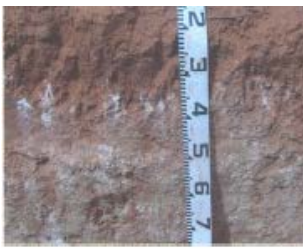
CLARK LINDBECK & ASSOCIATES PTY LTD
Environmental Management Consultants

WARRO JOINT VENTURE



WARRO PROJECT

PILOT SOIL GAS GEOCHEMISTRY AND SHALLOW PILOT BOREHOLE

SUPPLEMENT TO EPA REFERRAL

Document produced to support the referral of this proposal to the Environmental Protection Authority (EPA) under Section 38(1) of the Environmental Protection Act 1986

Report prepared for: ***Latent Petroleum Limited***

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1 INTRODUCTION

1.1 Background

The Warro Gas Field, 200 km north of Perth, was discovered by West Australian Petroleum Pty Ltd (WAPET) in 1977 with the drilling of the Warro-1 & 2 gas wells, which penetrated several hundred metres of gas saturated sands in the lower part of the Late Jurassic Yarragadee Formation.

Subsequently, the Warro Joint Venture (WJV) comprising Latent Petroleum (Operator) and Alcoa Australia drilled two further wells in 2008 and 2010. These wells (Warro-3 and Warro-4) were drilled, fracture stimulated and tested and established the presence of producible gas at a depth range of 3750 – 4300 m below the surface. The WJV also conducted a 3D seismic survey of the western part of the Warro field.

The gas contained within this area is known as a "tight gas play", where the gas is held within low porosity and permeability sandstone and requires fracture stimulation before commercial flow rates are possible.

The Warro Gasfield is considered to be potentially commercial and is in the process of being moved into a Retention Licence.

The WJV expects to carry out further gas well drilling over the next 18 months. Prior to this activity the WJV is seeking to establish baseline environmental data for:

- Water resources
- Soil gas geochemistry
- Passive seismic activity.

The WJV has been investigating water quality in the Watheroo Area since it commenced operations in 2008. This data along with hydrological studies are continually updated as part of the WJV's monitoring programme.

The WJV recognises the importance of establishing the natural background levels of any hydrocarbon gases in the near surface and is working with experts at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the University of Western Australia (UWA) to measure this parameter.

The utilisation of fracture stimulation technology elsewhere has raised the concern whether future seismic events may be related to, or increased in frequency, as a result of any gas well operations and subsequent production. The WJV proposes to monitor naturally occurring seismic events in the area to gain baseline data.

The WJV proposes to carry out pilot studies for two base line surveys in the vicinity of the Warro Gasfield. The first will comprise the measurement of the methane content of soils along a two kilometre SE-NW transit near Warro-3 with up to 12 sampling points. The second pilot study will monitor naturally occurring seismic events in the area in a shallow borehole, similar to a water borehole, which is fitted with recording equipment.

The purpose of each pilot study is to determine the most appropriate recording methods for longer term monitoring and the definition of baseline levels of soil gases as well as naturally occurring seismic activity.

1.2 Location

The project is located approximately 200 km north of Perth, 60 km east of Jurien Bay and 25 km west of Watheroo township (Figure 1) in private, cleared agricultural land.

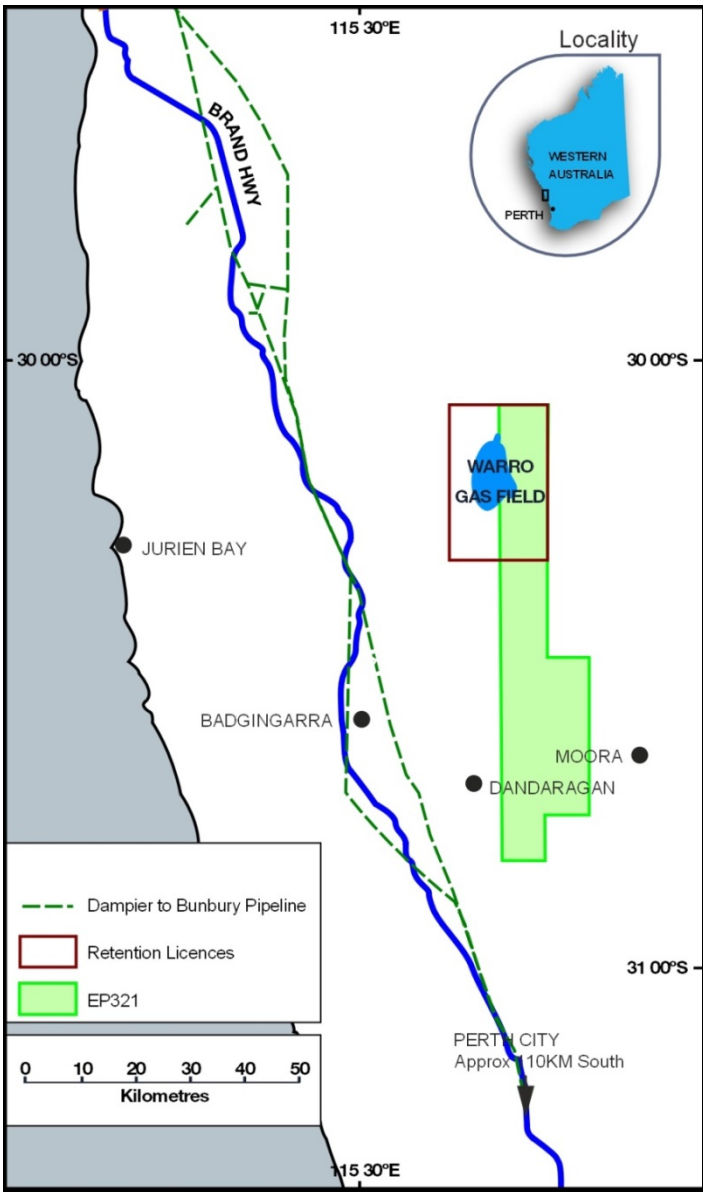

Figure 1 - Location of project area

1.3 Tenure

The tenure of the proposal area is presented in Table 1 and Figure 2.

The proposal is located on Freehold – Lot 10323 within Exploration Permits (EP) 321 and EP 407.

Table 1 - Land Tenure of the proposed project area

AREA	HOLDER
EP407	Latent Petroleum
EP 321	Latent Petroleum
Freehold - Lot 10323	J & R Raffen

2 PROJECT DESCRIPTION

2.1 Overview

Latent Petroleum (Latent), as Operator of the WJV, proposes to carry out pilot studies for two base line surveys in the vicinity of the Warro Gasfield. The first will comprise the measurement of the methane content of soils along a two kilometre SE-NW transit near Warro-3 with up to 12 sampling points. The second is the monitoring of naturally occurring seismic events in the area in a shallow pilot borehole, similar to a water borehole, fitted with recording equipment.

The purpose of each pilot study is to determine the most appropriate recording methods for longer term monitoring and the definition of baseline levels of soil gases as well as naturally occurring seismic activity.

2.2 Soil Geochemistry

Using the Warro 3D seismic data, the WJV has recognised a 'zone of interest' through which thermogenic gases could be reaching the surface (Figure 2).

Prior to embarking on a full scale survey to assess this zone, a pilot project is required to determine the most efficient and accurate means to reliably record variations in soil gas in the longer term.

The pilot survey will comprise the placement of a small number of gas collection chambers, which are buried to a depth of approximately 10cm into the soil, at regular intervals along a transit across the boundary of the zone of interest. These remain in the soil following a period for gases to accumulate and a small gas sample is extracted for laboratory analysis in Perth. This could be repeated up to 12 times depending on soil conditions. The whole survey is expected to be carried out over two days.

The sampling approach will depend on local conditions and will be developed once the level of gas intensities is understood. The timing of the sampling survey will be controlled by the Department of Mines and Petroleum (DMP) approval schedule and the availability of people and equipment thereafter. WJV currently proposes to carry out the work during May – June 2014.

Further information regarding the methodology for the soil geochemistry work is provided in Appendix 1.

2.3 Passive Seismology

In order to establish the level of naturally occurring seismic activity in the area, the WJV proposes to set up a set of recording arrays. Prior to this happening, a pilot study needs to be carried out to determine the appropriate recording equipment and the optimum depth it should be placed to obtain the highest fidelity recordings.

The pilot passive seismic study, part of this proposal, will require the drilling of a shallow pilot borehole to approximately 100m (10 m below the water table which is expected to be encountered at 90 m below ground surface).

This well will be drilled with low toxicity water based muds which are utilised in standard water bore drilling practices. PVC tubing will be inserted in the hole and grouted in place to ensure hole stability and isolate any near surface units. It is estimated between 4 and 6 sondes will then be placed in the borehole. The depths of these sondes will depend on conditions at the time and the position of the water table (expected at 90m) but Latent envisages they will be installed at depths of 5 m, 10 m 20 m, 50 m, and 100 m below ground

level. The sondes will be grouted in place. Each sonde will be connected to an electrical cable which will run to surface and be connected to recording equipment. This recording equipment will be powered by either solar cells or by a nearby electricity supply. The surface recording equipment is capable of storing about 1 month of data. Each month the data will be downloaded and analysed. A description of the sondes and surface equipment is set out in in Appendix 2.

The goal of this work is to determine be optimum depth to position a sonde for long term, high fidelity seismic recordings of naturally occurring seismic events. This borehole will provide long term research benefits and will remain in place for the duration of the Warro Project.

Low toxicity, water-based drilling fluids will be used during the borehole operations.

Flammable material will be cleared from the working area. As no clearing of native vegetation is involved, this would involve only grazing crops. Fire extinguishers will be provided in vehicles and fire awareness will be reinforced to all visitors to site. Practical fire training will be implemented for selected staff and contractors as appropriate.

The borehole is subject to the Rights in Water and Irrigation Act and will be licensed by the Department of Water. The timing of the seismic work will be controlled by the DMP approval schedule and the availability of people and equipment thereafter. Latent is currently planning on carrying out the work during May – June 2014.

It is envisaged that the pilot borehole will remain active for the duration of the Warro project after which it may continue to be used to gather research information or be abandoned by severing the cables below surface and filling the last remaining upper section of the hole with grout. All components in the pilot hole are benign and will not have any significant impact on the environmental conditions of the area.

2.4 Drilling fluids

Low toxicity, water-based drilling fluids will be used during the borehole operations. All substances used are benign.

All substances used during drilling will be fully disclosed in accordance with regulation 15(9) of the *Petroleum and Geothermal Energy Resources (Environment) Regulations 2012* (WA) and *Chemical Disclosure Guideline* to the DMP with the Environmental Plan for this proposal.

2.5 Resource Requirements

Water required for drilling will be supplied from the existing licensed water bore.

If power is required, it will be sourced from the homestead located in the vicinity of the pilot borehole site or by use of solar cells.

Accommodation, if required, will be provided in nearby townships.

2.6 Waste

All putrescible and industrial waste material will be disposed of offsite. All mobile equipment will contain sealable containers for waste disposal.

All waste hydrocarbons (e.g. oils, oily rags, hydrocarbon contaminated material) will be collected in bunded drums and removed to a licensed facility for disposal.

2.7 Site Access

The proposal area is situated on freehold land where access by the general public is not permitted. The area is fenced off and the land owner will be made aware of operational requirements and safety procedures by Latent management.

All vehicles will utilise the existing and designated tracks.

Vehicle transport to the project site will be via existing main access roads (e.g. Marchagee Track, Watheroo West Road, and Coalara Road).

2.8 Rehabilitation

Upon completion of all activities, all equipment, personnel and supplies will be demobilised from the area.

Rehabilitation of the drill site will be undertaken using standard exploration drilling rehabilitation techniques which will be outlined in the Environmental Plan to be approved by the DMP.

Passive Seismic & Soil Geochemistry Survey
Warro Gas Field

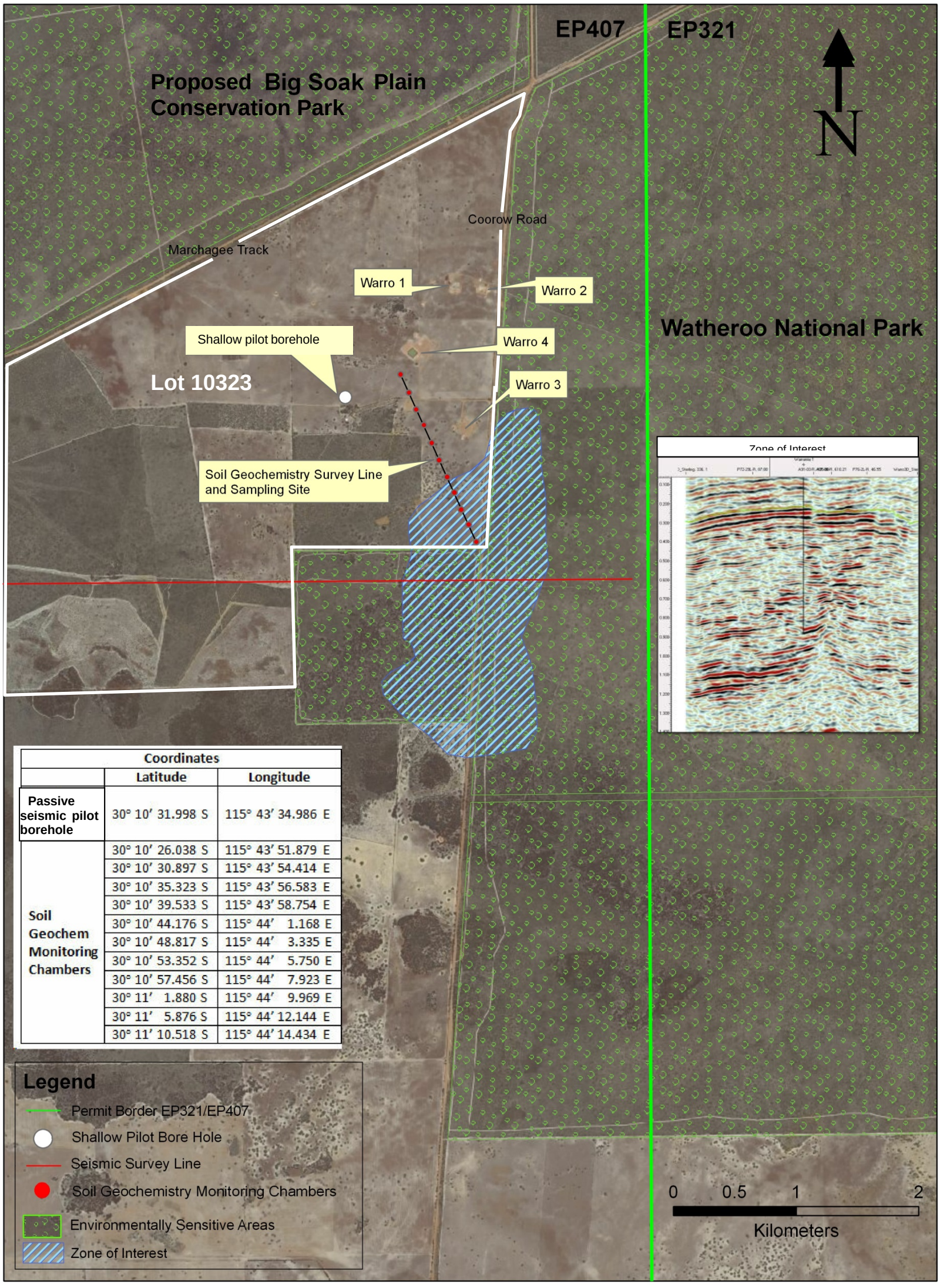

Figure 2 - Location of Pilot Study Project Infrastructure

3 EXISTING ENVIRONMENT

3.1 Landform and Soils

The proposal is located on cleared agricultural land.

The near surface soil is predominantly deep sands and duplex sandy gravels over clays which are well drained.

3.2 Flora and Fauna

3.2.1 Vegetation & Flora

The proposal area and surrounding areas of native vegetation were surveyed as part of the work for the Warro 3D Seismic Survey (Keith Lindbeck & Associates 2009).

The proposal area is situated on Lot 10323, which is cleared freehold agricultural land. No native vegetation is located within the proposal area.

3.2.2 Weed Species

No Declared Pests, as listed by the Department of Agriculture and Food (2013) in accordance with Section 22 of the *Biosecurity and Agriculture Management Act 2007* are in the proposal area.

3.2.3 Dieback

As no areas of native vegetation will be entered during this project, the risk of spreading dieback is minimal. Nonetheless any vehicle associated with the project will be assessed to determine whether they could pose a threat (i.e. been to infected areas prior to this project) and appropriate clean down action taken prior to entering the proposal area. Any surface water will be contained within the drill pad to further reduce the potential for dieback spread.

Assessments of the surrounding native vegetation by NPC Consulting in 2012 and 2013 recorded no evidence of *Phytophthora* spp. (dieback) in the local area.

3.2.4 Fauna

No native fauna (apart from macropods) have been sighted on Lot 10323 as it is located on cleared freehold agricultural land and used mainly for sheep grazing

The proposal area is located near a portion of the Watheroo National Park that contains a small breeding population (6-10 breeding pairs) of Carnaby's Black-Cockatoo during the breeding season (approx. July – Feb) and provides foraging habitat (Johnstone & Kirkby 2008). The project will not have any impact on this species as it does not impact breeding or foraging habitat and it is of short duration and low intensity.

The White Bellied Sea Eagle, Rainbow Bee-eater, Great (White) Egret, Cattle Egret and the Fork-tailed swift were recorded as potential migratory species from the desktop EPBC search of the region. The Great Egret has been recorded in the region on the Birds Australia database. This species prefers shallow freshwater and saltwater and rarely dry pastures (Johnstone & Storr, 2004).

As the project is located on cleared agricultural land, these pilot studies do not involve clearing of any native vegetation or any suitable habitat for migratory species, Latent anticipates there will be no impact to native fauna species or grazing stock.

3.3 Surface Water

There are no drainage lines or surface water bodies in the proposal area or surrounds.

3.4 Groundwater

The project is located within the Jurien Groundwater Area, over the Yarragadee Formation and Leederville Aquifer, which was previously included in the Parmelia-Leederville Aquifer (Northern Agricultural Catchments Council, 2002).

The WJV has been monitoring the groundwater in the areas by sampling three nearby boreholes (located on Lot 10323). This sampling work commenced with the drilling of Warro-3 and has been carried out every six months since. As shown in Table 2, there are no detectable contaminants in the waters.

Rockwater has undertaken a hydrological assessment of the aquifer system in the area (Rockwater Pty Ltd 2013) adding to WJV's understanding of the local system.

Table 2 - Groundwater quality analysis results from water bores on Warro property (sampled on 17 March 2014)

Analyte	UNITS	LQL	HOUSE BORE	RANGERS BORE	WARRO BORE
Aluminium	0.005	mg/L	<0.005	0.008	<0.005
Arsenic	0.001	mg/L	<0.001	<0.001	<0.001
Barium	0.002	mg/L	0.025	0.093	0.045
Boron	0.02	mg/L	0.02	0.05	0.03
Cadmium	0.0001	mg/L	<0.0001	<0.0001	<0.0001
Calcium	0.1	mg/L	0.8	2.1	1.3
Chromium	0.001	mg/L	<0.001	<0.001	<0.001
Cobalt	0.005	mg/L	<0.005	0.030	<0.005
Copper	0.002	mg/L	<0.002	<0.002	<0.002
Iron	0.005	mg/L	1.7	5.0	1.8
Lead	0.0001	mg/L	0.0005	0.0005	0.0002
Magnesium	0.1	mg/L	7.8	23.3	8.3
Manganese	0.001	mg/L	0.41	0.32	0.082
Molybdenum	0.001	mg/L	<0.001	<0.001	<0.001
Nickel	0.001	mg/L	0.003	0.017	0.002
Potassium	0.1	mg/L	13.9	19.3	11.5
Sodium	0.1	mg/L	133	195	116
Sulphate (from S)	0.1	mg/L	9.7	34.2	53.0
Vanadium	0.005	mg/L	<0.005	<0.005	<0.005
Zinc	0.005	mg/L	0.17	0.046	0.010
Methane*	0.01	mg/L	1.5	<0.01	<0.01

3.5 Social Environment

3.5.1 Aboriginal Heritage

An Aboriginal heritage survey was undertaken in late September 2008. There are no Native Heritage sites in the project area. Latent has in place a Native Title agreement with the Yued people and will follow the site identification requirements set out in that agreement.

3.5.2 European Land Use

No areas of European heritage significance are located within the proposal area.

The project is located on cleared farmland and evidence of previous gas exploration and farming activities remain on site.

3.6 Adjacent Conservation Areas to Project

The closest conservation areas to the proposal area are (Figure 2):

- Watheroo National Park - soil geochemistry transit approaches within 50 metres of the National Park while the pilot monitoring borehole is 1.25 km distant from the Park.
- Big Soak Plain (Proposed) Conservation Park – approximately 1.7 km north of the proposal area.

4 IDENTIFICATION OF ENVIRONMENTAL IMPACTS & IMPACT ASSESSMENT

4.1 Overview

Environmental impact assessment and management for the proposal is based on a risk management approach consistent with EPA Environmental Assessment Guideline (EAG) 9 for '*Application for a significance framework in the environmental impact assessment process – Focusing on the key environmental factors'*.

An assessment of the potential impact of the proposal on environmental factors as identified in EPA EAG 8 for '*Environmental factors and objectives'* has been undertaken and is presented in Table 3.

4.2 Environmental Factors

Latent has identified and assessed environmental factors using the EPA's significance framework. The results show no significant Environmental Factors for this proposal. Nevertheless, Latent is managing environmental factors such as Terrestrial Environmental Quality and Hydrological Processes and applying its standard operating procedures and protocols used for previous activity in the area which have been subject to regulatory approvals processes. Additional details are provided in Table 3.

4.3 Assessment of Significance

Latent considers the proposal meets all the EPA objectives and is not likely to have any significant impact on any of the environmental factors listed in EAG 8. Management measures to be implemented by Latent will further reduce the inherent risks (which are not significant) of the proposal on the environment.

As has been previously stated, the goals of the pilot studies that form this proposal are:

- Passive seismic - to determine the most appropriate recording methods for longer term monitoring and the definition of baseline levels of soil gases and naturally occurring seismic activity.
- Soil geochemistry - to determine be optimum depth to position a sonde for long term, high fidelity seismic recordings of naturally occurring seismic events. This borehole will provide long term research benefits and will remain in place for the duration of the Warro Project.

This project is associated with petroleum activities, however, this proposal is only to gather baseline information. The results will inform future petroleum work.

Table 3 - Assessment of proposal on EPA Environmental Factors, management and significance

Theme	EPA Factor	EPA Objective	Potential Impact – Inherent Risk	Impact Management – Residual Risk	Assessment of Significance
Land	Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environment values, both ecological and social, are protected	Proposal is located on cleared agricultural land. There is a potential, albeit low risk of fire outbreak due to drilling activities.	Fire extinguishers will be provided in vehicles and drilling equipment. Flammable material will be cleared from the working area. Fire extinguishers will be provided in vehicles and fire awareness will be reinforced to all visitors to site. Practical fire training will be implemented for selected staff and contractors as appropriate	Not significant.
Water	Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.	The proposal is located on cleared agricultural land. There are no surface drainage lines or water bodies within or in the vicinity of the proposal. The pilot bore to be drilled will be grouted and not remain open. Groundwater will be obtained from existing licensed bores in accordance with existing Water required of low volume and for short duration (2 days).	Groundwater bores are subject to the RIWI Act 1914 are do not require further assessment by the EPA. Any water encountered during drilling will be contained within a lined sump. As only standard drilling additives and grout will be utilised, there will be no impact to local groundwater. All chemicals and other substances to be used down hole during the activities will be fully disclosed in accordance with regulation 15(9) of the *Petroleum and Geothermal Energy Resources (Environment) Regulations 2012* (WA) and *Chemical Disclosure Guideline*.	Not significant.

5 BIBLIOGRAPHY

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APPENDICES

APPENDIX 1 – SOIL GEOCHEMISTRY SAMPLING PROCESS

Project proposal – PILOT STUDY

Targeted assessment of current levels of CH_4 efflux from surface soils in the prospective Warro gas field, Western Australia

Suman J. George; Allison L. Hortle and Linda Stalker

Project overview and scope

TranservEnergy are interested in assessing current levels of soil surface CH_4 flux over a spatial and seasonal scale around the Warro tight gas field area, Perth Basin, prior to any operational activities. The reservoir gas is contained within cemented sandstone of the Yarragadee Formation, three to four kilometres deep within the Dandaragan Trough, Perth Basin. The field is located approximately 200 km north of Perth and 31 km east of both the Dampier-Bunbury Natural Gas Pipeline (DBNGP).

The proposed project aims to undertake an assessment of current levels of CH_4 flux across a nominated transect in the area of interest. Gas flux measurement is considered a more robust measure to calibrate the processes controlling the ambient concentration of CH_4, compared to transient measurements of gas concentration. However, there is scope to test for concentrations during the preliminary evaluation.

The program of work will be modularised to develop the best possible monitoring program for soil gas and geochemistry for long term observations at the Warro Field. Key modules proposed are

(i) Module 1: Pilot study
(ii) Module2a: Preliminary study
(iii) Module2b: Preliminary study

This proposal describes the workflow and outputs for Module 1.

Overview of Module 1 Pilot Study

Objective

CH_4 will have a plant and microbially driven diurnal (24 hr) flux and concentration cycle for soil surface and will show an equivalent pattern for at the Warro field site. A literature review followed by a short field trial is proposed to be conducted to best understand the impact of the diurnal cycle on the methane flux in the environment around the Warro Field. The objective of this short field trial will be to analyse the diurnal variation of soil surface CH_4 cycle and define the optimum repeatable window for measuring soil surface gas flux. This will provide information on how many samples can be measured during a day in Module 2a. The literature review should be supported by information provided by Transverse Energy about geomorphology and subsurface geology to inform the survey design.

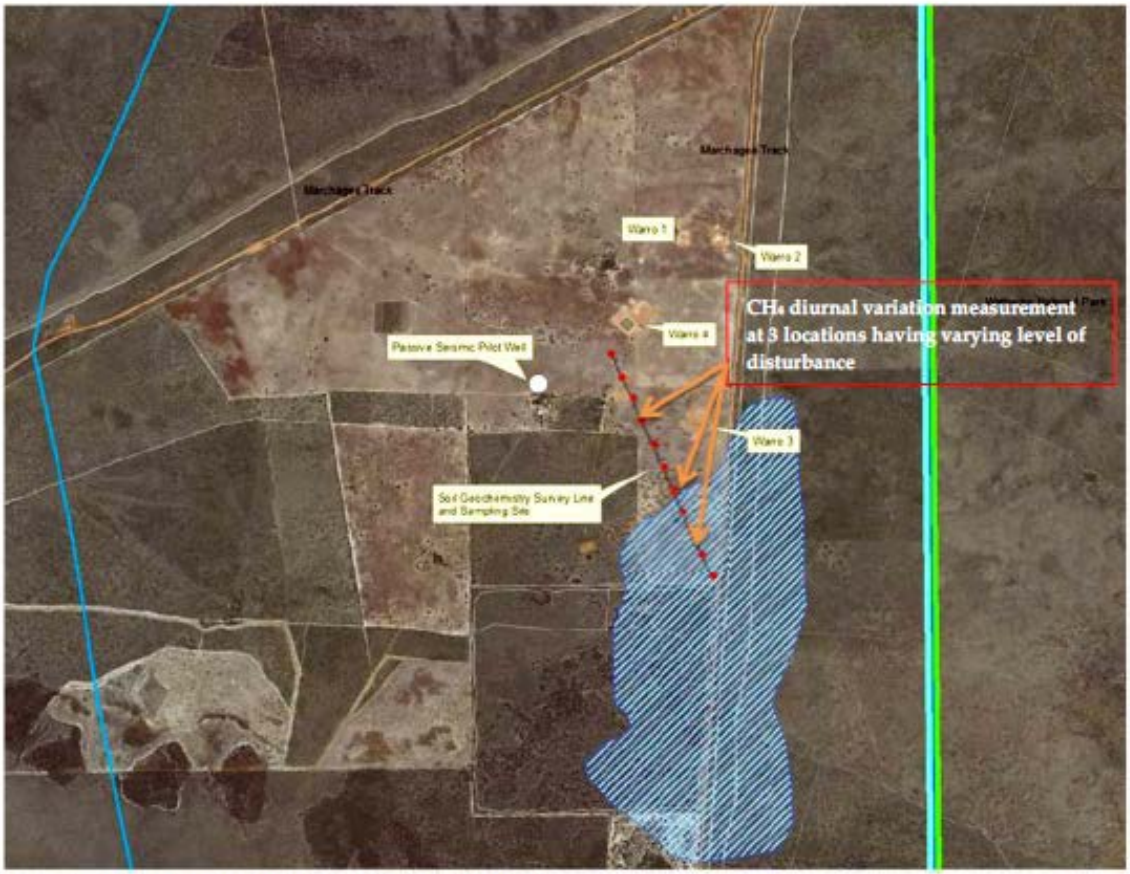

Figure 1 Area of interest (from TranservEnergy)

Field method for measuring soil flux:

Three locations will be selected based on the level of site disturbance (undisturbed, interphase zone and disturbed zone). At each location a section of PVC pipe (dimensions: internal diameter 20 cm; height 12 cm; thickness 0.6 cm) serving as a collar for the soil-gas flux chamber will be inserted into the surface soil to a depth of about 3-4 cm. This will be done at least 24 hours prior to the commencement of soil-gas flux measurements to allow any soil disturbance effects to settle. For the pilot study, the intended period of measurement will be 24 hours so as to cover a whole diurnal cycle.

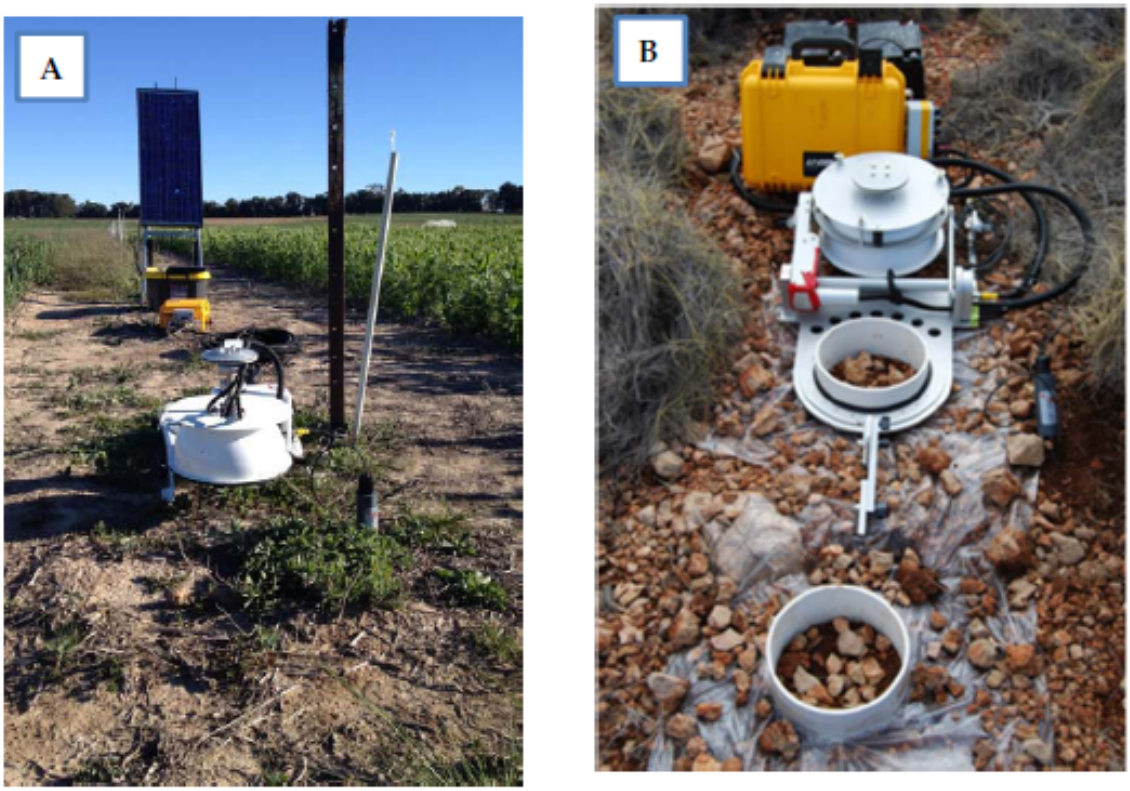

Fig 2 A. Long-term soil gas flux measurement chamber; B Soil Collar (PVC pipe (dimensions: internal diameter 20 cm; height 12 cm; thickness 0.6 cm) will be inserted into the surface soil to a depth of about 3-4 cm.

Work Schedule

1	Literature Review	4 days	Including data and maps provided by TransversEnergy
2	Field Trial: CH4 flux diurnal cycle at 3 locations (Fig 1)	8 days (2 people, 4days each)	Including travel, collar installation and flux measurements at up to three sites.
3	Data analysis and interpretation	3 days	Including QC of data
4	Project managment	2 days	Including logistics, budgeting and reporting

Project Organisational Structure

Ms. Allison Hortle - will oversee the overall project co-ordination, contracting, reporting, quality control and budget supervision.

Assistant Professor Suman George: He will also provide supervision with the respirometry, laboratory analysis, geospatial data acquisition and statistical analysis. I will ensure periodic project evaluation with

APPENDIX 2 – UWA PASSIVE SEISMIC MONITORING STATIONS

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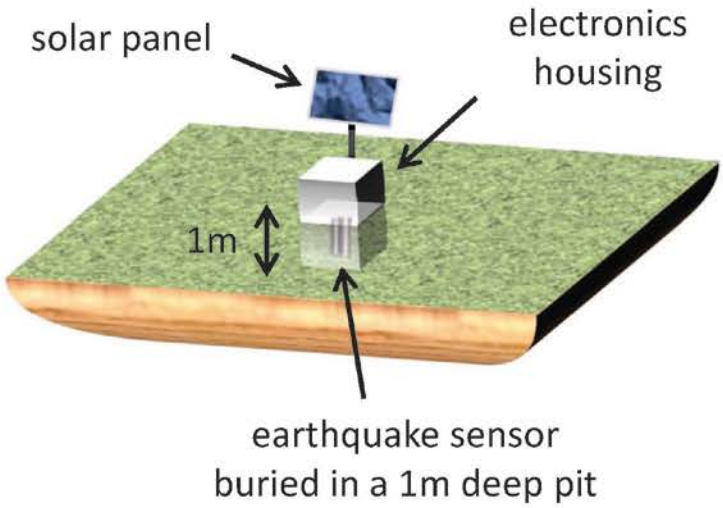
UWA Geophysics
March 2014

1. Broadband seismic monitoring station (surface)

Purpose: Detection and location of local M>0 and distant M>2 (micro)-earthquakes



1.1 Schematic of broadband seismic monitoring station

1.2 Example electronics housing (box) with mains power (on UWA campus). Broadband sensors are buried at 1m depth below surface.

for more information contact: nader.issa@uwa.edu.au or david.lumley@uwa.edu.au

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March 2014

1.3 Inside the housing box showing electronics for data collection and power supply

1.4 Example broadband sensor (0.03-100 Hz) installed in 1m pit

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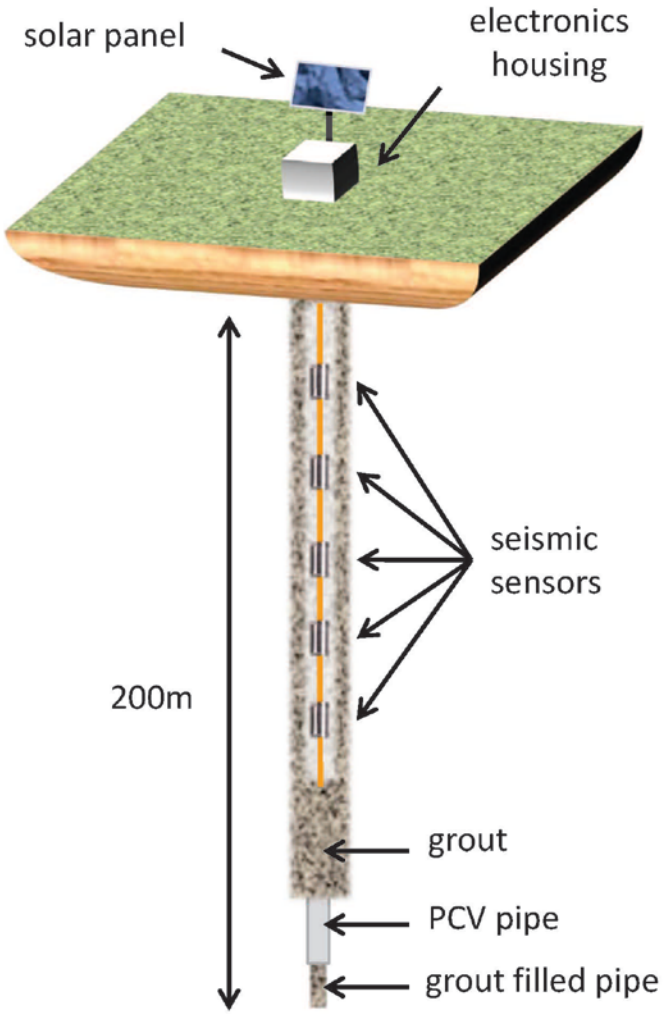
UWA Geophysics
March 2014

2. Shallow borehole monitoring array station

Purpose: S/N characterization and monitoring of local seismic events M>-1 (natural or induced)



2.1 Schematic of shallow borehole monitoring array station

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2.2 Example electronics housing with solar power and radio communication

2.3 Inside the housing showing electronics for data collection

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2.4 Example of seismic sensor (sonde) to be installed in borehole array

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