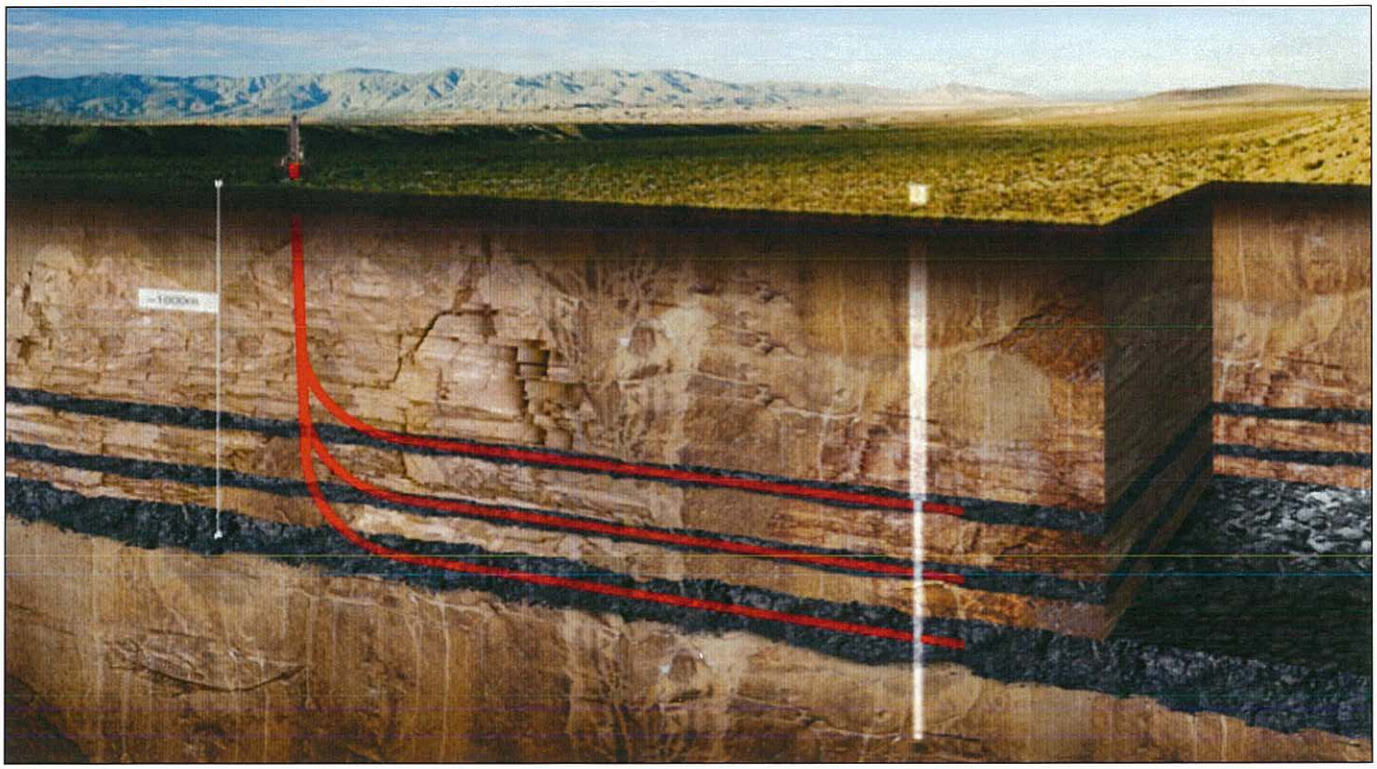
Eastern Star Gas uses a Schramm TXD drilling rig for drilling of production well sets at Narrabri. An important measure of the capability of a drilling rig is its lifting capacity. The rig must of course be capable of pulling the entire drill string out of the well.

Drilling is carried out on a 24 hour basis with two crews operating 12 hour shifts. Crew accommodation is in a dedicated camp close to the project site to minimise travel risks.

How is the Drilling Process Steered?

Turning into and steering through coal seams is referred to as directional drilling. Unlike normal or vertical drilling, when

Section view of Lateral Well



the whole drill string rotates, directional drilling is achieved using a downhole 'mud-motor' to turn the drill bit. The mud-motor is driven by high-pressure drill fluid pumped down the drill string. In addition to driving the mud-motor, the drill fluid keeps the drill bit cool and carries rock or coal cuttings back to the surface. The mud-motor and drill bit assembly are mounted at a very slight angle (1.15 degrees) to the drill string so that drilling proceeds in a gentle curve that the drill string itself can follow.

Steering is achieved by controlling the direction in which the mud-motor and drill bit are pointing. Sensors mounted close to the mud-motor can read the earth's magnetic field to determine the location of the drill bit and to steer it so that it intersects the vertical production well. Eastern Star Gas was also first in Australia to use specialised 'rotating-magnet' techniques to increase steering accuracy.

What is the Drill Fluid? Is it Safe?

The drill fluid is safe. It is made up of fresh water with a small percentage of additives to make it thick enough to reliably carry rock or coal cuttings back to the surface. Additives used by Eastern Star Gas may include:

- bentonite, a fine clay;
- caustic soda, to ensure the pH of the water is stable;
- sodium chloride (common salt) or potassium chloride (a salt substitute) to match conditions downhole so that reactive clays in the formation do not swell up;
- 'Pac R' (cellulose ethyl ether) which is itself used as an additive in the food industry for thickening and taste enhancement; and
- xanthum gum (a thickening agent also used in the food industry) and lime.
- All additives are used in concentrations that are neither toxic nor harmful to the environment.

When it returns to the surface, the drilling fluid is put through screens to remove rock or coal cuttings and is then reused.

'Completion' of Production Wells Sets

Gas production wells are cased with steel that is cemented into place. There are two sets of casing. The first runs from surface down through the Pilliga sandstone (which contains aquifers used by the Narrabri community) to the layer of rock beneath the sandstone. The second runs from surface down to the target coal seam.

In addition to being cased, the vertical production well is fitted with:

- a progressive cavity pump ('PCP') that is shaft-driven by a variable speed electric motor mounted on the wellhead;
- facilities to measure and handle water and gas production;
- an automatic control system with back-to-base radio communications; and
- if required, a small gas engine driven electricity generator to power the site.

Gas and water from the production well are transported through buried pipelines to a central location for processing, use and sale.

About Eastern Star Gas

Eastern Star Gas is a public company working to develop the coal seam gas potential of the Narrabri region. It has a 65 per cent interest in the Narrabri Coal Seam Gas Project. The company has entered into preliminary agreements to supply gas for NSW-based electricity generation and is investigating a range of downstream gas processing initiatives.

Eastern Star Gas' preference wherever possible is to employ local people and utilise local contractors and the Company also supports a wide range of local charities and community groups.

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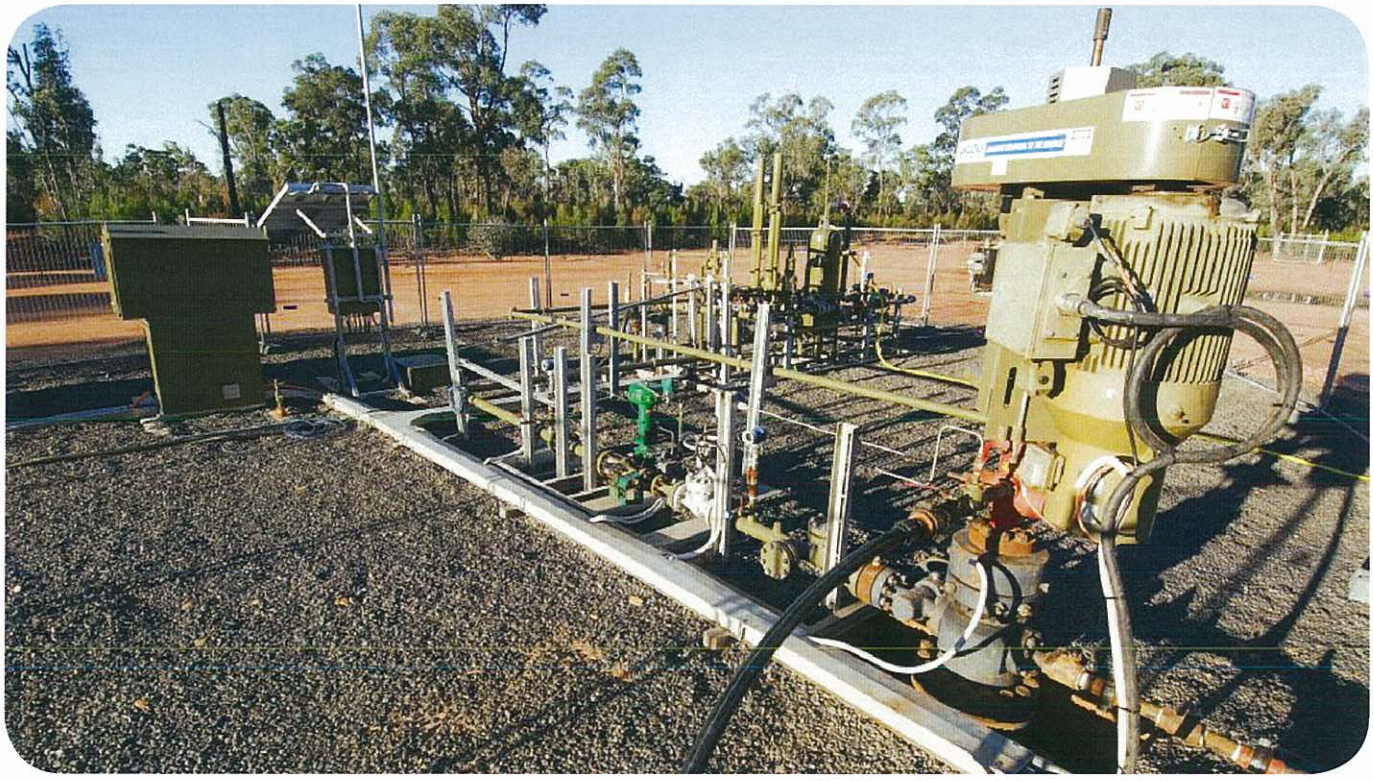

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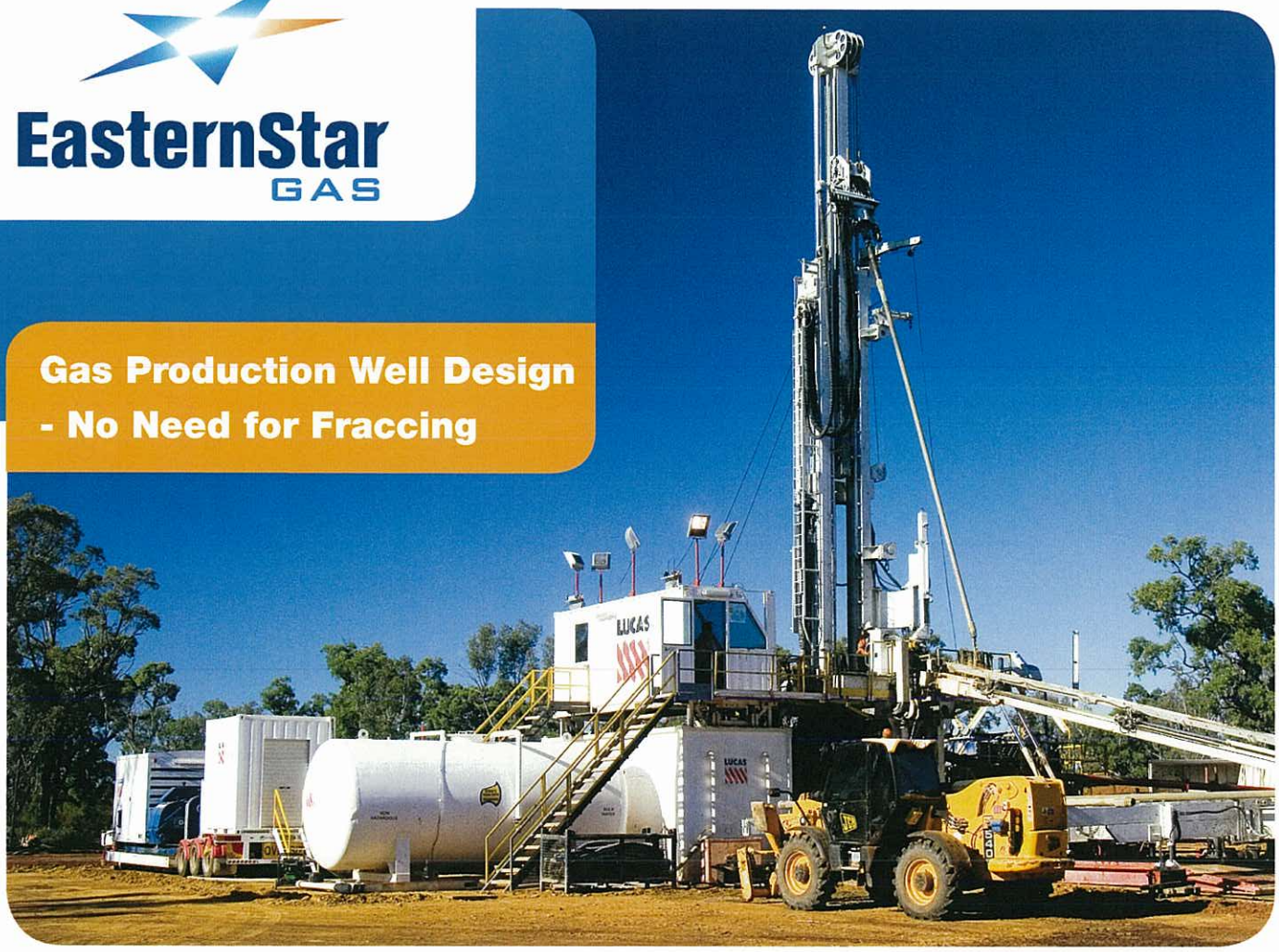
Gas Production Well Design - No Need for Fraccing



Coal Seam Gas and How it is Produced

Coal seam gas is one form of natural gas, an environmentally friendly fuel used by households, by industry and for electricity generation. Coal seam gas is formed as a by-product of the process by which plant matter is turned into coal. Once formed, the gas is held in place within the coal by the pressure of water within the coal seam. The higher the water pressure within a coal, the greater the quantity of gas that can be contained within the coal.

For coal seam gas to be produced the water pressure within the coal seam must be reduced so that the gas is released from the coal. To do this involves drilling a production well into the coal seam, allowing water to be removed and gas produced.

The Role of Permeability

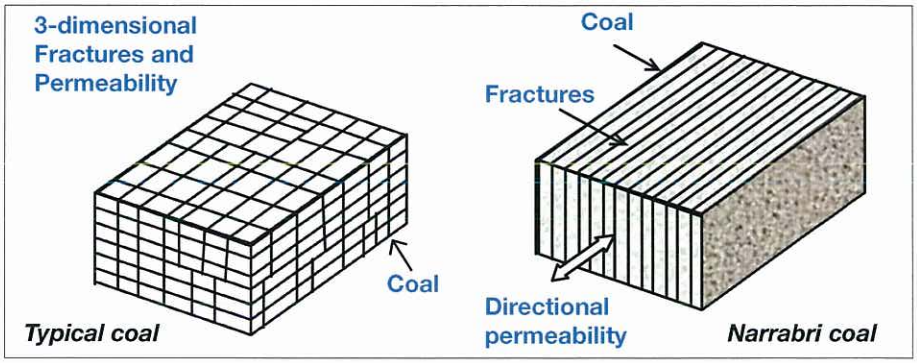
Since coal seam gas production requires water and gas to flow through the coal seam to the production well, the permeability of the coal is a key factor in determining whether coal seam gas can be economically produced from a particular coal. The permeability of a coal is a measure of how easily water and gas can move through pores and cracks within the coal. The higher the permeability, the easier it will be to produce gas and the bigger the area of coal that may be accessed by a single production well.

As a general rule, the greater the depth of burial of a coal seam within the earth, the lower will be the permeability of the coal. This is because the weight of the earth above the coal seam closes up pore spaces and cracks that form permeability pathways, making it more difficult to remove water and gas from the coal. In addition the rank, or age, of a coal can have an effect upon its permeability.

The Unique Structure of Narrabri Coals

Coal seams targeted by the Narrabri Coal Seam Gas Project have a unique structure compared to other coals on the east coast of Australia. Typical coals, like those mined for export through Newcastle, have a three-dimensional network of fractures a bit like the joins between bricks in a wall. These fractures provide permeability pathways through which water and gas can flow, albeit less effectively as the depth of burial of the coal increases.

In contrast, coals targeted at the Narrabri Coal Seam Gas Project are characterised by a one-dimensional series of fractures,



a bit like a sliced loaf of bread. The fractures are near-vertical, allowing the coal to support the weight of the earth above it without loss of permeability, but meaning water and gas can predominantly only flow through the coal in one direction. The unique structure of Narrabri coals is a critical consideration in the design of gas production wells for the Narrabri CSG Project.

Coal Seam Gas Well Fundamentals

The major cost of producing coal seam gas is that associated with drilling of production wells. It is therefore important for each individual coal seam gas project to identify the well design that is best suited to its coals, the objective being to efficiently produce as much gas as possible per dollar of well cost.

The most commonly used well configurations include:

- Vertical wells, drilled down to and through the target coal seams. This well design lends itself to coal seams that have high permeability or to circumstances, as are common in parts of Queensland, where gas is to be produced from multiple coal seams one above the other. Fraccing, to increase the permeability of target coal seams, may also be carried out.
- Lateral wells, drilled down to and then horizontally through the target coal seam. This well design is typically used in coals of low permeability, with the length of hole drilled through the coal compensating for the low permeability by increasing the overall area from which water and gas can be produced.

Lateral wells are ideally suited for use at the Narrabri Coal Seam Gas Project since, when drilled perpendicular to the natural fracture system of the target coals, they achieve outstanding deliverability of both water and gas.

What is Fraccing? Is it Safe? And is it Used at Narrabri?

Fraccing is the common name for a process that involves pumping a mixture of fluid and sand into a coal seam at high pressure in order to create fractures in the coal so as to improve permeability and, in turn, gas production rates. The fractures that are created are held open by the sand that is pumped into the coal.

Fraccing carried out by Australian coal seam gas companies is entirely safe. The fluid used may be either water or, more commonly, water with other materials added to it to make a thicker mixture (or 'gel') that carries sand more efficiently. Materials used to create the gel include polymers, surfactants, oxidants and enzymes, all of which are in common use in the food industry.

Drilling Rig near Narrabri

Fraccing activities are designed to limit resultant fracturing to the target coal seam. This is confidently achievable since coal is much weaker than the rock that surrounds it. For example, when drilling a coal seam gas well at Narrabri it takes about 1 week to drill around 1 kilometre through rock to reach the coal seam, but only 1 day to drill 1 kilometre through the coal.

Fraccing was trialled at Narrabri but the process was found to be unsuitable to the one-dimensional fractures within the coals of the Narrabri CSG Project. Lateral wells as now utilised are much more efficient and cost effective.

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LNG Newcastle Project

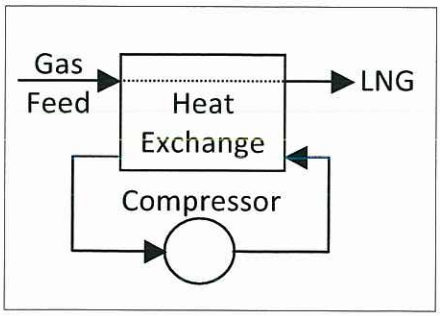
What is LNG?

Liquefied Natural Gas (LNG) is natural gas that has been cooled to -161°C, at which point it condenses into a liquid. As a liquid, LNG is neither explosive nor flammable. It is stored at atmospheric pressure in cryogenic tanks.

LNG takes up less than 1/600th of the space that it would take up as a gas. This makes it ideally suited to long distance ocean-borne transport where gas pipelines are not available. After delivery to overseas terminals, LNG is regasified for environmentally-friendly use in domestic, industrial and power generation applications.

What does the liquefaction process involve?

Liquefaction of natural gas to form LNG is a straightforward mechanical process. Natural gas, delivered by pipeline to the liquefaction plant, is cooled in a heat exchange in much the same way that air is cooled in an air conditioner. The heart of this process, or liquefaction train, is a refrigerant compressor that powers the cooling process.



What is proposed for Newcastle?

Eastern Star Gas (ESG) is investigating development of an LNG production and export facility on Kooragang Island, Newcastle. ESG proposes to use mid-scale technology, with liquefaction trains incorporating electric motor driven compressors capable of producing 0.5 million tonnes per annum of LNG. ESG has purchased a 24 hectare parcel of land on Kooragang Island as a site for the LNGN Project and is seeking relevant approvals for its development. It is envisaged a minimum of 2 liquefaction trains will be installed initially, giving capacity for export of 1 million tonnes of LNG per annum (equivalent to 55 PJ/a of gas). Capacity may be progressively expanded to as much as 4 million tonnes per annum.

LNG will be stored on site for loading into specially built LNG carriers. As an established port in close proximity to Narrabri, Newcastle is the stand-out location for liquefaction of gas from the ESG operated Narrabri Coal Seam Gas (CSG) Project.

What are the advantages of electric motor driven mid-scale technology?

Conventional wisdom has been that economies of scale may be achieved through using large, gas-turbine driven gas refrigerant compressors and maximising the capacity of individual liquefaction trains. But this paradigm is set to change with electric motor driven, mid scale, single mixed refrigerant technology offering multiple advantages, especially for LNG projects fed by coal seam gas. Key advantages of the technology are:

- Low capital cost and quick construction, owing to modular design;
- High reliability, high efficiency and low environmental impact owing to the use of electric motor drives;
- Operational flexibility, through turn-down capability of electric motors, and train size that allow gas supply from a coal seam gas project to be optimally ramped-up and managed; and

Schematic of LNG Newcastle Project at Kooragang Island *(Image courtesy of Toyo Engineering Corporation)*

- Reduced space requirement and low noise, both of which are important for the Newcastle location.

Project ownership and timetable

As proponent of the LNG Newcastle (LNGN) Project, ESG is working with specialist organisations with a view to committing to development of the project around the end of 2011 with a target export of end 2014. Hitachi Ltd and Toyo Engineering Corporation are providing project design and development services. Marubeni Corporation has a lead role in LNG marketing activities.

It is anticipated Marubeni Corporation, along with other purchasers of LNG, will take equity in LNGN and, potentially, in upstream infrastructure including the Narrabri CSG Project.

Narrabri CSG Project

ESG has 65% ownership, and is Operator, of the Narrabri CSG Project, located near the township of Narrabri in New South Wales. The Narrabri CSG Project presently has in place independently certified 2P reserves of 1,520 PJ and 3P reserves of 2,797 PJ. In addition the project has independently certified contingent gas resources of 6215 PJ.

Feed gas for the LNGN Project will be sourced primarily, but not necessarily exclusively, from the Narrabri CSG Project. Gas will be transported from Narrabri to Newcastle through a 400 km gas transmission pipeline.

Project benefits

Development of the LNGN Project will deliver significant benefits to NSW including:

- Employment - Short term and long terms jobs will be created in Narrabri and Newcastle. The first stage of the LNGN Project will itself directly employ around 500 people during construction and around 80 people for ongoing operations.
- Investment - Capital expenditure on gas production activities will exceed $1 billion over the life of the project. A further $1 billion will be expended upfront for construction of stage 1 of the LNG Project and around $500 million on gas pipeline infrastructure from Narrabri to Newcastle.
- Security of gas supply - NSW currently imports over 90% of its gas supplies from interstate sources. Development of the Narrabri CSG and LNGN Projects will increase NSW domestic gas production and provide security of supply of gas to NSW.
- State Royalties revenue - Royalties payable on gas produced at Narrabri will be a major source of income for the NSW State Government, improving scope for Government services and infrastructure investment.

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