



PANGAEA

**BIRDUM CREEK-1, TARLEE-1, TARLEE-2 & WYWORRIE-1
APPRAISAL WELLS**

ENVIRONMENTAL PLAN SUMMARY

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1. INTRODUCTION

EP167 and EP168 are located approximately 350 km southeast of Darwin in the Northern Territory (NT) in the western McArthur Basin. The basin is essentially unexplored for hydrocarbons, either conventional or unconventional, and from a shale gas or oil perspective, there is limited information on thermal maturity, total organic carbon (TOC), porosity, permeability, gas content or saturation. The tenements fall within the Victoria-Daly, Roper-Gulf and Barkly Shires plus the Katherine Municipality.

EP167

Two of the proposed appraisal wells will be located in the south-eastern portion of EP167 in central Northern Territory. The Birdum Creek-1 appraisal well will be located approximately 160 km south-southeast of Katherine. The Wyworrie-1 appraisal well will be located approximately 113 km south-southeast of Katherine.

EP168

Two of the proposed appraisal wells will be located in the central-northern portion of EP168 in central Northern Territory. The Tarlee-1 appraisal well will be located approximately 175 km south-southeast of Katherine. The Tarlee-2 appraisal well will be located approximately 165 km south-southeast of Katherine.

A location map and coordinates of the activity are provided in Figure 1.

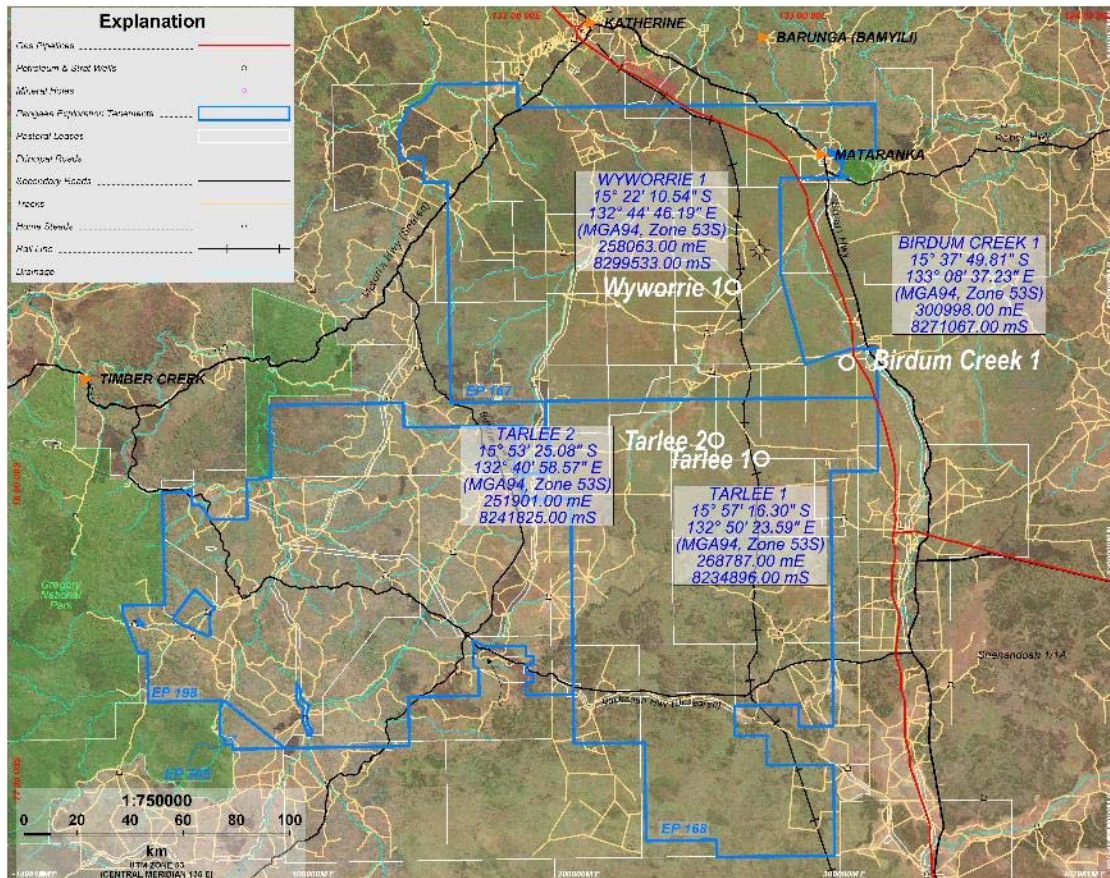


Figure 1: Appraisal Wells within EP167 & EP168

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2. DESCRIPTION OF ACTIVITY

The objectives of the Appraisal Wells in EP167 & EP168 are to:

- Identify thick intervals of organic-rich shale within the wet to dry gas hydrocarbon generation windows;
- Confirm the stratigraphy and tie this stratigraphy to the regional seismic interpretation;
- Collect velocity information to improve the time to depth conversion for the regional seismic interpretation;
- Evaluate the thermal maturity, gas content, gas saturation, gas composition, mineralogy, porosity and permeability of the shale units within the Roper Group from core and wireline logs; and
- Collect data to evaluate the geo-mechanical attributes of the rock.

By way of a summary, the evaluation proposed for the Appraisal Well sites will comprise of coring, wireline logging and formation testing operations. The final wells will not be used as production wells. Following testing operations, the wells may be used as a future micro-seismic monitoring bore, cased and suspended or plugged and abandoned.

3. DESCRIPTION OF THE ENVIRONMENT

The region's climate is *'semi-arid tropical, with rainfall concentrated in the wet season months between November and April. Though rainfall can be variable from year to year, there is a distinct gradient of decreasing mean annual falls from 850mm in the north to less than 500mm'* in southern areas of EP167 and EP168, with nearly all the rainfall occurring between November and April (see Williams *et al.* 1997¹, Hennessy *et al.* 2004²). The mean maximum temperature varies from 27°C in July to 40°C and beyond in November.

Condition is generally good across much of the bioregion. The drilling campaign in EP-167, inclusive of the access route to the drill sites, will intersect with the Forrest land system. The Forrest land system consists of gently sloping sandy surfaced plains with few indistinct drainage depressions on sandy red earth soils. Vegetation is dominated by eucalypt woodlands and perennial grasses, the systems are generally suitable for pasture improvement and have moderate to high grazing potential. The Forrest land system consists of vegetation that have a relatively low forage quality in the dry season but it can benefit from strategic burning to manage woody thickening (Northern Territory Government, no date³).

The drilling campaign in EP-168, inclusive of access routes to the drill sites, will intersect with the Banjo land system. The Banjo land system consists of almost level to gently undulating plains on the plateau surface that lack drainage lines. Consisting of variable depth red earth soils with or without gravel; mixed eucalypt woodlands and perennial grasses, the systems are generally suitable for pasture improvement and have moderate to high grazing potential. The Banjo land system consists of vegetation that has a relatively low forage quality in the dry season although can benefit from strategic burning to manage woody thickening (Northern Territory Government, no date⁴).

¹ Williams, R.J., Cook, G.D., Ludwig, J.L. and Tongway, D.L. (1997). Torch, trees, teeth and tussocks: disturbance in the tropical savannas of the Northern Territory (Australia). In: *Frontiers in Ecology. Building the Links*. Eds. N. Klomp and I. Lunt. Elsevier, Oxford: pp55-66.

² Hennessy, K., Page, C., McInnes, K., Walsh, K., Pittock, B., Bathols, J. and Suppiah, R. (2004). *Climate Change in the Northern Territory*. Consultancy report for the Northern Territory Department of Infrastructure, Planning and Environment. CSIRO, Melbourne.

³ Northern Territory Government (no date) Land Condition Guide - Sturt Plateau District; Understanding the productivity of grazing lands. Produced in association with the Northern Territory Cattlemen's Association as part of the Caring for Our Country project "Grazing Land Management – Demonstration, Continuation and Evaluation".

⁴ Northern Territory Government (no date) Land Condition Guide - Sturt Plateau District, Understanding the productivity of grazing lands. Produced in association with the Northern Territory Cattlemen's Association as part of the Caring for Our Country project "Grazing Land Management – Demonstration, Continuation and Evaluation".

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4. DESCRIPTION OF THE ACTIVITY IN RELATION TO THE ENVIRONMENT

The Appraisal Wells have been designed with due consideration of the surface and subsurface environments. The sites have been selected and will be constructed to avoid large scale levelling and clearance of vegetation.

The drilling operations have been designed to:

- Complete all operations without injuries;
- Isolate permeable zones within the well;
- Maintain separation between potable water aquifers;
- Prevent uncontrolled discharge of water, gas or oil from the well while drilling; and
- Prevent cross flow between potential reservoirs or formations.

These objectives are achieved by the appropriate selection of:

- Surface equipment (including drilling rig and well control equipment);
- Surface facilities/pits for the containment of drilling fluids;
- Casings and setting of casing depths to ensure aquifers are isolated;
- Drilling techniques;
- Down hole technology; and
- Suspension or plug and abandonment procedures.

5. ENVIRONMENTAL RISKS OF PROPOSED ACTIVITY AND CONTROL MEASURES

Fauna and flora

Potential impacts to surrounding flora and fauna at the well sites will be assessed and minimised by measures including weed and pest inspections on all vehicles and personnel clothing prior to arrival at site and the use of signage and appropriate fencing.

Groundwater

The well will be grouted and completed according to industry's best practice for sealing requirements. Any well that encounters an artesian or sub-artesian flow will be sealed to prevent contamination or cross-contamination of aquifers and will be sealed with cement plugs to prevent surface discharge of groundwater. Appropriate sedimentation and erosion control measures will be put in place at the well sites. The amount of hazardous material on site will be kept to a minimum and all materials stored according to regulations.

Noise and surface

Speed limits will be enforced on access tracks to limit and minimise dust and noise generation. Vehicular movements to and from the work sites will be minimised by travel during daylight hours and be compliant with land access agreements. Soil erosion will be minimised by the use of existing tracks, deviating around creeks, river banks and naturally formed depressions and not accessing roads in wet conditions.

Waste management

Waste will be stored in suitable receptacles and disposed of accordingly at municipal managed locations. Hazardous material shall be transported, stored and handled in accordance with the requirements of the relevant legislation and guidelines.

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6. CONSULTATION

During the past several months Pangaea has consulted with stakeholders, which has included:

- A detailed cultural heritage assessment and sacred site clearance process with the Northern Land Council and Traditional Owners;
- The negotiation and signing of voluntary access agreements with directly-affected Pastoralists;
- Direct engagement with communities and representative groups at exhibition booths during district and agricultural shows e.g. Katherine District Shows (2014, planned mid-2015);
- Notification to local government councils, police authorities and local businesses of exploration activities; and
- Compliance with legislation and guidelines from the NT Department of Mines and Energy and other regulatory agencies eg. Department of Transport and Department of Infrastructure.

Pangaea’s engagement process is aimed to identify and address issues of concern, reach agreement and in general engage in goodwill communication.

Pangaea will continue this process with stakeholders throughout the life of the project.

7. PANGAEA RESOURCES LIAISON PERSONNEL

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