

SEPTEMBER 2010

PETROLEUM

IN WESTERN AUSTRALIA

WESTERN AUSTRALIA'S DIGEST OF PETROLEUM EXPLORATION, DEVELOPMENT AND PRODUCTION



Contents



Monument to workers, Karratha
(Photo courtesy of Nirmal Mathew)

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Cover Photo: Bunda 3D seismic survey
(Photo courtesy of Buru Energy Ltd)

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ARTICLES

- 03 Minister's Message
- 04 Executive Director's Message: Who Watches the Watchers? Ensuring Best Practice Regulation
- 06 Petroleum Exploration, Production and Development Activity in Western Australia — Highlights from January to June 2010
- 14 Petroleum and Geothermal Acreage Availability
- 18 Gingin West 1 Gas Discovery in the Perth Basin
- 20 The Outlook for Domestic Gas in Western Australia
- 23 Tight Gas Reserves in the Canning Basin
- 30 State Award of Geothermal Exploration Permits
- 34 Awards of Petroleum Exploration Permits
- 35 The Petroleum and Geothermal Register (PGR) — Moving Forward
- 36 Policy Initiatives Streamline Petroleum Acreage Release

TABLES

- 37 **Table 1.** 2009 Production by Field and Cumulative Production as at 31 December 2009
- 39 **Table 2.** Petroleum Reserves Estimates by Basin as at 31 December 2009
- 40 **Table 3.** Seismic Surveys in Western Australia 2009–10 Fiscal Year — Statistical Summary
- 40 **Table 4.** Petroleum Wells in Western Australia 2009–10 Fiscal Year — Statistical Summary
- 41 **Table 5.** Seismic Surveys in Western Australia Operating 2009–10 Fiscal Year
- 42 **Table 6.** Petroleum Wells in Western Australia Operating 2009–10 Fiscal Year
- 48 **Table 7.** List of Petroleum and Geothermal Titles and Holders in Western Australia as at 5 January 2010
- 60 Trade and Investment Offices

Key Petroleum Contacts



WESTERN AUSTRALIA

Opportunities to Explore

BIDS INVITED FOR ACREAGE

PETROLEUM ACREAGE



RELEASE ONE Canning Basin

There is one release area in the Lennard Shelf of the Canning Basin. The area is 4,091 km² in size.

Hydrocarbon shows are widespread on the Lennard Shelf, with economic accumulations of oil immediately southeast of the release area. These accumulations are found in a Devonian carbonate reef and in Permo-Carboniferous clastics.

Perth Basin

There is one area in the coastal waters of the northern Perth Basin. The area is 1,331 km² in size.

The northern Perth Basin has numerous seismic lines, wells, and oil and gas production from Permian reservoirs. Two gas pipelines occur to the east of the release area. A sealed highway connects to the State capital, Perth, and the Kwinana oil refinery.

Bids close 4 November 2010

RELEASE TWO Canning Basin

There are five release areas in the Paleozoic Canning Basin. These areas range in size from 2,712 km² to 6,056 km². Targets include Permo-Carboniferous sandstones, Upper Paleozoic sandstones, and Ordovician carbonates and sandstones.

Carnarvon Basin

There is one release area in the Carnarvon Basin. It straddles the Exmouth Gulf and is partly onshore. Area size is 2,813 km². Targets include Mesozoic sandstones.

Perth Basin

There is one release area in the northern Perth Basin. Area size is 2,633 km².

Targets include Permian and Jurassic sandstones.

Bids close 10 March 2011

GEO THERMAL ACREAGE



Whole of State

The second geothermal acreage release of 2010 covers the whole of the State not covered by permits or applications.

Companies are invited to tender for predetermined areas:

Region	Release areas size (approx.)
Perth Basin and adjacent	320 km ²
Carnarvon Basin and adjacent	6,400 km ²
Southeast region	6,400 km ²
Northeast region	8,000 km ²

Companies interested in geothermal acreage are allowed to bid for multiple areas and are expected to drill at least one well to a depth of 400 m during the first two years of obtaining a geothermal title.

Bids close 10 December 2010

Acreage release CD packages are available from DMP and a web version is also available:
www.dmp.wa.gov.au/acreage_release

Acreage release packages contain relevant information about the release areas, land access and how to make a valid application for an Exploration Permit.

FURTHER INFORMATION

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Hon. Norman Moore MLC
Minister for Mines and Petroleum

Minister's Message

The petroleum sector's importance to the Western Australian economy is unquestionable. Since the first discoveries of gas in the State's North West the petroleum sector's domestic and national value has been well recognised, however its international significance, particularly to the Asia-Pacific region, is rapidly gaining recognition.

The number of major international petroleum conferences recently held in Perth is testament to Western Australia's growth in the sector. This includes conferences such as LNG World, Subsea Australasia and the Society of Petrophysicists and Well Log Analysts Symposium - which was held outside of the Northern Hemisphere for the first time in the organisation's 50 year history. These events reflect and recognise the growth in Western Australia's oil and gas sector.

One hundred and forty billion dollars of investment is planned for Liquefied Natural Gas developments in the State alone. This will make Western Australia the world's second-largest exporter of LNG by 2020. Despite the rapid rise of LNG in Western Australia, we are by no means a one trick pony.

The overall value of petroleum production in the State last year was \$21 billion dollars, with crude oil and condensate worth more than half of that amount.

The growth of unconventional oil and gas, as well as geothermal energy, are all adding to the diversity of Western Australia's petroleum sector.

The State Government announced an All-of-State geothermal acreage release in April this year, paving the way for an increase in applications for geothermal permits.

In the last round of applications the State Government granted 10 permits covering the Carnarvon Basin and the Southeast regions. With the All-of-State release we can expect the figure to jump considerably by the end of 2010.

The latest releases represent an excellent opportunity for explorers to obtain geothermal permits with good potential in key locations of the State.

This year also saw the first exploration well for shale gas drilled in Western Australia. The Woodada Deep 1 well, located in the onshore Perth Basin about 100 km north of Lancelin near Eneabba, was drilled by Australian oil and gas exploration company AWE. This project has the potential to spark a new industry which may significantly increase WA's economic growth and enhance its reputation as an international resources hub.

Unconventional gas, such as shale gas, now accounts for more than 40 per cent of natural gas production in the United States. AWE believes the shale gas potential in the Perth Basin appeared comparable with the successful shale gas fields of North America.

The State Government's commitment to approvals reform has also taken a major leap forward. The establishment of an online approvals system by the Petroleum Division is revolutionising the lodgement, tracking and payment of geothermal, oil and gas approvals for industry.

Phase two of the PGR pipelines module was officially launched to industry on April 14. This technology will not only save time, money and resources for companies using the system but also allow Petroleum Division staff to dedicate more time to processing approvals.

PGR has significantly streamlined the approvals process and offered a new level of transparency to the public and industry. Industry has the ability to lodge, pay for and immediately track the progress of an application to its completion.

Using the pipelines module as a prototype, future releases of PGR will see all other application types integrated into the system and go online.

With the global financial crisis behind us the next period of growth presents an exciting opportunity for companies, investors, employees and Western Australia.

This issue of PWA provides a comprehensive insight into those opportunities. ■



Bill Tinapple

Executive Director
Petroleum Division

Who Watches the Watchers? Ensuring Best Practice Regulation

The *Deepwater Horizon* Gulf of Mexico and Montara Timor Sea oil spills and the Varanus Island pipeline rupture have raised questions about oil and gas regulation in Australia. Much has been made of the need for institutional reform. However, I believe there are several more important aspects that need attention to ensure Australia and Western Australia attain best practice regulation in the oil and gas sector. Resulting from recent incidents is a move to utilisation of more third party checks or audits. This should also apply to Regulator functions. There is a need for the establishment of an ongoing Regulator compliance audit role.

The Western Australian government has established a Lead Agency Framework that will ensure all projects, and in particular, large complex projects, have a lead government agency with a case manager to advise on, and facilitate development and ongoing operations. The Western Australian Government has also committed to world's best practices in safety regulation and is already making major reforms in this area.

The Department of Mines and Petroleum (DMP) is the lead agency for most oil and gas projects and where this role is with the Department of State Development a contact officer has been assigned within DMP.

As a lead agency DMP has already made significant in-roads in improving regulatory and administrative processes relating to the oil and gas sector. The most common applications and payments can now be submitted online. The progress of each application can be tracked online by the proponent and all process charts are available as well as explanatory guidelines.

An immediate response following the Montara and *Deepwater Horizon* oil spills was more scrutiny of applications for drilling approvals, ensuring the appropriate technical input was provided. Also, a compliance review is being carried out on suspended wells and pipeline shore crossing operations.

Regulation of oil and gas operations is not an isolated process. It is born of the legislative process under which it operates. The efficiency and effectiveness of regulation relies not only upon the internal structures and resources of the Regulator but also the interaction with the industry that it regulates and other Regulators. All aspects of regulation must be integrated to achieve best practice regulation.

Recent reviews have failed to account for this and have single-mindedly focused on changing the Regulator leading to misconceptions that greater regulatory efficiency and rigorous assessment are not possible within the current administrative framework. However, addressing these other areas would yield better results for both industry and government. Collection and publication of performance data helps in ensuring Regulators are performing their roles effectively and identify areas for improvement. This also helps cement Australia's petroleum industry as the world leader.

The adjacent flow chart summarises the activities involved and the interactions that have to occur between various components (Fig. 1). Institutional reform proposals that only focus on the *Regulator* box sideline the critical role the other components play in ensuring regulation is efficient, rigorous, detailed and holistic. Best practice regulation

needs to provide for continuous improvement of all components to ensure there are no gaps and overlaps. Each of the components and the impact on regulatory processes are illustrated in the flow chart.

Regulatory Framework

Regulators can only carry out responsibilities they are empowered to do by the legislation under which they operate. Legislative and regulatory framework reform needs to reflect best practice but also reduce duplication and overlap. It is difficult if not impossible for Regulators to overcome shortcomings by administrative means. Under mirror legislation commitments with the states, the Commonwealth has to lead the way in legislative reform. This process has been slipping, for example, in the case of consolidation of regulations. Industry has far more worldwide experience in terms of technical applications and therefore the reform process should include comprehensive consultation with stakeholders.

Coordination with Other Regulators

Interaction with other Regulators is unavoidable thus coordination is highly important. In many cases the activity or facility being regulated interacts with activities or facilities in other jurisdictions and this is where overlaps or gaps can cause problems. Investigators reviewing incidents often identify this as an area of failure in regulation. There will always be jurisdictional boundaries because of the nature of our system of government; however, cooperation and coordination across boundaries have been proven to work effectively.

Activity Operator

As the oil and gas sector is such a highly technical and complex business, industry must accept full responsibility for the way it undertakes its business. Accordingly, the operator should be responsible for identifying new and critical issues that require immediate attention to ensure safety and efficiency.

Regulator/Activity Operator Interface

Excellent communications between the regulators and operators are critical, not only during the development stages but also during operations. For example, for drilling approvals, it is important for regulator representatives to attend HAZID, HAZOP, DWOP

and TWOP meetings to understand risk assessment methods and to identify high risk operational areas that need to be monitored. Attendance also reinforces the importance of communication between the Regulator and contractors. The Regulator is necessary to ensure community interests are taken into account and to assist industry by introducing new approaches and standards.

Benchmarking

Many efforts are made to describe good practice and best practice. For example we frequently use descriptors of “good industry practice” and “fit for purpose”; however, exact definitions are difficult to come by. Regulators need to have benchmarks to compare details of proposals. The *Deepwater Horizon* incident has led to the emergence of a range of new proposals including additional third party verification. Any new approach to setting procedures, baseline specifications and standards must be very carefully considered so that unnecessary complexity and delays are not added to projects.

Application, Assessment and Acceptance/Approval

The Productivity Commission, in its review of regulatory burden in 2009, indicated there was significant room for improvement in the time required for assessment and approval. As seen in earlier comments, Western Australia is making major improvements in this area and is leading Australia in the introduction of more efficient and transparent regulatory systems that are highly valued by industry. On the other hand, as response to recent incidents has shown, emphasis on the speed of assessment has to be tempered by regulatory rigour. The complex nature of the content of submissions requires careful consideration and discussion between the various interested parties to ensure all needs are met as far as is practicable.

Operational Audits

A significant part of Regulator function is to ensure that operators have complied with conditions that formed part of the grant of approval.

Regulator Compliance Audits

Given concerns about Regulator rigour, it seems appropriate to have routine checks on Regulator performance.

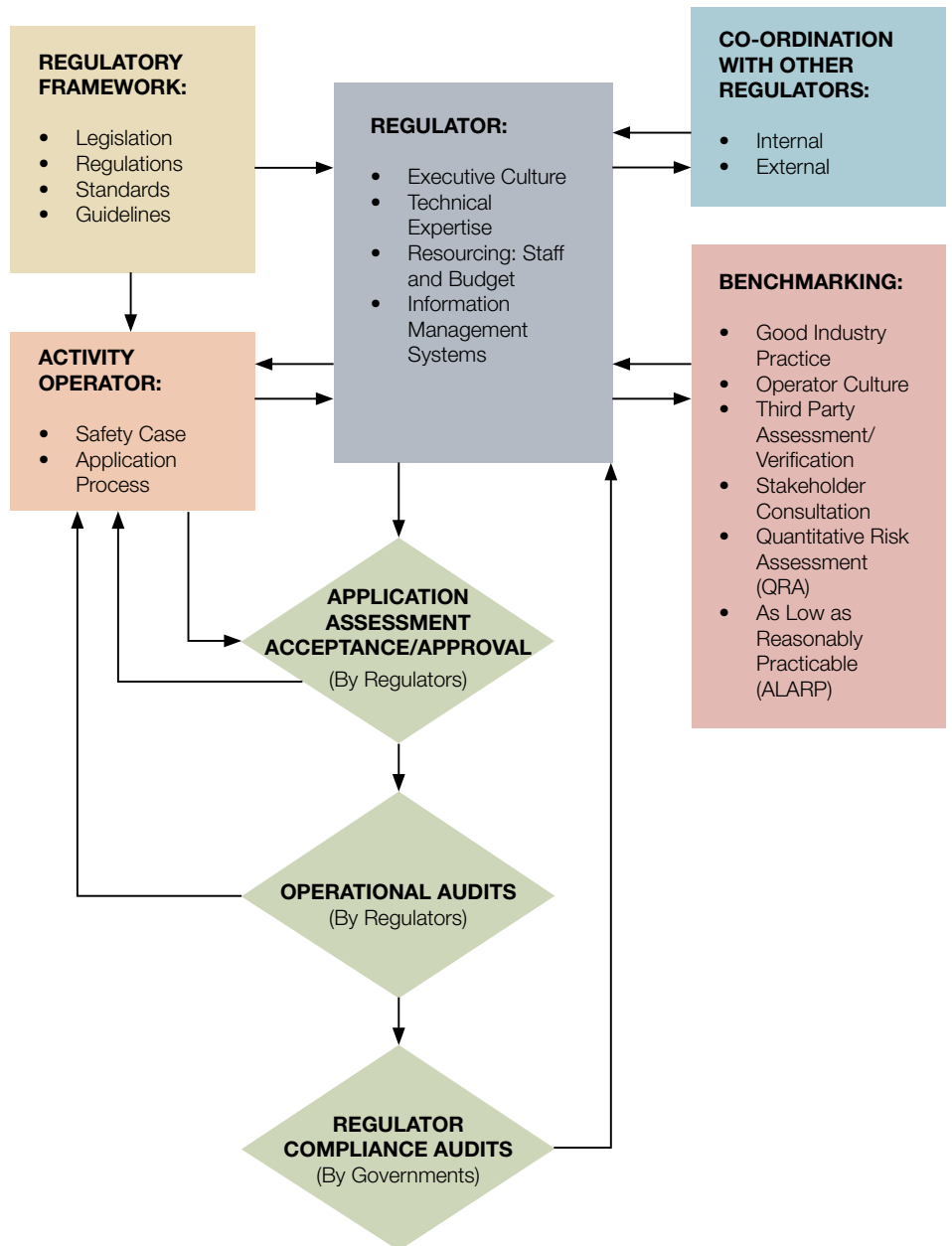


Figure 1 | Impacts on regulatory processes in the oil and gas sector

Checks or audits of Regulators and regular feedback will improve overall performance. Similar to financial audit functions, this should be carried out by an established independent auditor. The function could be carried out by a government agency, for example by the Commonwealth for its jurisdiction and by Western Australia for its jurisdictions or by an independent contractor overseen by a joint industry/government committee or board. This should give confidence to governments, the community and industry that best practice regulation is being carried out. ■



Petroleum Exploration, Production and Development Activity in Western Australia — Highlights from January to June 2010

Karina Jonasson and Charlotte Mack
Petroleum Geologists
Resources Branch



Vibroseis truck from the Bunda 3D survey near a beam pump at the Sundown oilfield in the Canning Basin (Photo courtesy of Burt Energy)

This article will highlight exploration, production and development activities for the second half of the 2009–10 fiscal year. A summary of activities carried out in the 2009 calendar year can be found in the April 2010 edition of the PWA magazine.

In 2009–10 there were 45 exploration wells, 17 appraisal wells and seven development wells drilled in Western Australia, with a 13 per cent success rate from new field wildcats in the period (see Figures 1–3). In addition, a total of 34,708 line km of 2D seismic and 27,073 km² of 3D seismic data were acquired in the State.

A small number of discoveries, all gas, were made in the first half of 2009. ConocoPhillips announced a significant gas discovery following the drilling of the Kronos 1 exploration well in the Browse Basin. Both Chevron and Empire Oil and Gas made announcements early in the year regarding exploration wells drilled at the end of 2009, namely Yellowglenn 1 and Gingin West 1. Chevron's Sappho 1, which was completed in May 2010, was recently announced as another gas discovery. Woodside will be able to add more gas into its Pluto project with the Noblige 1 gas discovery. Woodside has recently brought in the semi-submersible drilling rig *Ocean America* to assist its ongoing Pluto drilling campaign.

Western Australia's recent successes are reflected by new interest from Brazilian company Petrobras making its first entry into the Australian upstream sector

with the purchase of a 50 per cent acquisition of MEO Australia's offshore block WA-360-P within the Carnarvon Basin. The first well planned within the block is Artemis 1 which is designed to test the Artemis prospect, which may hold reserves of up to 340 Gm³ of gas.

Encouraging in terms of gas production for the future are attempts to replicate unconventional resource successes in other parts of the world. AWE announced plans to follow up on potentially lucrative shale gas resources within the Perth Basin. The AWE Woodada Deep coring program is designed to test the potential for gas production of three major shale sequences of up to 300 m thick, the Kockatea Shale, the Carynginia Formation and the Irwin River Coal Measures.

Fiscal year 2009–10 statistics for drilling and seismic acquisition can be found in the tables section at the back of this edition of the PWA.

EXPLORATION ACTIVITY BY BASIN

Bight Basin

A frontier exploration program was commenced by Arcadia Petroleum and its partner Enovation Resources within the Bight Basin last year, with the Bremer Basin 2D Marine Seismic Survey being completed 20 January 2010. A total of 4,443 line km of 2D seismic has been shot off the south coast of Western Australia and is currently being processed.

Bonaparte Basin

One offshore 2D survey was completed in the first half of the year with a total line distance of 394 km acquired by the Penguin 2010 2D M.S.S. for Eni. An offshore 3D survey was also conducted with a total of 2,750 km² acquired for RIL. No wells were drilled in the Western Australian portion of the basin.

Browse Basin

Two new offshore wells, Poseidon 2 and Kronos 1, were drilled in the Browse Basin both within the WA-398-P permit held by ConocoPhillips and Karoon Gas. The Poseidon 2 well discovered a new Montara Formation gas reservoir within the Poseidon field. Considerable reserves need to be appraised within the Poseidon field. Kronos 1 also encountered pay sands in Plover Formation reservoirs flowing at an equipment constrained maximum rate of 736 Mm³/d (26 MMscf/d). The discoveries are located about 480 km north of Broome and on trend with Woodside's Torosa gas-condensate field.

Three 3D offshore seismic surveys amounting to a total of 5,519 km² were completed in the Browse Basin as well as 4,101 line km of 2D with the completion of the Koolama 2D M.S.S. on 26 June 2010. Of significance is the Poseidon 3D M.S.S. that covered the greater Poseidon area including the southern structural high of the trend that previously only been defined on 2D surveys.

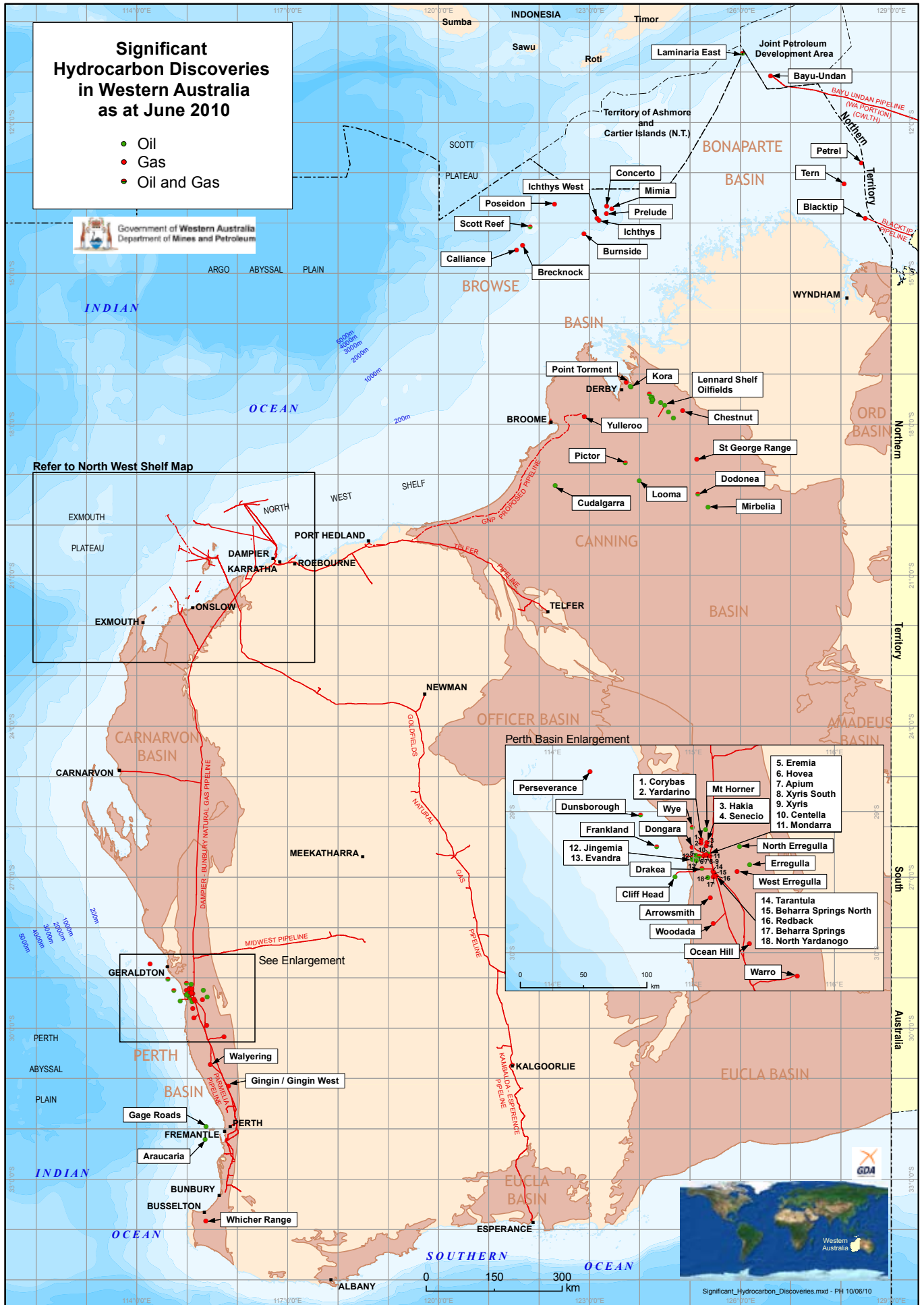


Figure 1 | Significant hydrocarbon discoveries in Western Australia

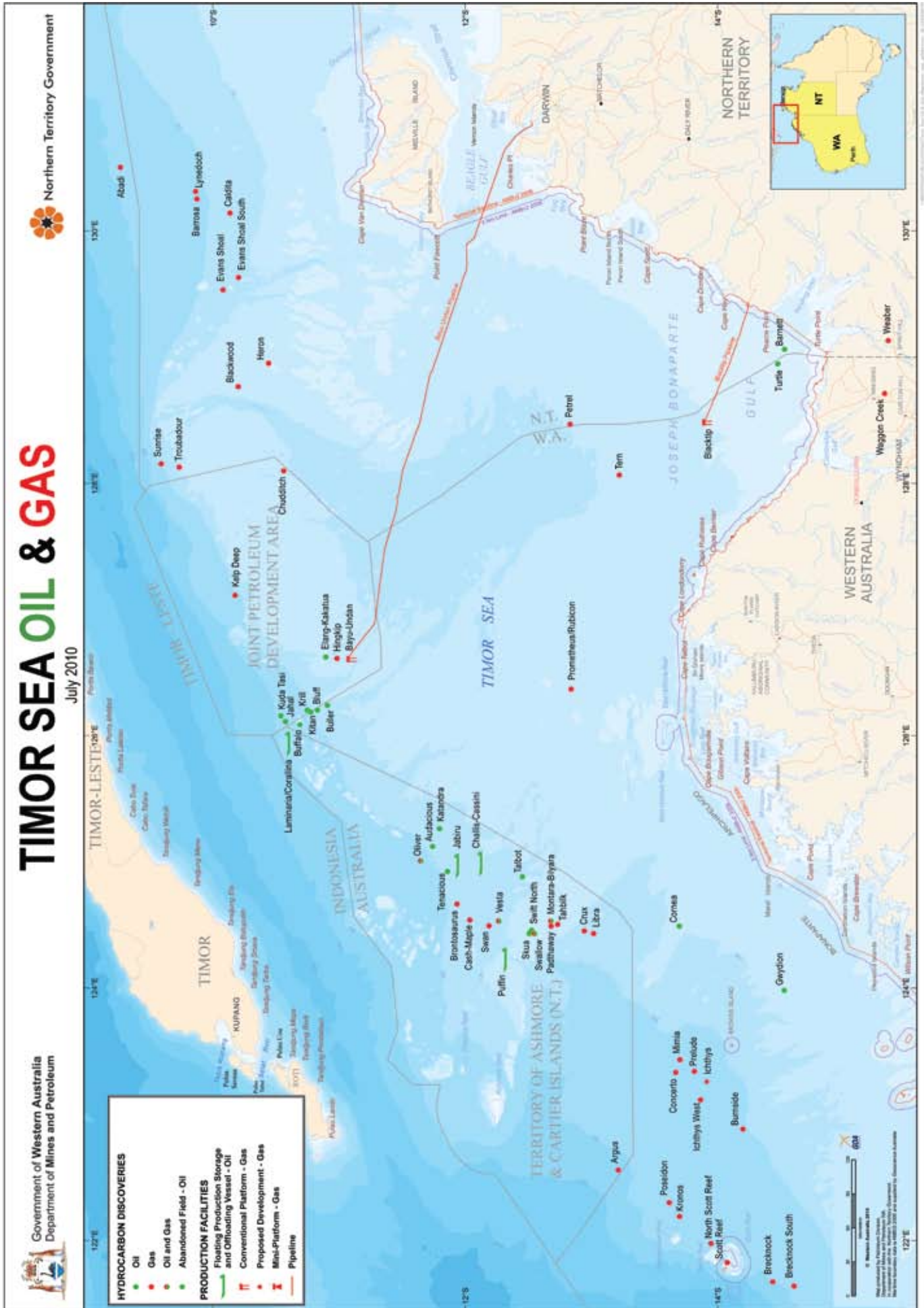


Figure 3 | Timor Sea production facilities and significant hydrocarbon discoveries

Canning Basin

One new well was drilled by Buru Energy in the basin. The Fairwell 1 exploration well commenced drilling on 18 May 2010 but failed to encounter hydrocarbons in the primary objective Grant Formation, nor in the Yellow Drum Formation and Nullara Formation secondary objectives. The next wells on Buru's drilling schedule are Paradise 1 and Leander 1 in the second half of 2010.

Buru continued to carry out exploration within the basin with the Paradise 2009 2D S.S. (at total of 103 line-km onshore) and Bunda 3D S.S. being completed September 2009. The Bunda Survey intended to provide greater clarity on the potential size of additional reserves at the Sundown oilfield and provide data for locating future exploration, appraisal and development wells within the 223 km² area covered by the survey.

Finder Exploration also carried out exploration activities recording 21,583 line km of aeromagnetic data in the offshore portion of the basin with the Bedout Sub-Basin Aeromagnetic Survey. Data from all surveys is currently being processed.

Carnarvon Basin

Successful exploration drilling for the first half of the year in the Carnarvon Basin resulted in three of 13 wells encountering hydrocarbons. In addition, six extension and seven development wells were drilled and three 3D seismic surveys were carried out to 30 June 2010. Two of the 3D surveys commenced in 2009–10 are continuing with the Eendracht 3D M.S.S. and the Schiele 3D M.S.S. recording 6,853 km² and 4,159 km² respectively, to date.

Apache had little success with Bath 1 failing to encounter significant hydrocarbons in the primary target and only encountering minor oil within its secondary objective. The follow-up well, Laurel 1, designed to test this secondary oil interval, failed to encounter oil at the same level. Drilling on Laurel 1 continues into the second half of the year.

Woodside drilled gas exploration well Noblige 1 in Exploration Permit WA-404-P. The well showed indications of gas from logs at several intervals. This included a 300-m gross interval within the intra-Triassic primary target.



The Fairway drilling rig at Leander 1 in the Canning Basin
(Photo courtesy of Buru Energy)

Chevron completed the Yellowglenn 1 well on 10 December 2009 but the announcement of the well as a gas discovery was held off until the first half of the year. The well encountered gas in WA-268-P in the Greater Gorgon Area intersecting a gas column of 137 m. Sappho 1 also marked a success for Chevron with potential to support both the Gorgon and Wheatstone LNG projects. The well encountered gas in WA-392-P with 75 m of net pay interpreted from logs. The announcement came a week after Chevron announced 79 m of net gas pay in the Clio 3 well in WA-205-P.

Glenloth 1 was the twelfth well in Hess Exploration's 16-well commitment program and was announced as a gas discovery. This raises the success rate for the company to ten discoveries to date. Plans have been made for completion of the current program mid-year with the company intending to follow up with an appraisal and flow testing phase in the second half of the year.

Officer Basin

Canadian explorer Rodinia Oil has been awarded two new petroleum exploration permit applications in the Western Australian portion of the Officer Basin. Blocks EPA 3/09-0 and EPA 4/09-0 cover an area of about 22,880 km² and are located immediately north of the company's current exploration acreage.

Rodinia has priority on the two permits and the right to convert them into Exploration Permits provided it negotiates native title agreements. The two permits include the GSWA Vines well on EPA 4/09-0 which was drilled to a total depth of 2,017 m in 1999 and encountered a gas show at 1,482 m.

Perth Basin

Gingin West 1 was a gas discovery for Empire Oil and Gas within the Perth Basin in 2009–10. While drilling was completed in December 2009 the announcement of the discovery was not made till the first half of this year. The well discovered a new Top D Sand in the Gingin West Block B prospect and flowed a stabilised rate

of 217 km³ (7.66 MMscf) gas and 47.8 kL (301 bbl) of condensate per day. The location of the well is within 1.6 km of both the Parmelia and Dampier to Bunbury gaslines allowing for rapid commercialisation of gas produced.

Westralian Gas and Power drilled a coal seam gas prospect with the Kaloorup Road 2 well on Drilling Reserve 10.

PRODUCTION

Production and reserves information to the end of the 2009 calendar year for specific fields can be located in the tables section at the back of the magazine.

Hydrocarbon accumulations are known in five of seven major sedimentary basins in Western Australia. Production in 2009 was sourced from 68 fields within the Bonaparte, Canning, Carnarvon and Perth Basins.

Crude oil and condensate produced averaged 46,566 kL/d and average gas production was 93,487 km³/d for the last calendar year.



Hess continues to have drilling success with the *Jack Bates* semisubmersible
(Photo courtesy of Hess/Robert Garvey)

Two new oil projects started up in 2010. Production from the Van Gogh oilfield commenced in February of this year. Van Gogh is Apache's first oil development using a floating production, storage and offloading (FPSO) system, the *Ningaloo Vision*. The production facilities comprise 19 production laterals, two water injection wells and one gas injection wells. The project is expected to produce 6,360 kL/d (40,000 bbl/d) of oil.

In February and March of 2010 the Pyrenees project comprising the Crosby, Ravensworth and Stickle oilfields started production ahead of schedule in BHP Billiton Petroleum operated permit WA-42-L. The full project includes a subsea gathering system and the *Pyrenees Venture* FPSO vessel capable of producing up to 15,263 kL (96,000 bbl) of oil and reinjecting 1.7 Mm³ (60 MMscf) of gas per day. Approximately half of the planned 13 subsea wells are currently ramping up from first oil with the remaining wells to be brought into production within six months of start up. Gas produced by the development will be reinjected into the reservoir of the nearby Macedon gasfield for future recovery.

The first half of the year also saw the recommencement of production at the Woollybutt oilfield by Eni. Production at the field resumed in March after nearly a year of suspension due to dry docking of the *Four Vanguard* FPSO.

Production Licence L15 was granted to Buru Energy over two blocks on the Lennard Shelf in the Canning Basin. The permit contains the West Kora 1 well which was drilled back in 1984.

DEVELOPMENT ACTIVITY OFFSHORE

Browse

In the 2009–10 fiscal year Woodside Petroleum put offshore production facilities out to bid for Front End Engineering and Design (FEED), after progressing to the Basis of Design phase for the Browse development. Plans for the project include a central gas processing and compression platform, three unmanned platforms on the Torosa, Brecknock and Calliance fields plus a 350-km, 1,030 mm (42-inch) pipeline from the main platform to the liquefaction plant sited at James Price Point in the Kimberley. The initial

onshore LNG processing is planned via three trains with a rate of 12 million tonnes per annum (Mtpa) with the option of increasing the number of trains in the future. The final investment decision for the project is expected mid-2012.

Gorgon

Activity is officially underway on the Gorgon project with a ground breaking ceremony held on Barrow Island in December of 2009. More than \$20 billion in contracts have been awarded including fabrication and assembly of the main LNG modules, construction of the 2.1-km LNG jetty and marine structures, manufacture of LNG tanks and for offshore pipe lay. Many of the contracts awarded include a large percentage of local, Australian and regional content.

The CO₂ Geosequestration Seismic Baseline Survey of Barrow Island was also completed late December and is the first phase of the project's groundbreaking carbon dioxide (CO₂) injection project. This will provide the baseline data for future monitoring of the behaviour of injected CO₂.

In the first half of the year the foundation Joint Venture Participants Chevron (~47%), ExxonMobil (25%) and Shell (25%) welcomed new participants Osaka Gas (1.25%), Tokyo Gas (1%) and Chubu Electric Power (0.417%). Total gas resources of 1.13 Tm³ (40 Tcf) will come from the Gorgon and Jansz-lo gasfields.

Ichthys

A final investment decision has been delayed on Inpex's Ichthys liquefied natural gas development with the \$20 billion project expected to be sanctioned in Q4 of 2011. The delay is attributed to project design and engineering requiring more time with production now expected to start in 2016.

The project design includes a large semi-submersible platform, a newbuild FPSO and an 885-km 1,030 mm (42-inch) diameter subsea gas trunkline. FEED contractors are Amec, Aker Solutions and JP Kenny for the offshore project and JGC, KBR and Chiyoda for the onshore project.

Julimar-Brunello

Apache have awarded the main FEED contract to Wood Group subsidiary JP

Kenny. The \$1.2 billion project includes a subsea gas gathering system of well head, christmas trees and manifolds. Also included is a 50-km pipeline to connect to the Wheatstone project to provide feed gas following an agreement made last year with Chevron. The development will include the Julimar Southwest 1 and 2 wells drilled this year. An estimated 59 Gm³ (2.1 Tcf) of gas reserves from two of Apache's largest discoveries will be contributed to the Wheatstone project.

North West Shelf – CWLH & NRB

The Cossack–Wanaea–Lambert–Hermes Life Extension Project is on schedule and budget with the conversion of the FPSO continuing. The new vessel will have a capacity of 9.5 ML/d (60,000 bbl/d). Jacket fabrication for the North Rankin B Gas Compression project is continuing ahead of schedule.

Macedon

The Macedon project is in its final stages of completion for the design of the project and BHP Billiton expects to sanction the project in the coming months. The development concept is based on four subsea wells connected via an 85-km subsea pipeline to an onshore gas plant. BHP Billiton proposes to build a gas processing plant at Ashburton North located approximately 17 km southwest of Onslow with a 67-km pipeline connected to the Dampier to Bunbury Natural Gas Pipeline.

Pluto

Woodside Petroleum, operator of the Pluto LNG project, expects to commence receiving feedstock gas from the field late 2010. LNG exports are targeted for early 2011.

Prelude

Shell is currently working towards the final investment decision for the Prelude Floating LNG (FLNG) project with the FEED contract having been signed with Technip in March. The field lies in wholly Shell owned WA-371-P and contains estimated reserves of 71 to 85 Gm³ (2.5 to 3.0 Tcf) gas and 1.9 GL (120 MMbbl) of condensate. The Final Investment Decision (FID) is targeted for early 2011 with first gas expected in 2016.

The Prelude FLNG development will be capable of producing 3.5 Mt of LNG per annum. It is also able to handle liquefied petroleum gas and condensate amounting to a total liquid production up to, and in excess of, 5 Mtpa.

Once the FID is made the construction of the 600,000 tonne vessel in Korea and towing the facility to Australia will take approximately five years. In the meantime Shell plans to commence drilling eight subsea production wells in 2013.

Reindeer

The Devil Creek Development Project (DCDP) and the associated Reindeer gasfield are being developed by Apache Energy Ltd on behalf of its joint venture partners. First gas is targeted at the end of 2011.

Go Marine Group will be providing barges and anchor handler tugs to transport a jacket and deck for the Reindeer project. The jacket and deck will be transported from China to Dampier. Offshore installation is scheduled to commence in late 2010.

Scarborough

ExxonMobil and BHP Billiton are currently working towards a development concept for the Scarborough field which is located 280 km northwest of Onslow in Retention Lease WA-1-R in 950 m of water.

Wheatstone

The first phase of the Wheatstone Project will consist of two LNG processing trains with a combined capacity of nearly 10 Mtpa. The facility will be located at Ashburton North on the mainland of Western Australia. FID on the first phase of the project is slated for 2011, after FEED.

Chevron has also negotiated what could be a \$90 billion dollar supply agreement from Wheatstone with Tokyo Electric Power Company according to energy experts and Western Australian Premier Colin Barnett. While both parties are yet to confirm the value of the agreement it is known that Tokyo Electric will purchase 3.1 Mtpa of LNG annually for 20 years. The company is also entitled to an additional 1 Mtpa based

on its 15 per cent equity stakes in the licences over the Wheatstone field.

DEVELOPMENT ACTIVITY ONSHORE

Latent Petroleum together with Transerv Energy plan to evaluate unconventional resources in the onshore Perth Basin with an appraisal well on the Warro gasfield. The Warro gas project Joint Venture received a major funding boost from Alcoa of Australia this year with the company formally committing to fund the Warro 4 appraisal well and a 3D seismic program at a cost of more than \$20 million. The funding was provided as part of a farm-in agreement with Alcoa receiving a 65 per cent interest in the project targeted to start later this year. The partners have also secured a licence to build a 150 TJ pipeline to feed the gas directly into the nearby Dampier to Bunbury and Parmelia pipelines with first production targeted by 2012 or early 2013. ■

In 2010 the Pluto LNG Project is transitioning from construction to commissioning phase in preparation for first gas from the field by the end of the year. This photo was taken in January. (Photo courtesy of Woodside Energy)



Petroleum and Geothermal Acreage Availability

Richard Bruce & Mike Middleton

Exploration Geologist &
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Prices Creek, Canning Basin
(Photo courtesy of Peter Haines)



State Areas Released for Petroleum Exploration, September 2010

DMP continues to promote the petroleum potential of Western Australia's vast sedimentary basins using a specific area release system.

A CD package accompanies the acreage release and contains information about the prospectivity of release areas, available data listings, land access and how to make a valid application for an Exploration Permit.

In September 2010, DMP released a total of seven blocks (Fig. 1). This comprised five blocks in the Canning Basin, one block in the Carnarvon Basin, and one block in the Perth Basin.

Interest in the Canning Basin has increased in recent times particularly with ARC Energy and ARC's spinoff company Buru Energy taking up extensive acreage holding, drilling wells and acquiring 2D and the basin's first 3D seismic. In addition, Mitsubishi Corporation, Japan's largest general trading company, has farmed in to Buru's acreage. The Canning Basin blocks range in size from 2,712 km² to 6,056 km².

Release area L10-6 is situated in the Willara Sub-basin and Broome Platform. Targets include Ordovician carbonates and sandstones, and Permo-Carboniferous sandstones.

Canning Basin release areas L10-7 and L10-8 lie in the Fitzroy Trough. Targets include large anticlinal structures with thick, predominantly clastic Upper Paleozoic units.

Canning Basin release areas L10-9 and L10-10 lie on the Balgo Terrace and Billiluna Shelf. Targets include Upper Paleozoic sandstones and possible Ordovician section.

Carnarvon Basin release area L10-11 covers 2,813 km², straddles the Exmouth Gulf and is partly onshore. Targets include Mesozoic sandstones.

Release area L10-12 is in the northern Perth Basin, which is noted for its discoveries and oil and gas production. It covers 1,331 km². The main targets in the basin are Permian sandstones and to a lesser extent Jurassic sandstones.

Work program bids for the release areas close at 4pm on Thursday 10 March 2011. Should you require any further information or assistance, please contact Richard Bruce (08 9222 3314) of DMP's Petroleum Division or Jeff Haworth (08 9222 3214) of the Geological Survey of Western Australia. All enquiries will be dealt with in strictest confidence.

State Geothermal Acreage

Acreage for geothermal exploration may be obtained through a Geothermal Special Prospecting Authority (GSPA) with Acreage Option (AO) until further

notice. The next geothermal acreage releases under the competitive bidding system will not be until 2011.

Geothermal exploration and production is administered under the *Petroleum and Geothermal Energy Resources Act 1967* (Act). The Act allows explorers to apply for a Geothermal Special Prospecting Authority with, or without, an Acreage Option in addition to the practice of acreage released under the competitive bidding system.

The GSPA is an up-to six months, non-renewable title granted for the purpose of conducting a geothermal energy resource exploration activity. Drilling a geothermal well is not permitted under a GSPA. On expiry of the GSPA term, proponents have a further six months in which to take up the AO and apply for either a Geothermal Exploration Permit (GEP) or Geothermal Drilling Reservation (GDR). It is important to note that the Acreage Option must form part of the GSPA application and cannot be applied for retrospectively.

Accordingly, GSPAs may be granted for exploration work (other than drilling a well) as a preliminary to an applicant exercising the option to submit an application for a GEP or GDR. These authorities are limited in time to a specific exploration activity (e.g. a seismic survey or magnetotelluric survey) and cannot be *dealt with*, i.e. cannot be transferred or encumbered. The Act provides for more than one



GSPA to be granted over the same area. In such cases the Minister shall serve notice in writing on each party advising them of the exploration particulars and any conditions.

Areas that are available for GSPA are shown on the map in Figure 2. Essentially, all areas in the State are available except those under title or under assessment.

The Department's acceptance of each GSPA/AO application is on a case-by-case basis. The minimum number of (5' x 5') contiguous graticular blocks deemed acceptable for a GSPA is four blocks and the maximum number is 160 blocks. The survey activity proposed should be commensurate to the number of blocks in the application, and the AO is often on a reduced area.

Further, it is important to recognise that if the company is drilling under a separate title or licence (e.g. mineral tenement or Department of Water licence), it would be possible to apply for a GSPA to conduct a survey, such as a downhole Vertical Seismic Profile Survey (VSP), utilising these holes, provided no drilling is undertaken under the GSPA.

GSPAs which involve ground disturbing work (including seismic surveys) are not subject to the Right to Negotiate provisions of the *Native Title Act*. However, proponents will be prohibited from entering lands where native title rights and interest in that land has not been fully extinguished, except with the consent of the native title group.

Explorers are encouraged to liaise with the DMP Petroleum Division at the earliest opportunity so that any potential difficulties or constraints may be dealt with prior to the proposed commencement date.

Once the SPA/AO period has expired, the data acquired is to be made publicly available.

Generally, the acceptance of a GSPA application, and grant of title, will depend upon the rationale for the proposed program, the applicant's financial and technical capability and supportable evidence provided, and is at the discretion of the Minister.

The grant of a GSPA/AO prevents the area being subject to a bidding round, until the GEP/GDR application period

has expired. The acceptance of an associated Acreage Option is also at the Minister's discretion, as some surveys may not be regarded as worthy of such exclusivity.

The Acreage Option is only extended to the application for a title and does not infer any obligation on the part of the Minister to grant a GEP or GDR. Such an application will only be granted on the merits of the proposed work program in the same way as an Exploration Permit or Drilling Reservation application under the competitive bidding system. Applications are subject to the same criteria for assessment, permit conditions and administration as under the competitive bidding system, wherein they pledge a program of work and the grant is made (or not) on the efficacy of that work program. Consideration is also given to the technical and financial ability of the applicant. For further information, consult the Department's website {<http://www.dmp.wa.gov.au/847.aspx>}.

GDR assessment conditions and administration follow closely those for Exploration Permits. A GDR is granted for a period not exceeding 3 years. The essential difference between a GEP and GDR is that a well cannot be varied out of the work program, and that the GDR can only be extended (a further 12 months) if a well is in progress or to enable the conversion of any discovery made to a Geothermal Production Licence or Geothermal Retention Lease.

An announcement will be made on 9 September 2010 at the Department's Petroleum and Geothermal Open Day regarding the criteria and guidelines for accepting GSPA and GSPA/AO applications. Applications should be made to the Department of Mines and Petroleum, which should also include a fee of \$958 payable to "The Department of Mines and Petroleum", and is refundable for unsuccessful applications. Please consult the Department's website at www.dmp.wa.gov.au {<http://www.dmp.wa.gov.au/847.aspx>} for application forms.

Should you require any further information or assistance, please contact Mike Middleton (08 9222 3076) or Richard Bruce (08 9222 3314) of DMP's Petroleum Division. All enquiries will be dealt with in strictest confidence. ■

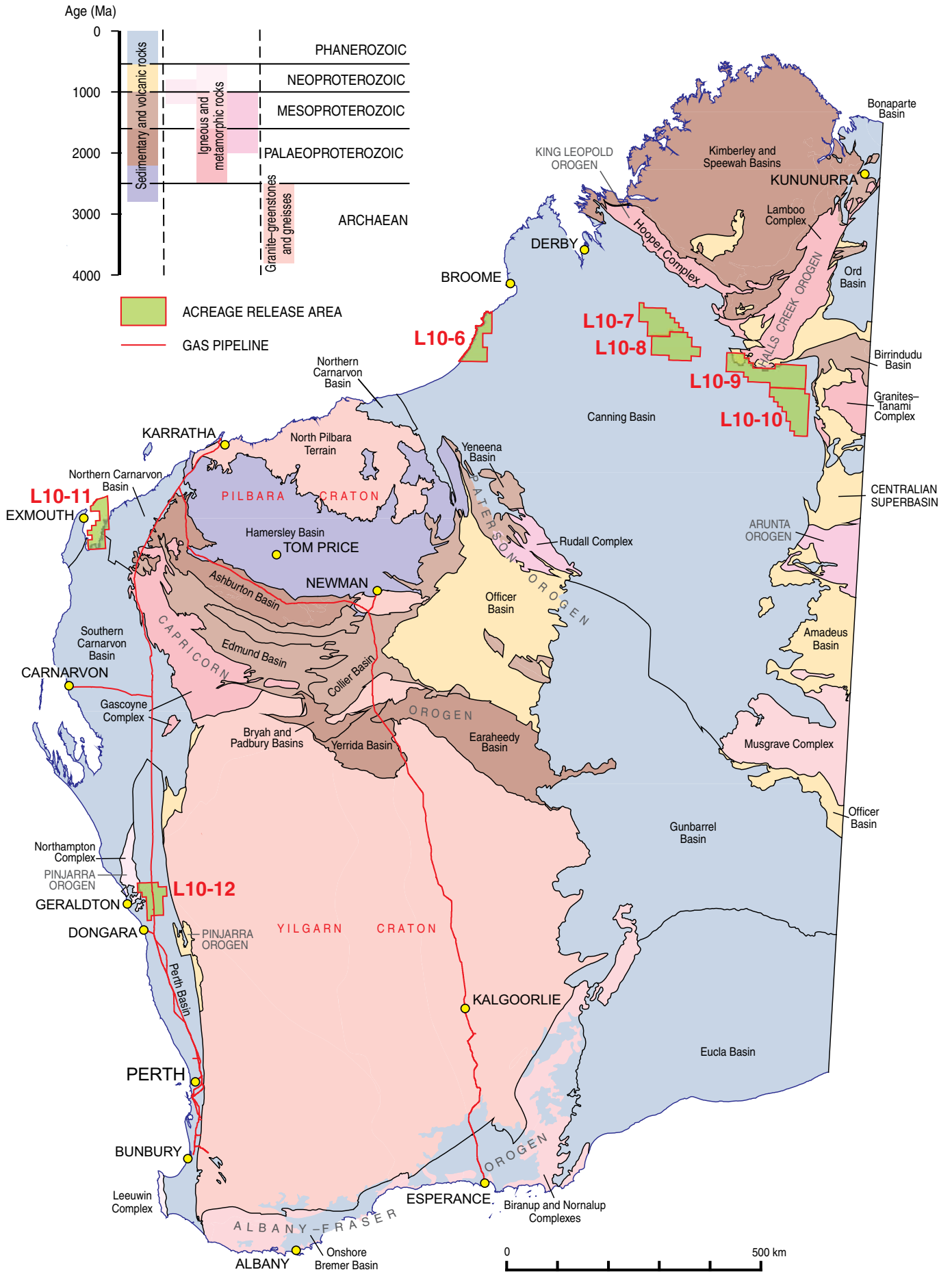


Figure 1 | September 2010 petroleum acreage release areas

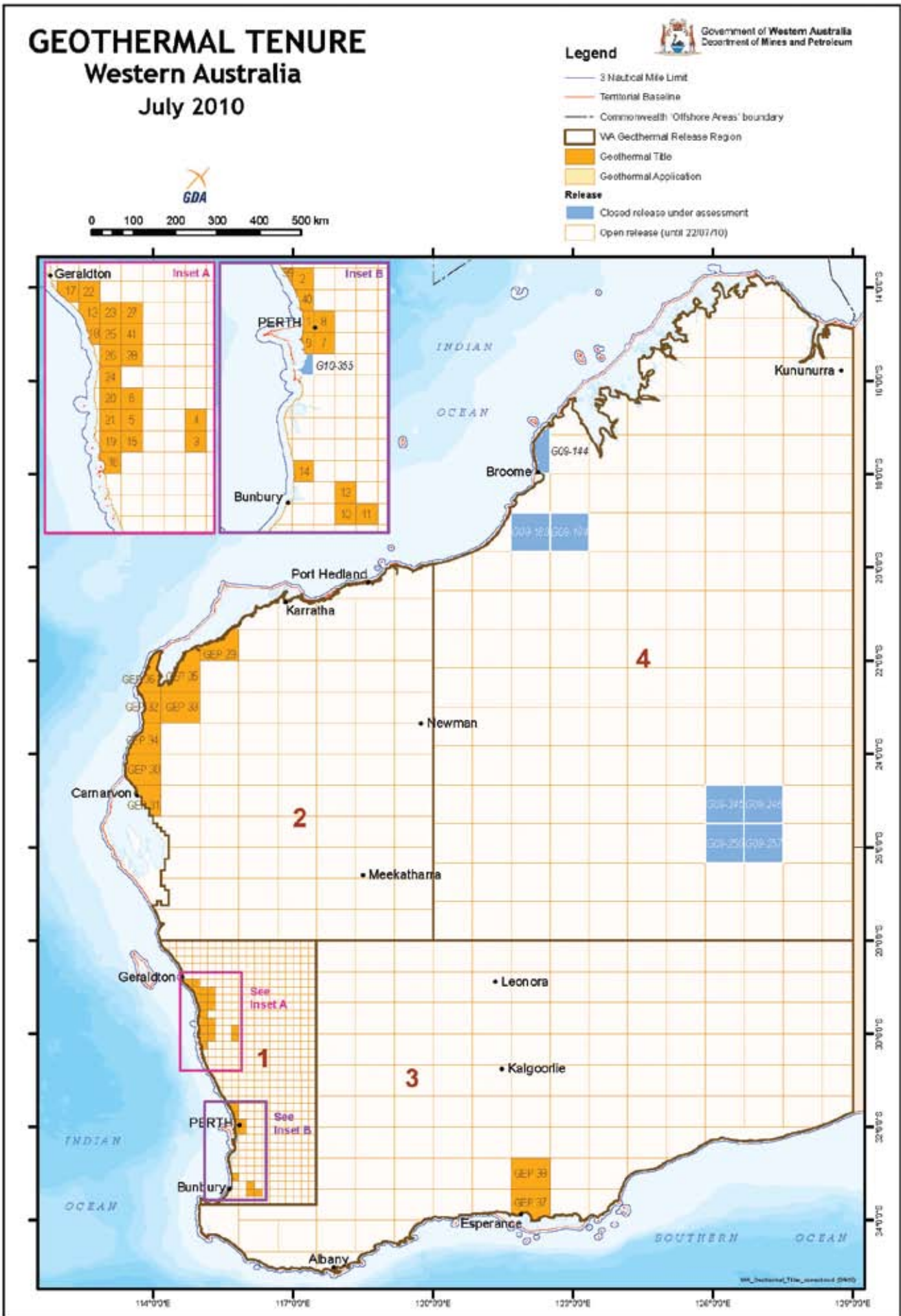


Figure 2 | Current geothermal titles in Western Australia

Gingin West 1 Gas Discovery in the Perth Basin

Empire Oil & Gas N.L.



Equipment at Gingin West 1 in the Perth Basin
(Photo courtesy of Empire Oil and Gas N.L.)

Empire Oil & Gas N.L. announced a gas and condensate discovery at the Gingin West 1 well on 13 April 2010. The well is located in Exploration Permit EP 389, in the Perth Basin, approximately 80 km north of Perth. The field is located 2.8 km from Compression Station No. 5 on the Parmelia Pipeline. The Gingin West 1 well is the closest economic gas and condensate discovery to the Perth metropolitan area and industrial satellites in WA.

Interpretation and Depth Conversion of seismic mapping from the 45 km² Gingin West 3D Seismic Survey, acquired April–May 2008, plus 444 km of 2D Vibroseis seismic over the EP 389 permit and reprocessing of 333 km of existing seismic was completed in early 2009.

Gingin West 1 was drilled in late 2009 using the Weatherford Rig 826. The rig was released 25 December 2009. In January 2010, a petrophysical evaluation detailed the interpreted three separate hydrocarbon bearing intervals in the well. Two of the three hydrocarbon intervals were tested. The production test at Gingin West 1 has produced the largest gas and condensate flow in the Gingin area.

The 3,760 m D Sand – The Bootine Sand

The interpreted gross interval is 3,760 to 3,777.5 m MD (Measured Depth) giving a potential gross pay of 17.5 m. This equivalent interval in the Bootine 1 well flowed gas at a rate of 62,297 m³/d (2.2 MMcf/d).

The perforated interval is 3,764.5 – 3,773 m. This interval demonstrated hydrocarbon saturations on the electric logs with modest gas shows in the well. This may be due to the reservoir quality and the slow drilling (tight formation).

The Jurassic aged Cattamarra Top D Sand

The Top D Sand recorded very good hydrocarbon fluorescence shows and a gas peak while drilling. The gross interval is 3,571.5 to 3,586.8 m MD giving a potential gross pay of 15.3 m.

The perforated interval is 3,572 to 3,575 m; nearly the whole interval. This sand recorded very good hydrocarbon fluorescence and a gas peak while drilling and demonstrates on logs, good reservoir quality and hydrocarbon saturations.

A stabilised flow rate of 217,000 m³/d (7.66 MMcf/d) gas and 47.8 kL/d (301 bbl/d) condensate was established on the second day of the test on a 15 mm (0.5 inch) choke. The maximum flow rate achieved was 228,234 m³/d (8.06 MMcf/d). The well was shut in after flowing for 15.5 hours.

Condensate recoveries in the multi-rate production test were higher than recorded on the initial cased hole test of the Gingin West 1 well. Condensate rates were observed to be at an average of 280.72 kL/MMm³ (50 bbl/MMcf), up from 224.58 kL/MMm³ (40 bbl/MMcf) on the initial test.

The condensate rates vary between 252.65 to 393.02 kL of condensate per MMm³ of gas (45 to 70 bbl/MMcf)

which is a bonus, demonstrating the condensate rich reservoir of the Jurassic aged Cattamarra Coal Measures, D Sand. The multi rate production test of the Gingin West 1 well and all the gas and condensate sampling has been completed. Gas flow rates are consistent with the initial test.

Empire's Managing Director, Craig Marshall, said "This is an exciting discovery. The Perth Basin has great potential with excellent infrastructure for producing and selling gas. It is our ambition to become a significant gas and condensate producer in the region. This discovery opens up the Jurassic gas and oil play in the Perth Basin and there is good potential for further new discoveries along the 60 km trend in this permit alone."

Empire plans to drill another well, Red Gully 1, immediately adjacent, to test the separate Gingin West Block A structure. If this well is successful, the size of the Gingin West gas and condensate resource could significantly increase.

Testing of the third interval in the Coaly Unit Sands, which contained a number of individual potential gas-bearing sands from 3,287.5 to 3,375 m MD, will be carried out upon depletion of the Top D Sand reservoir in the future. ■

Interests in EP 389:

Empire Oil & Gas N.L. (Empire Oil Company (WA) Limited – Operator) - 68.75%

ERM Gas Pty Ltd - 21.25%

Wharf Resources Plc - 10%



Gas flaring on production test at Gingin West 1
(Photo courtesy of Empire Oil and Gas N.L.)

The Outlook for Domestic Gas in Western Australia

Andy Separovic and Derek Perez
Policy and Coordination Branch



Gas plant at dusk
(Photo courtesy of Woodside Energy)

Natural gas is vital to the Western Australian economy and accounts for half of the total primary energy consumed in this State. This heavy reliance is set to continue and will be driven by growth of the resources sector. Given the importance of natural gas in meeting Western Australia's energy requirements, a model was constructed by the Department of Mines and Petroleum to show how the notional demand and supply of domestic gas in Western Australia may grow during the next 20 years. Key findings are presented in this article.

The volume of natural gas sold domestically in Western Australia in 2009 amounted to 9.4 billion cubic metres, or 976 terajoules per day (TJ/d). Most of this gas is consumed by the mining, manufacturing and electricity generation industries which collectively account for up to 90 per cent of the State's total domestic gas consumption. Over the past twenty years, Western Australia's domestic gas consumption has grown strongly at an average annual rate of around five per cent.

Future demand for gas will largely be driven by the State's minerals and energy sector. Forecasting this demand is difficult and depends on the extent to which new resource projects are developed and/or expanded. Significant increases in demand will be underpinned by a handful of large mineral processing or manufacturing projects. The lumpy nature of investment in these projects,

changes to project status and timing can result in significantly different gas consumption forecasts.

The methodology adopted to estimate gas demand was based on aggregating the projected energy demands of known resource projects over time, with some adjustment for the probability they will proceed. In addition, allowance was made for growth in residential consumption due to population increase, and growth of the State's economy. Western Australia's gross State product (GSP) has recorded long-term average growth of 4.4 per cent per annum in real terms.

A low, reference, and high growth demand scenario were derived as part of the analysis. In the reference case as shown in Figure 1, gas consumption is estimated to grow at an average annual rate of 3.5 per cent, with total demand for gas projected to increase from 976 TJ/d in 2009 to 1,962 TJ/d in 2030. This rate of growth is in alignment with recent ABARE energy projections which forecasts gas consumption in Australia rising by 3.4 per cent a year to 2030.

Nearly all of Western Australia's domestic gas is supplied by the North West Shelf joint venture and the Varanus Island hub. Given the expected decline in production from current fields, supply of gas to meet forecast growth will need to come from new sources. Much of the future domestic gas supply will depend on new LNG projects located in offshore gasfields and potentially from

unconventional sources such as tight and shale gas in the longer term.

Supply forecasts for domestic gas were determined by summing existing supply agreements (State Agreement gas from the North West Shelf and Gorgon projects), and anticipated gas from the development of new fields either for domestic gas (as in the case of Macedon and Reindeer), or for LNG projects where a 15 per cent reservation potentially applies.

Low and high supply projections are provided and based on different assumptions in relation to the rate of decline in gas production from the major existing gasfields supplying the domestic market. In addition, the projections differ in regard to the likelihood of new gas projects coming on stream which can supply the domestic market. Table 1 provides details of known new projects supplying domestic gas, which underpin both supply forecasts and lists those projects which are also included in the high supply scenario.

Figure 1 illustrates the notional outlook for gas demand supply and for Western Australia based on the methodology described.

As shown, two contrasting projections are provided which are dependent on the underlying assumptions. In the short term (i.e. 2010–2011), gas supply in both scenarios meet demand given the impact of the global recession and falling commodity prices which resulted

Table 1. Known new projects supplying domestic gas

Project	Estimated start-up
Reindeer (Devil Creek)	2011
Macedon (a)	2013
Gorgon	2015
Pluto (b)	2016
Wheatstone (b) (c)	2016
High supply forecast also includes	
Warro (d)	2012
Halyard/Spar	2013
Browse (e)	2023
Scarborough (e)	2023

(a) Includes gas reinjected from Pyrenees development.
 (b) Domestic gas supply subject to commercial viability.
 (c) Includes gas from Julimar and Brunello fields.
 (d) Unconventional gas development (tight gas).
 (e) Supply based on 15 per cent domestic gas commitment.

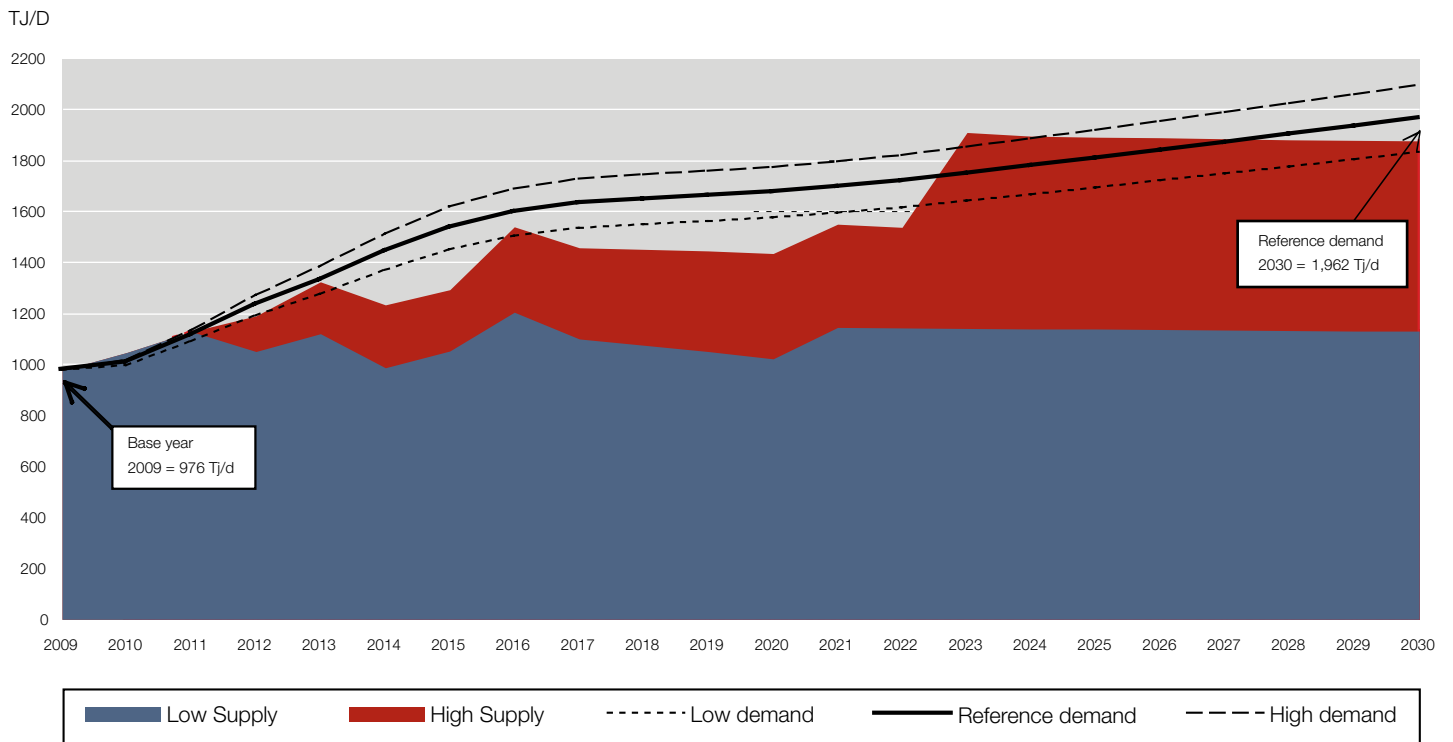


Figure 1 | Western Australian Domestic Gas Demand and Supply Outlook (a) (b)

Note:
 (a) Demand projections largely based on known major resource sector projects and excludes price effects. Gas consumption in the reference scenario is projected to grow by 3.5% per year over the outlook period.
 (b) Supply forecasts based on known potential sources.

Source: Department of Mines and Petroleum

in the deferral or abandonment of a number of projects. As an example, this was highlighted by Alcoa's decision to defer the expansion of its Wagerup alumina refinery. It is important to note that not all projects included in the demand scenarios may proceed due to a range of factors such as international demand, supply and global commodity prices, over which local producers have little control.

The improving outlook for the world economy along with an expected return to strong growth in the State's resources sector, points to a sharp increase in the demand for gas in the next five years before moderating over the outlook period. A number of major resource projects under construction are scheduled to start up in the near term. These include BHP Billiton's Rapid Growth 5 and 6 iron ore expansion projects; CITIC Pacific's iron ore magnetite project; and Worsley's alumina refinery expansion. The emergence of new energy-intensive magnetite iron ore projects may also push up the demand for gas in the future.

Given the expected surge in demand, Figure 1 indicates that in the low supply scenario, of around 1,200 TJ/d from around 2020, supply is less than unconstrained demand growth in all scenarios — low, reference or high. This suggests that domestic gas prices may rise to bring the market into equilibrium. Projects unable to source gas at commercially viable prices could be deferred, cancelled or switched to an alternative energy source such as coal.

In the high supply case, which assumes a 15 per cent domestic gas commitment from the Browse and Scarborough LNG projects, domestic gas supply is sufficient to meet demand in the low demand case in most years, although it struggles to keep pace with reference demand. As illustrated in Figure 1, it appears that in a world of very high notional demand for gas even the most optimistic assessment of domestic gas supply is unable to keep pace with estimated demand growth.

The analysis presented in this article is intended to provide a guide only given the complexities in estimating

gas demand and supply over a long period. However, it does highlight some of the domestic gas supply issues and broader energy security challenges facing Western Australia. In particular, the analysis suggests that gas prices will rise and in turn influence the demand for gas relative to other fuel sources such as coal.

Recognising the importance of addressing long-term domestic gas supply, the Department has been working to promote and facilitate the exploration and development of onshore unconventional gas, including tight gas, shale gas and geothermal energy, as a means of increasing and diversifying gas supply. As witnessed in the United States, unconventional gas production can play a major role in the growth of domestic gas supply and in the process placing downward pressure on gas prices. In addition, the Department, through work it is undertaking on the Collie Hub Carbon Capture and Storage project, is examining ways in which coal can play an increasing role in domestic energy security, while still allowing for the impact of any future carbon price. ■

LNG export from the Burrup Peninsula
(Photo courtesy of Woodside Energy)



Tight Gas Reserves in the Canning Basin

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Petroleum Engineer
Resources Branch

Outcropping of the Poole Sandstone in the Poole Range, Canning Basin
(Photo courtesy of Peter Haines)



Introduction

The production of natural gas resources by conventional methods has been in the forefront of the gas supply picture in Western Australia for years as it is the easiest, most practical and least expensive way to produce natural gas. However, growing demands of the energy market require Western Australia to look at other options for the production of natural gas.

The development of unconventional gas resources, a significant contributor to the US gas market, has the potential to supplement Western Australia's domestic gas supply, maximise production and facilitate further growth in the gas industry for the future. As the name suggests, unconventional gas resources are difficult to produce and require unconventional methods for development. Such unconventional resources include shale gas, tight gas and coal seam methane. Western Australia potentially has an abundance of these resources in its onshore basins, and in recent years advances in drilling and fracturing technology are making it possible to venture into such projects.

A tight gas study was conducted on the resources in the onshore Canning Basin of Western Australia by the Department of Mines and Petroleum in July, 2010. This article is based on the above study in which a total of seven potentially productive tight gas occurrences were identified in the basin. The geological, technological and drilling parameters for each of these occurrences were

reviewed and evaluated in detail and are summarised herein. The study also proposes a way forward with recommendations for Western Australia's unconventional resources industry for future tight gas development in the Canning Basin.

Tight Gas Occurrences in the Onshore Canning Basin

The onshore Canning Basin lies in the Kimberley region of central northern Western Australia and covers an area of 400,000 km² (refer Figure 1). It is the largest onshore sedimentary basin in Western Australia and it contains over 10,000 m of mainly Paleozoic sediments. The basin is located 2,300 km north of Perth and it has two population centres, Broome and Derby.

The Canning Basin is believed to be the least explored Paleozoic aged onshore basin in the world and it is analogous to other basins worldwide that have proven major reserves. The geological setting of the onshore Canning Basin with its petroleum systems and stratigraphy is shown in Figure 2.

The lack of activity in the Canning Basin can be explained by the low number successful wells encountered relative to other basins in Western Australia. However, the lack of successful results for most of these wells can be associated with uncoordinated exploration work, lack of infrastructure, application of old technology and distance from markets.



Figure 1 | Canning Basin, Western Australia

Identification of Tight Gas Occurrences

An initial review of the wells in the onshore Canning Basin was conducted with the aim of locating potential sites for tight gas development. It is based on data from the Western Australian Petroleum Information Management System (WAPIMS).

A total of 279 wells have been drilled in the Canning Basin since the early 1920s, of which 265 wells were drilled onshore and 14 wells were drilled offshore. Of the 265 onshore wells, 43 were found to have gas shows. This study focuses only on onshore Canning Basin wells with natural gas production potential.

Table 1. Tight gas occurrences

Wells	Year	Operator	TD (m)	HC shows
Meda 1	1958	WAPET	2,684.98	Oil and gas
Meda 2	1959	WAPET	2,325.01	Oil and gas
Yulleroo 1	1967	Gewerkschaft Elwerath Inc.	4,572.3	Gas
Yulleroo 2	2008	ARC Energy	3,730.0	Gas
Ellendale 1	1979	Amax Petroleum Pty Ltd	3,190.5	Oil and gas
Fitzroy River 1	1980	Amax Petroleum Pty Ltd	3,134.0	Minor gas kicks
Pictor 1	1980	BHP Petroleum Pty Ltd	2,146.0	Oil and gas
Point Torment 1 Deepening	1980	Stirling Resources N.L.	2,603.6	Gas
Looma 1	1996	Shell Development Australia	2,535.0	Oil and gas

As per the definition tight gas occurs in reservoir rocks with permeability lesser than or equal to 0.1 millidarcy (mD). Those wells where gas was encountered with such low values of permeability were listed as tight gas occurrences. As a result, seven tight gas occurrences were identified from the list of 43 onshore gas wells and these occurrences are shown in Table 1 and Figure 3. These wells are discussed in detail in the following pages.

Meda

The Meda 1 well was the first exploratory well drilled by WAPET in 1958 on the Lennard Shelf, about 60 km east of Derby. The Meda 2 well, located about 1.2 km south of Derby was drilled in 1959 to further evaluate the oil and gas shows encountered in Meda 1.

Meda 1 was spudded in alluvium overlying the Lower Triassic Blina Shale and the Permian sequence was penetrated, consisting of the Liveringa Formation, Noonkanbah Formation, Poole Sandstone with its Nura Nura Member and Grant Formation. The well was drilled to a total depth (TD) of 2,685 m.

The lithologies of the formations penetrated in Meda 2 closely resemble those in Meda 1. A small amount of gas was observed in fractured zones in the Fairfield Group equivalent. Meda 2 reached a TD of 2,325 m within the Nullara Formation. The secondary objective of Meda 2 was the Laurel Formation and the top of this formation was estimated to be about 305 m lower than what was seen in Meda 1.

Hydrocarbon Shows

In Meda 1, drill stem test (DST) 2 (2,029.5 m to 2,042 m) recovered gas at 2.83 Mm³/d (100 Mcf/d), which dropped

to 849.6 m³/d (30 Mcf/d) after two and a half hours of testing. Formation tests through perforated casing by DST 7 (four intervals between 2,011 and 2,042 m) produced an unquantified moderate flow. DST 8 (1,601 m to 1,619.5 m), through the perforated casing in Meda 1, resulted in gas shows but in amounts too small to measure. Other DSTs carried out in Meda 1 were either dry or recovered salt water.

Modest shows of oil and gas were detected during the drilling of Meda 2 in the Fairfield Group. Results from DST 4B (2,308.25 to 2,325.01 m) showed that the permeable section contained salt water with slight gas saturations (predominantly methane) which was similar to the results in Meda 1.

Reservoir Properties

From the results of the Meda wells, the dolomitic sandstones of the Laurel Formation were found to have a good porosity (about 20%) and moderate permeability. The permeability in this section could have been greatly improved by methods such as acidising. The Devonian Reef and terrigenous facies showed very poor porosity and permeability. Compared to the above zones, the fore-reef facies of the Devonian Reef mostly showed good permeability and the cores from this section had good vuggy porosity.

Summary of Results

Although the presence of a valid trap was not fully demonstrated in the Meda wells, the reason for the absence of hydrocarbons in the Fairfield, Nullara and Pillara units is probably due to the poor development of the potential reservoirs. The Upper Carboniferous on the other hand, clearly lacks an effective trap (Crostella 1998). Meda 2 was

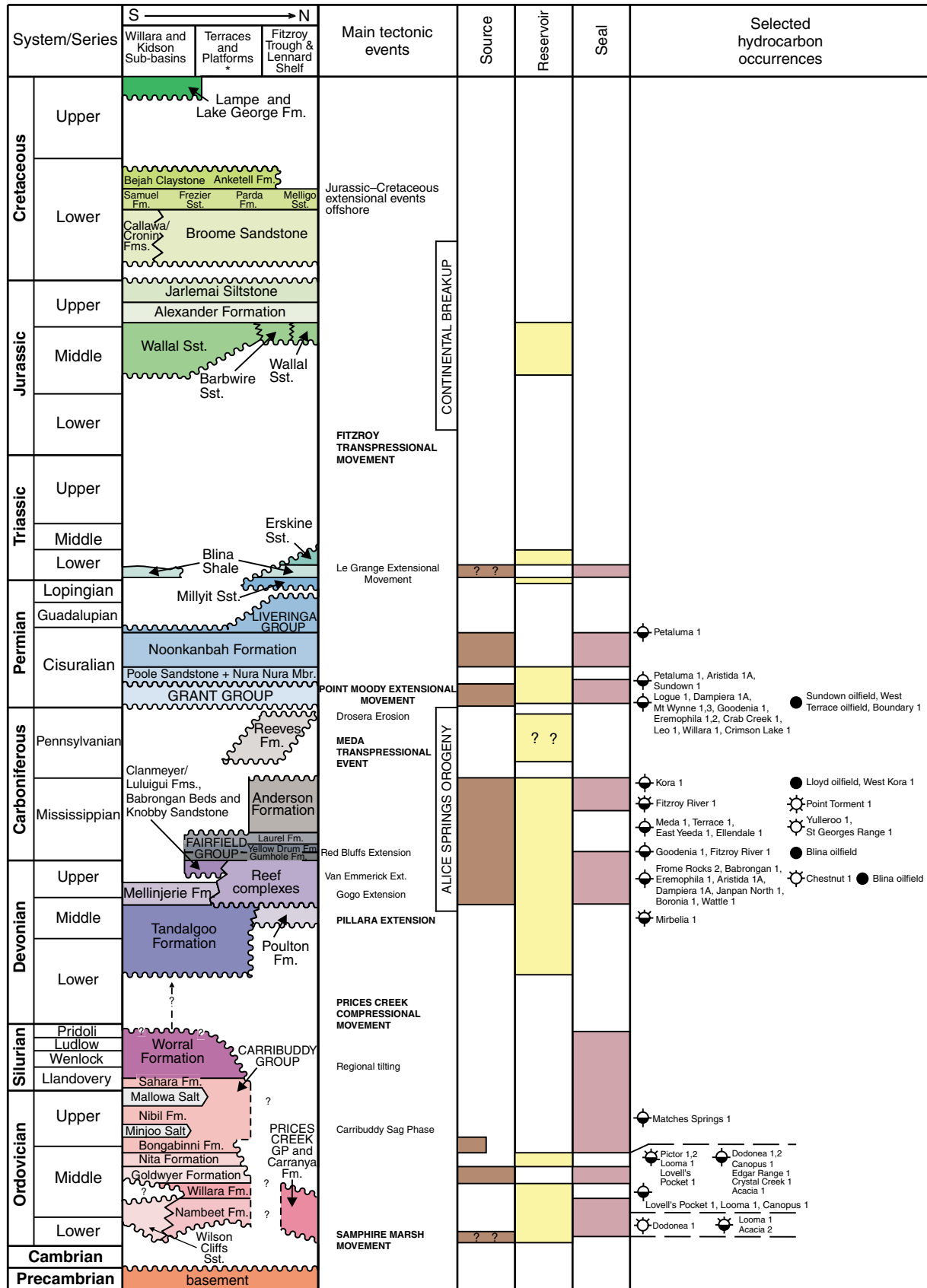
designed with a large open hole section and this may have prevented proper treatment and formation evaluation of this section. The DSTs in Meda 2 were conducted within this open hole section, which might explain why the well produced salt water with small gas shows.

Yulleroo

The Yulleroo 1 well is located in the southwestern part of the Fitzroy Trough and it lies 70 km to the east of Broome. The well was drilled in 1967 by Gewerkschaft Elwerath. Based on the promising results of Yulleroo 1, ARC Energy drilled the Yulleroo 2 well in 2008, 2.5 km to the east of the Yulleroo 1 discovery.

Yulleroo 1 penetrated Quaternary, Cretaceous, Jurassic, Permian, Carboniferous and Upper Devonian sediments. The well intersected the Carboniferous section (Carboniferous Units A, B and C), which was entirely proved to have a Lower Carboniferous age. The Upper Devonian strata conformably underlie the Carboniferous section. The gas sands in the well are sealed by a thick sequence comprised of dominantly shale, with minor interbeds of siltstone, sandstone and some limestone. The primary objective Tournaisian gas sands were encountered at approximately 2,850 m in Yulleroo 2. The secondary objective was the Famennian Limestone section.

Yulleroo 1 was drilled to a TD of 4,572.3 m and Yulleroo 2 reached a TD of 3,730 m. As per the drilling program in Yulleroo 2, four main sand zones with a net potential pay of about 30 m (over a 170 m stratigraphic section) were planned to be tested. However, the drilling rig encountered operational difficulties and testing could



PWH83 04.05.09
 ⚡ Gas show ● Oil well or field Fm. Formation Sst. Sandstone *Jurgurra, Mowla, and Barbwire Terraces, Broome and Crossland Platforms
 ⚡ Oil show ⚡ Gas well Gp Group ~ Unconformity
 ⚡ Oil and gas show

Figure 2 | Stratigraphy and petroleum systems of the onshore Canning Basin (GSWA 2009)

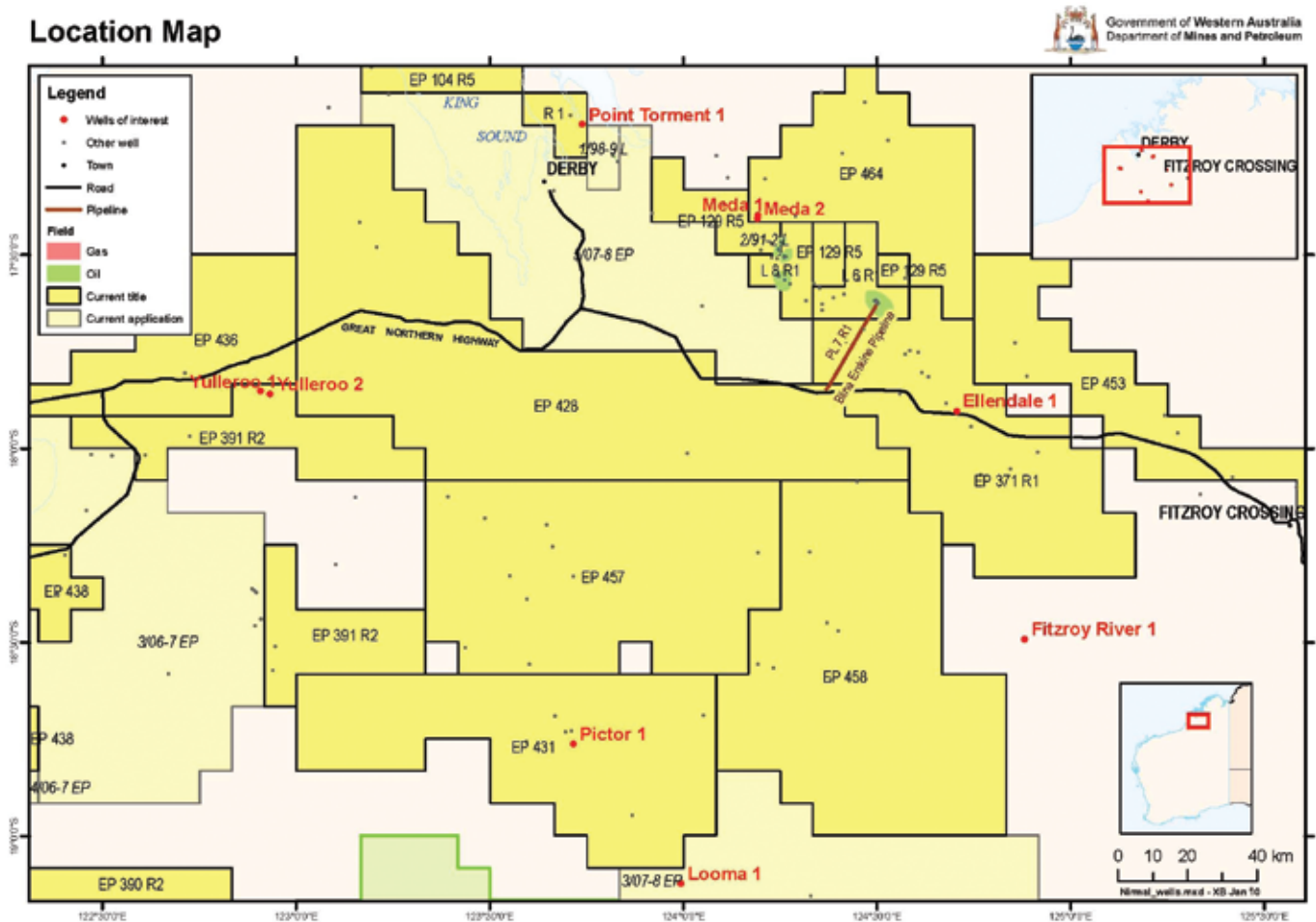


Figure 3 | Location map of the tight gas occurrences in the Canning Basin

not be completed. Yulleroo 2 was suspended as a potential gas producer (Buru Energy 2008).

Hydrocarbon Shows

In Yulleroo 1, two sandstone beds were intersected in the Lower Carboniferous and moderate to strong gas shows were encountered in this section. Satisfactory results could not be obtained in the open hole DSTs that were carried out because the well bore was washed out such that the packers could not seal properly. Subsequently, a 7" casing liner was run in from 3,047.09 m to 3,447.9 m. Two pay zones, A (3,342.13 to 3,357.37 m) and B (3,394.86 to 3,407.66 m), were perforated and three cased hole DSTs were carried out. The gas flow from both sandstone horizons was estimated at 1.70 Mm³/d (60 Mcf/d).

Reservoir Properties

The sandstones encountered in Yulleroo 1 have both intergranular and fracture porosity and are interpreted to be turbiditic in origin. Analysis of

the Yulleroo cores shows that they are highly disturbed, fractured and heavily cemented. Thin sections within the sandstones show the presence of swelling clays which suggests sensitivity to water based drilling fluids such as those used in Yulleroo 1 (Kimberley Oil 2004). Core analysis results from Yulleroo 1 showed an average porosity of 9–10% and mean permeability around 0.2 mD. Subsequent testing of the cores showed that the reservoir permeability is greatly affected by pressures applied which mandates greater care in testing these sands. The test results also showed that acidisation increased the permeability significantly (Kimberley Oil 2004). The Tournaisian sandstones intersected in Yulleroo 2 appeared similar to the ones encountered in Yulleroo 1, but showed better developed porosity. The Fammenian Limestone section intersected was found to be relatively tight which might be the reason that there were no gas shows in this section.

Summary of Results

The reservoir sands in the Yulleroo prospect are understood to be adequate for gas. Therefore improved drilling, completion and stimulation practices should ensure better flow rates. Extensive fracturing observed in most of the core below the top of the objective sands indicates that the entire volume of rock within closure could be potential reservoir. The fractures present are important in terms of storage and production capacity of the structure through fracture porosity and permeability (Kimberley Oil 2004). The sandstones encountered in Yulleroo 1 are relatively tight and show the presence of swelling clays, which suggests sensitivity to water based drilling fluids. Acid treatment (HCl-HF) improved the flow rate of the 'B' sand; however, fracturing would be the preferred method. The open-hole DST did not yield satisfactory results because the well bore was washed out such that the packers could not seal properly.

Ellendale

The Ellendale 1 well drilled in 1979 by Amax Petroleum is located 135 km east-southeast of Derby near the Great Northern Highway. The well was drilled 5 km south of the Harvey Fault System which defines the southern limit of the Lennard Shelf and therefore formally lies within the Fitzroy Trough.

Ellendale 1 was drilled into the Permian aged Liveringa Formation and with TD at 3,190 m in the Fammenian Napier Formation. The basal unconformity of the Grant Formation was seen at around 1,425 m. The Early Carboniferous Laurel Formation which had good hydrocarbon shows was intersected below the Anderson Formation at 2,067 m (Crostella 1998).

Ellendale 1 encountered problems while drilling and most time lost was associated with the blowout preventer (BOP) system. There was also excessive wear on bits and stabilisers between 1,000 m and 1,100 m in an abrasive section of the Grant Formation sandstone. There were no other major problems encountered during the drilling operation.

Hydrocarbon Shows

Hydrocarbon shows in the Anderson Formation were minor and of doubtful significance. However, strong shows of liquid hydrocarbons and gas were obtained in the upper clastic member of the Laurel Formation and in a thin sandstone in the lower clastic section. DST 3 in this interval yielded a small volume of gas. Several gas kicks of varying intensities occurred from fracture porosities in the tight carbonate section below 2,067 m, however open-hole testing in this interval was unsuccessful. Failure was attributed to the collapse of the cement surface (in the case of DST 1) and to the packer not being set properly (in the case of DST 1A). A brief gas flow of about 2.83 Mm³/d (100 Mcf/d) and minor oil were obtained by DST 2.

Reservoir Properties

Porosity determinations in Ellendale 1 were complicated by factors such as calcite cementation, clay matrix effects and fracturing. Logging results were also affected by severe caving and fracturing. It was concluded that the Grant Formation has moderate porosity, whereas the Anderson/Laurel Formation is generally tight, although flow can be

expected through fractures. Porosities in the Anderson/Laurel were generally low with a maximum of 11%. The Grant Formation is generally tight and little evidence of permeability has been obtained. The failure of DST 3 can be associated with this factor.

Summary of Results

Ellendale 1 encountered hydrocarbons in both the sandstones of the Laurel Formation and fractured limestones of the Nullara Limestone. The apparent thickening of the Laurel Formation on the southern side of the structure, but still within closure, should be an important consideration in further studies of the Ellendale structure. Poor recovery from the DSTs could be explained by the tight nature of the potential reservoirs.

Fitzroy River

The Fitzroy River 1 well was drilled on 29 August 1980 by Amax Petroleum to a TD of 3,133.8 m. The well was drilled into the Noonkanbah Formation and continued into the Lower Permian succession as predicted. The Anderson Formation was intersected below a major unconformity at 1,715 m and is underlain by the Laurel Formation with an apparent unconformity at 2,075 m. The interval 2,095 m to 3,134 m was of Tournaisian age and the whole section was correlated with the Laurel Formation of the Fairfield Group.

While tripping at 1,739.1 m for a bit change a tight spot was encountered at 1,715 m and the string had to be worked through. The hole was tight from 3,133.5 m to 2,936.3 m which was apparent when pulling out the core barrels. The electric logs that were run could not reach the bottom due to the tight nature of the well bore.

Hydrocarbon Shows

The first small oil show occurred at the top of a coarse- to medium-grained sandstone with a small gas kick at 1,869 m. Other hydrocarbon shows occurred below 2,095 m and continued up to 2,808 m as gas peaks (up to a maximum of 150 units). Several other zones with similar gas peaks also occurred from 2,850 m to TD. A section of intense gas activity was seen on the mud logs over a 900-m interval within the Laurel Formation (Kimberley Oil 2004). DST 1 was run from 2,743 to 2,800 m and it resulted in a gas flow too small to measure.

Reservoir Properties

Analysis of log data showed the Grant Formation has porosities ranging from 3 to 21% with moderate permeability. Porosities in the Anderson Formation were seen to range from 3 to 15% and permeabilities varied from poor to moderate. Both zones had low clay content and were water saturated. Scattered intergranular porosities up to 15% were observed in the Laurel Formation but this zone had considerable clay content and low permeability.

Summary of Results

The section from 1,715 m to TD is intermittently hydrocarbon bearing, with a minor light oil show at 1,869 m and a small gas show in the sandstone beds below 2,075 m. Fractures are common in the sandstone sections and some very narrow high gas peaks may be related to fractures. The source material is generally low except for intermittent sections with fair source character. Lack of permeability is the main problem associated with the poor hydrocarbon recovery in Fitzroy River 1.

Pictor

The Pictor 1 well is located approximately 200 km southeast of Broome and was drilled by BHP Petroleum Pty Ltd in 1984 to a total depth of 2,146 m. Pictor 1 tested a compressional anticline and the northwest-southeast trending Pictor structure is a tight fold bounded by high angle reverse faults. Fractures anticipated as a result of structuring were believed to enhance the permeability of the reservoir intervals.

The well intersected the 146 m thick Carribuddy Formation where the first significant indications of hydrocarbons were encountered. The Nita Formation immediately underlying the Carribuddy Formation consisted of 162 m of predominantly dolomite and dolomitic limestone, with poor general porosity and possible presence of microfractures. Subsequently, the Goldwyer, Willara and Nambet formations were encountered as anticipated.

Hydrocarbon Shows

Significantly high gas readings were obtained whilst drilling through the Carribuddy, Nita and Willara formations. The hydrocarbon shows were further evaluated based on information derived from wireline logs, conventional cores and

The Poole Range in the Canning Basin
(Photo courtesy of Peter Haines)



formation testing. Formation testing was only attempted over the Nita and Willara formations due to encouraging results from cores and wireline logs. Following an initial drill stem test, the prospective Nita interval was cased and production tested. The stabilised flow through a 1.25 inch choke gave 62.30 Mm³/d (2.2 MMcf/d) of gas and 3.82 m³/d (24 bbl/d). No drilling problems were encountered in the well.

Reservoir Properties

Average core porosities in the Nita dolomites and dolomitic limestones were 12% and 6%, respectively. Moderate quality source rocks are present within the Willara and Nambheet Formation. The Willara source rocks indicate potential for light oil and gas, whereas the Nambheet source rocks are predominantly gas prone. The sandstones within the Willara Formation occur in stringers intercalated between tight dolomites.

Summary of Results

The well encountered hydrocarbons within the Carribuddy, Nita and Willara formations. Coring and wireline log analysis indicated the presence of moveable hydrocarbons within the Nita and Willara formations. Gas was produced from the Nita Formation and selective production from this interval was thought not to be feasible since the core was of continuous limestone/dolomite matrix with varying degrees of matrix clay. This also implies that fracture stimulation could be limited within the Nita reservoir. Detailed interpretation of the Willara reservoir was not possible due to lack of data.

Point Torment

The original Point Torment 1 exploration well was drilled by Anzoil (N.Z.) N.L. in 1992. The well is located approximately 20 km northeast of Derby and 12.9 km northwest of the West Kora 1 well. The Point Torment 1 Deepening well was drilled in 1994 to a TD of 2,603 m. The deepening of Point Torment 1 was

carried out after a technical evaluation of the area suggested a good probability for additional net pay below the initial total depth.

The primary reservoir objective of the deepened well was the Anderson Formation Unit C but unfortunately this interval was not as thick as prognosed and contained poor quality reservoir beds. The Point Torment structure is a clearly defined rollover of the Permo-Carboniferous sediments into the Pinnacle Fault. The Point Torment 1 well also intersected the Laurel Formation and the Nullara Limestone.

Hydrocarbon Shows

The main well was cased and suspended at a TD of 2,130 m after flowing gas at a stabilised rate of 121.78 m³/d (4.3 Mcf/d) from an interbedded sandstone at the base of the Anderson Formation Unit B. Numerous hydrocarbon zones were encountered during the deepening of Point Torment 1. These shows

indicated that the hydrocarbon column intersected in the initial Point Torment 1 well may have extended down to 2,427 m within the Nullara Limestone.

Reservoir Properties

The deepened section of Point Torment 1, which was the Anderson Formation Unit C, lacked any reservoir beds with effective permeability and contained only a few reservoir beds with porosity over 10%. The Laurel Formation has porosities less than 10% and very poor permeabilities whereas the Nullara Limestone carbonates were tight with very low porosities and permeabilities.

Summary of Results

The initial Point Torment 1 well had encouraging hydrocarbon shows and a gas flow, whereas the results of the deepening of the well showed lower reservoir potential. Numerous hydrocarbon zones were encountered in the well and all reservoir sections had very low porosities and permeabilities.

Looma

The Looma 1 well was drilled on 4 July 1996 by Shell Development Australia Pty Ltd and is located 260 km southeast of Broome. The well reached a TD of 2,535 m and penetrated tight oil bearing sections in the Nita Formation and Acacia Sandstone and had gas shows within the Nambheet Formation. Looma 1 was drilled using a slimhole hydraulic rig.

The stratigraphy encountered in Looma 1 was largely as expected. The best reservoir section occurred in the intra-tidal dolomitic section 73 m beneath the top of the Nita Formation. One of the key results of Looma 1 was the confirmation of the presence of the Acacia Sandstone.

Hydrocarbon Shows

Gas cuttings in Looma 1 indicated no significant hydrocarbons above 1,262 m while gas levels increased through the Nita, Goldwyer, Upper Willara, and Acacia formations. Moderate gas levels were also recorded through the Nambheet Formation. The well did not flow in DST 1, which was within the Nita Formation thereby indicating an impermeable interval. Two tests were conducted over the Acacia Sandstone. DST 2 (2,005 m to 2,045 m) was a conclusive test which flowed gas to surface at a rate too small to measure suggesting a very tight interval. The permeability could not be determined in

this interval. The well did not flow on DST 3 (2,019 m to 2,026 m) although bubbles were observed at the surface. No cores were cut nor were DSTs carried out over the Nambheet Formation.

Reservoir Properties

Looma 1 failed to encounter any significant permeability within the Nita Formation. Core analysis results indicated a 1 to 5% porosity range with permeabilities less than 0.01 mD. The presence of Acacia Sandstone was confirmed within the Willara Formation and the porosity in this unit is present as both primary intragranular (up to 11%) and secondary porosity (up to 4%). The Nambheet Formation from 2,362 m to 2,373 m indicated average porosities of 3–6% in silty sandstone and hydrocarbon saturations of around 20 to 30%.

Summary of Results

The results of Looma 1 provided significant encouragement for prospectivity of the area for tight gas and in particular at the level of the Acacia Sandstone. Poor reservoir quality is the main contributing factor for the lack of any significant hydrocarbon flow. The absence of viable reservoir properties within the Nita Formation confirms that fracture permeability is required to achieve a commercial flow rate. An overall increase in the reservoir potential for the Acacia Sandstone is expected eastward of the Looma 1 location.

Way Forward

This study has identified potential sites which could be followed up for future tight gas development and has provided a better understanding about unconventional hydrocarbon resources in Western Australia. Some important points for the way forward are:

- Proper application of existing and new technology to develop such resources;
- Evaluate why existing unconventional gas projects have not been developed;
- Determine what would be required to bring unconventional gas resources to market;
- Locate additional onshore areas of the State with potential for unconventional gas;

- Locate areas where natural fractures are present;
- Increase industry focus on exploration and exploitation of unconventional gas prospects;
- Follow patterns and technologies employed by major international unconventional gas developers rather than totally relying on domestic technology;
- Study analogous fields around the world and how they apply the most modern and applicable technology which is available today;
- Encourage service companies specialised in servicing unconventional gas industries to establish their offices in Western Australia for long term commitments;
- Patience and perseverance with a supportive business environment.

It is recommended that DMP continue to investigate similar studies in which existing tight gas resources as well as other forms of unconventional gas resources can be identified from the other onshore basins of Western Australia.

References

- Buru Energy, 2008, Canning Basin overview, Buru Energy Project, viewed on 10th July, 2010, < <http://www.buruenergy.com.au/web/Projects/Canning-Basin-Overview/>>.
- Crostella, A., 1998, A review of oil occurrences within the Lennard Shelf, Canning Basin, Western Australia: Western Australia Geological Survey, Report 56, 40p.
- Geological Survey of Western Australia (GSWA), 2009, Summary of petroleum prospectivity, Western Australia 2009: GSWA, 2009 Edition, p.10-18.
- Kimberley Oil, N.L., 2004, The Yulleroo prospect, Canning Basin, Western Australia, (unpublished). ■



Dawn at the Jolokia 1 geothermal well, South Australia
(Photo courtesy of Geodynamics Ltd)

State Award of Geothermal Exploration Permits

Mike Middleton & Richard Bruce

Senior Energy Geotechnologist &
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The first titles for geothermal energy exploration in Western Australia were awarded in July 2009. Since then, Geothermal Exploration Permit (GEP) awards have resulted from acreage releases in 2009, and further applications have been received from a Whole-of-State release in April 2010.

The interest in geothermal acreage has grown with each release; there currently being 41 titles granted in WA (Table 1). The Perth and Carnarvon basins continue to be the main focus for

geothermal energy exploration with 39 of the total currently awarded GEPs. The other two GEPs are in the Eucla Basin. As of early July, applications have been made for a further seven GEPs in the Canning and Officer basins.

The players in the Western Australian geothermal game are Green Rock Energy Ltd, Granite Power Ltd, Geothermal Power Pty Ltd, New World Energy Ltd, AAA Energy Pty Ltd, Geothermal Energy Pty Ltd, Greenpower Energy Ltd and BHP

Billiton Worsley Alumina Pty Ltd. All, but one, of these are all small Australian companies. Two research institutions, University of Western Australia and CSIRO, are working together with some of these companies.

Within the work programs proposed by the title holders of the 41 GEPs, a commitment has been made for some 72 shallow and 6 deep geothermal wells to July 2012. Indicative expenditure for this period by these companies is over \$26.5 million (Table 2). ■

Table 1. Awarded Geothermal Exploration Permits (GEP) to July 2010

Basin	Title	Operator	Awarded
Perth Basin	GEP 1	Green Rock Energy Ltd & UWA	July 2009
	GEP 2	Green Rock Energy Ltd	
	GEP 3		
	GEP 4		
	GEP 5	Granite Power Ltd	
	GEP 6		
	GEP 7	Geothermal Power Pty Ltd	
	GEP 8		
	GEP 9		
	GEP 10	Green Rock Energy Ltd & BHP Billiton Worsley Alumina Pty Ltd	September 2009
	GEP 11		
	GEP 12		
	GEP 13	New World Energy Ltd	
	GEP 14		
	GEP 15		
	GEP 16		
	GEP 17		
	GEP 18		
	GEP 19		
	GEP 20		
	GEP 21		
	GEP 22	AAA Energy Pty Ltd	
	GEP 23	Green Rock Energy Ltd	
	GEP 24		
	GEP 25		
	GEP 26		
	GEP 27		
	GEP 28		
Carnarvon Basin	GEP 29	Geothermal Energy Pty Ltd	February 2010
	GEP 30	New World Energy Ltd	
	GEP 31		
	GEP 32		
	GEP 33		
	GEP 34		
	GEP 35		
	GEP 36		
Eucla Basin	GEP 37	Greenpower Energy Ltd	
	GEP 38		
Perth Basin	GEP 39	Green Rock Energy Ltd	April 2010
	GEP 40		
	GEP 41		

Table 2. Proposed geothermal exploration work programs

Title	Firm Two Year Program includes	Indicative Expenditure	Secondary Program includes	Indicative Expenditure
GEP 1	Geoscientific studies, 400 m well	\$375,000	Geotechnical studies, two deep wells and economic studies	\$9,000,000
GEP 2	Geoscientific studies, two 200 m wells, one 400 m well	\$260,000	Geotechnical studies, two deep wells, economic studies	\$17,500,000
GEP 3	Geoscientific studies, one 400 m well	\$150,000	Geotechnical studies, two deep wells, economic studies	\$17,500,000
GEP 4	Geoscientific studies, one 400 m well	\$150,000	Geotechnical studies, two deep wells, economic studies	\$17,500,000
GEP 5	Geoscientific studies, 25 km 2D seismic survey, two shallow wells	\$902,000	Two deep wells and pilot plant	\$49,150,000
GEP 6	Geoscientific studies, 25 km 2D seismic survey, two 800 m wells	\$902,000	Two deep wells and pilot plant	\$49,150,000
GEP 7	Geoscientific studies, one 400 m well	\$217,000	Three deep wells, one shallow well	\$1,300,000
GEP 8	Geoscientific studies, one 400 m well	\$217,000	Three deep wells, one shallow well	\$1,300,000
GEP 9	Geoscientific studies, one 400 m well	\$217,000	Three deep wells, one shallow well	\$1,300,000
GEP 10	50 km magnetotelluric survey, geoscientific studies, one 400 m well, two 200 m wells	\$375,000	Geotechnical studies, two deep wells, fracture stimulation, economic studies	\$14,000,000
GEP 11	50 km magnetotelluric survey, geoscientific studies, one 400 m well, two 200 m wells	\$375,000	Geotechnical studies, two deep wells, fracture stimulation, economic studies	\$14,000,000
GEP 12	50 km magnetotelluric survey, geoscientific studies, one 400 m well, three 200 m wells	\$460,000	Geotechnical studies, two deep wells, fracture stimulation, economic studies	\$17,500,000
GEP 13	209 km gravity survey, geoscientific studies, three 500 m wells	\$878,500	50 km magnetotelluric survey, geotechnical studies, two deep wells, fracture stimulation	\$12,114,100
GEP 14	Geoscientific studies, two 500 m wells, one deep well	\$1,939,050	Geotechnical studies, two deep wells, pilot plant	\$16,126,800
GEP 15	209 km gravity survey, geoscientific studies, three 500 m wells	\$878,500	50 km magnetotelluric survey, geotechnical studies, three deep wells, fracture stimulation	\$8,676,900
GEP 16	209 km gravity survey, geoscientific studies, two shallow wells	\$717,750	50 km magnetotelluric survey, geotechnical studies, two shallow wells, two deep wells	\$5,590,100
GEP 17	209 km gravity survey, geoscientific studies, two shallow wells	\$717,750	Geotechnical studies, two shallow wells, two deep wells, fracture stimulation	\$11,020,100
GEP 18	209 km gravity survey, geoscientific studies, three shallow wells	\$907,950	Three shallow wells, three deep wells, geotechnical studies, geophysical survey, fracture stimulation	\$19,852,900
GEP 19	209 km gravity survey, geoscientific studies, three 500 m wells	\$878,650	Geotechnical studies, three deep wells	\$8,676,900
GEP 20	Geoscientific studies, two shallow wells, one deep well	\$1,939,050	Geotechnical studies, two deep wells, pilot plant	\$12,626,800
GEP 21	Geoscientific studies, two shallow wells, one deep well	\$1,939,050	Geotechnical studies, two deep wells, pilot plant	\$11,626,800
GEP 22	Geoscientific studies, 60 km 2D seismic survey, one deep well	\$4,375,000	Geotechnical studies, one deep well, fracture connection test, pilot plant	\$10,500,000
GEP 23	Geoscientific studies, two 200 m wells, one 400 m well	\$260,000	Geotechnical studies, two deep wells, fracture connection test, economic studies	\$17,500,000
GEP 24	Geoscientific studies, two 200 m wells, one 400 m well	\$260,000	Geotechnical studies, two deep wells, fracture connection test, economic studies	\$17,500,000
GEP 25	Geoscientific studies, two 200 m wells, one 400 m well	\$260,000	Geotechnical studies, two deep wells, fracture connection test, economic studies	\$17,500,000

Table 2. Proposed geothermal exploration work programs

Title	Firm Two Year Program includes	Indicative Expenditure	Secondary Program includes	Indicative Expenditure
GEP 26	Geoscientific studies, one shallow well	\$150,000	Geotechnical studies, two deep wells, fracture connection test, economic studies	\$17,500,000
GEP 27	50 km magnetotelluric survey, geoscientific studies, one 400 m well, three 200 m wells	\$460,000	Geotechnical studies, two deep wells, fracture stimulation, economic studies	\$17,500,000
GEP 28	Geoscientific studies, one shallow well	\$150,000	Geotechnical studies, two deep wells, fracture connection test, economic studies	\$17,500,000
GEP 29	Geoscientific studies, two 450 m wells	\$350,000	Geoscientific studies, 20 km 2D seismic survey, magnetotelluric survey, three deep wells, reservoir studies	\$15,800,000
GEP 30	Geotechnical studies, one 800 m well	\$344,250	Four deep wells, geothermal studies	\$1,962,650
GEP 31	Geotechnical studies, one 800 m well	\$358,750	Four deep wells, geothermal studies	\$1,962,650
GEP 32	Geotechnical studies, one 800 m well	\$359,250	Four deep wells, field review	\$1,962,600
GEP 33	Geothermal studies, one 500 m well	\$207,375	Geothermal studies, one 500 m well, three deep wells	\$8,859,825
GEP 34	Magnetotelluric survey, geoscientific studies, one deep well	\$648,450	Geoscientific studies, two deep wells, economic studies	\$10,546,300
GEP 35	Seismic interpretation, geoscientific studies, one deep well	\$644,450	Geoscientific studies, two deep wells, economic studies	\$8,903,200
GEP 36	Geoscientific studies, one 800 m well	\$462,450	Geothermal studies, three deep wells, economic studies	\$9,246,150
GEP 37	Geotechnical studies, one shallow well	\$700,000	Engineering studies, two deep wells	\$20,750,000
GEP 38	Geotechnical studies, one shallow well	\$700,000	Engineering studies, two deep wells	\$20,750,000
GEP 39	Geoscientific studies, one 400 m well	\$200,000	Geotechnical studies, one deep well, reservoir testing	\$4,410,000
GEP 40	Geoscientific studies, one 400 m well	\$200,000	Geotechnical studies, one deep well, reservoir testing	\$4,410,000
GEP 41	Geoscientific studies, one 400 m well	\$200,000	Geotechnical studies, two deep wells, reservoir testing	\$12,410,000

Note:

Shallow well < 1,000 m

Deep well >= 1,000 m



Richard Bruce
Exploration Geologist
Resources Branch

Awards of Petroleum Exploration Permits

Commonwealth Award of Petroleum Exploration Permits

These new permits result from the first round of the 2009 Acreage Release that closed on 3 December 2009.

Commonwealth award information was sourced from Western Australia's online Petroleum and Geothermal Register.

The total indicative value of work commitments for the following Commonwealth permits is A\$304.23 million.

In April 2010 permits granted were WA-442-P and WA-443-P. In May 2010 permits granted were WA-444-P to WA-449-P. In June 2010 the permit granted was WA-450-P.

WA-442-P (released as W09-Special) in the Bonaparte Basin off Western Australia has been awarded to *DVM International Ltd.* The company proposed a guaranteed work program of 2D seismic processing, 100 km² of new 3D seismic surveying and one exploration well to an estimated value of \$17 million. The secondary work program consists of two exploration wells and 500 km² of new 3D seismic surveying to an estimated value of \$35 million. There were two other bids for this area.

WA-443-P (released as W08-13) in the Roebuck Basin has been awarded to *Camarvon Petroleum Ltd.* The company proposed a guaranteed work program of 1,400 km of 2D seismic reprocessing and geotechnical studies to an estimated value of \$320,000. The secondary work program consists of 300 km new 2D seismic surveying, geotechnical studies and one exploration well to an estimated value of \$16.6 million. There were no other bids for this area.

WA-444-P (released as W09-10) on the Rankin Platform has been awarded to *Chevron Australia Pty Ltd.* The company proposed a guaranteed work program of geotechnical studies and 80 km² new 3D seismic surveying to an estimated value of \$2.2 million. The secondary work program consists of geotechnical studies to an estimated value of \$800,000. There were three other bids for this area.

WA-445-P (released as W09-9) on the Rankin Platform has been awarded to *Finder No. 2 Pty Ltd.* The company proposed a guaranteed work program of 80 km² 3D seismic reprocessing and geotechnical studies to an estimated value of \$926,667. The secondary work program consists of geotechnical studies and one exploration well to an estimated value of \$35.35 million. There were no other bids for this area.

WA-446-P (released as W08-1) in the Petrel Sub-basin of the Bonaparte Basin has been awarded to *Finder No. 1 Pty Ltd.* The company proposed a guaranteed work program of purchasing 1,200 km of 2D seismic data and geotechnical studies to an estimated value of \$605,000. The secondary work program consists of geotechnical studies and one exploration well to an estimated value of \$6.3 million. There were no other bids for this area.

WA-447-P (released as W09-2) in the southern Browse Basin has been awarded to *Woodside Energy Ltd.* The company proposed a guaranteed work program of 2,000 km seismic reprocessing, geotechnical studies and 2,010 km² new 3D seismic surveying to an estimated value of \$14.58 million. The secondary work program consists of geotechnical studies and one exploration well to an estimated value of \$25.06 million. There were no other bids for this area.

WA-448-P (released as W09-12) on the Rankin Platform has been awarded to *Woodside Energy Ltd.* The company proposed a guaranteed work program of geotechnical studies, 243 km² 3D seismic reprocessing and 243 km² new 3D seismic surveying to an estimated value of \$4.45 million. The secondary work program consists of geotechnical studies, 243 km² 3D seismic reprocessing and one exploration well to an estimated value of \$31.38 million. There were three other bids for this area.

WA-449-P (released as W09-1) in the southern Browse Basin has been awarded to *Woodside Energy Ltd.* The company proposed a guaranteed work program of 2,000 km 2D seismic reprocessing, geotechnical studies and 610 km² new 3D seismic surveying to an estimated value of \$5.42 million. The secondary work program consists of geotechnical studies and one exploration well to an estimated value of \$25.06 million. There were no other bids for this area.

WA-450-P (released as W09-11) on the Rankin Platform has been awarded to *Finder No. 4 Pty Ltd.* The company proposed a guaranteed work program of purchase of 80 km² 3D seismic data, geotechnical studies, seabed coring and one exploration well to an estimated value of \$54.65 million. The secondary work program consists of geotechnical studies and one exploration well to an estimated value of \$28.53 million. There were five other bids for this area.

State Award of Petroleum Exploration Permits

There were no State awards of Petroleum Exploration Permits from January to June 2010 inclusive. ■

The Petroleum and Geothermal Register (PGR) — Moving Forward

Hazel Harnwell

Project Coordination and Information Management Manager
Strategic Business Development Branch



The PGR team (L-R): Mark Firth, Walter Law, Tegan Parker, Mark Gabrielson, Hazel Harnwell, Paul McCoy, Sean Wichman and Ken Phua

Phase two of the PGR Pipelines module was formally launched to industry on 14 April 2010. Staff from the Petroleum Tenure and Land Access Branch (PTLAB) of the Petroleum Division and the Information Services Branch provided a presentation and demonstration on the system highlighting new features. A significant inclusion is the ability for industry to submit and store technical pipeline data.

Industry was well represented with 30 invitees from Chevron, DBP, Woodside, Shell Development, APA Group, Apache Energy, ERM Power, Avon Energy, Rio Tinto, CITIC Pacific Mining and WestNet Energy attending.

Attendees were given an introduction to the PGR system before being shown existing and recently introduced pipeline lodgement functionality. The pipelines functionality within PGR now enables industry to:

- lodge and pay for pipeline licence, pipeline licence renewal or pipeline variation applications online;
- monitor approval processes and pipeline fees;
- track an application once it is lodged;
- compile, document and store technical specifications for a pipeline application in PGR; and
- create and store documentation in PGR, allowing the proponent to discuss and review with PTLAB staff prior to formal lodgement with the Petroleum Division.

The two hour session was well received with positive feedback directed to the PGR system as a whole. Further positive feedback has been received by the Petroleum Division following the launch.

A number of attendees commented on the transparency and user-friendliness of the system and all are looking forward to the introduction of future PGR releases.

Using the pipelines module as a prototype, future releases of PGR will see all application types integrated into the system and go online.

The PGR online system will now enable industry to perform the following as well as the new functions listed above:

- a customised Home Page for registered users of Online Payments and/or Online Lodgement;
- the issuing of Tax Invoices and Receipts;
- the ability to pay all fee types online;
- enhancements to Approvals Tracking;
- integration with the Global Information System (GIS) allowing a detailed Map Viewer to display a map identifying the location of a petroleum or geothermal title; and
- integration with the Environmental Assessment and Regulatory System (EARS) allowing Petroleum Environmental Registrations against petroleum or geothermal titles to be displayed within PGR.

Further upgrades in 2010 will include:

- the ability to lodge and track Change of Company Name, Well, Survey and Special Prospecting Authority applications online;
- the ability to view title information and track applications by Project;
- Electronic Funds Transfer (EFT) facilities for the payment of fees; and

- the ability to lodge and track more title applications online.

The Executive Director Petroleum Division, Bill Tinapple, said that PGR continued to expand, providing greater transparency and accountability to industry.

“It is exciting to see how continuous improvement of the PGR system and work processes and procedures has become part of our daily activities. Feedback from staff and industry has been very positive. This is due to their involvement and ongoing feedback during development. PGR has been described as being extremely user friendly”, he said.

Mark Gabrielson, General Manager of the Business Development Branch, said that the PGR project team continued to deliver enhancements to develop a quality system that is revolutionising the way business is being conducted by Petroleum Division.

“The PGR system continues to lift the bar by increasingly providing more comprehensive titles information and greater functionality for both internal and external users. In the last two years the PGR system has gone from strength to strength. The team has managed competing work priorities very effectively to meet deadlines”, he said.

Standing behind these developments is the fact that the Petroleum Division has been accredited and certified under Australian Standard ISO 9001:2008 for its Quality Management System (QMS) showing that it meets statutory and regulatory requirements by following set procedures to ensure consistency in customer services as part of the Division’s certification. This has helped to develop PGR in a systematic way. ■

Policy Initiatives Streamline Petroleum Acreage Release

Adam Westerhout

Policy Officer
Strategic Business Development Branch



Drilling on the Hovea field, onshore Perth Basin
(Photo courtesy of ARC Energy)

In accordance with the Department's *Strategic Plan for Success: 2009 to 2012*, the Petroleum Division of the Department of Mines and Petroleum has been proactively directing their operational policy focus to implement the vision of the Government.

Evidence of this effort was displayed in June with the development of two new policies addressing issues surrounding acreage release. Efficient, timely and high quality releases of new acreage are vital to the Department's ability to encourage responsible exploration and development of the State's resources.

"Operational Policy development such as this is important for Petroleum Division, as it provides certainty to both regulators and industry" said Bill Tinapple, Petroleum Division's Executive Director.

The *Petroleum Acreage Release Approval Process Policy* and the *Petroleum Acreage Bid Assessment Process (State Waters and Onshore) Policy* both provide a means to accomplish this task as well as helping to address the pressing issue of energy security.

The policies ensure the procedures used to manage petroleum acreage releases and the assessment of applications for acreage are conducted consistently and appropriately.

The *Petroleum Acreage Release Approval Process* aims at clarifying the roles of the three principal areas

associated with designing the acreage release package. These areas include the Resources Branch, the Petroleum Tenure and Land Access Branch and the Geological Survey Division.

Previously, the process and integration of these principal areas seemed intricate and complex. However the *Petroleum Acreage Release Approval Process Policy* has successfully outlined a thorough methodology to allow for greater transparency and efficiency in the way the State releases acreage for bidding.

The *Petroleum Acreage Bid Assessment Process (State Waters and Onshore) Policy* clearly outlines the process which the Department uses when assessing and awarding applications for acreage.

In addition to managing the process, the *Petroleum Acreage Bid Assessment Process (State Waters and Onshore) Policy* also serves as a structured guideline detailing the assessment criteria of applications. The policy also functions as a comprehensive source of background information regarding the fundamental objectives of acreage bid assessment criteria.

"We hope to provide similar clarity for other issues in the regulation of the WA petroleum industry, and would welcome suggestions from industry regarding where they would like more information about our internal processes", said Mr Tinapple. ■

Table 1. 2009 Production by Field and Cumulative Production as at 31 December 2009

Field	Operator	2009 Production by Field			Cumulative Production			Permit
		Oil	Condensate	Gas	Oil	Condensate	Gas	
		kL	kL	10 ³ m ³	kL	kL	10 ³ m ³	
Albert	Apache	6,202	2	1,567	57,334	28	5,171	TL/6
Angel	Woodside	0	2,251,058	7,337,073	0	2,442,503	8,084,589	WA-3-L
Apium	AWE	0	77	7,606	0	291	26,253	L1
Artreus	Apache	213	0	106	32,827	14	3,813	TL/6
Bambra	Apache	102,964	19,419	207,666	241,135	84,620	523,038	TL/1
Barrow Island	Chevron	318,990	0	45,574	49,985,141	0	5,280,015	L1H
Beharra Springs	Origin	0	293	35,374	0	23,870	2,238,167	L11
Blacktip	Eni	0	532	61,327	0	532	61,327	WA-33-L
Blina	Buru Energy	1,372	0	0	296,127	0	0	L6
Boundary	Buru Energy	50	0	0	20,451	0	0	L6
Chinook/Scindian	BHP Billiton	37,741	0	23,149	4,802,479	0	1,832,979	WA-10-L
Cliff Head	ROC Oil	225,581	0	757	1,430,068	0	5,867	WA-31-L
Cossack	Woodside	403,621	0	10,632	12,584,664	0	377,935	WA-9-L
Cowle	Chevron	2,712	0	1,362	526,746	1,748	87,767	TL/4
Crest	Chevron	422	0	1,157	274,755	108	61,991	L12, L13
Dongara	AWE	1,575	159	27,568	191,877	49,677	12,870,043	L1, L2
Double Island	Apache	14,067	4	3,553	676,011	2,776	45,051	TP/8
Echo/Yodel	Woodside	0	369,035	408,917	0	10,571,539	13,366,709	WA-23/24-L
Enfield	Woodside	1,679,578	0	188,371	7,603,055	0	652,060	WA-28-L
Eremia	AWE	8,460	0	1,977	239,789	0	11,608	L1
Eskdale	BHP Billiton	84,133	0	80,273	311,285	0	182,042	WA-32-L
Exeter	Santos	128,830	0	589	2,485,256	0	4,848	WA-27-L
Goodwyn	Woodside	0	1,646,622	8,249,768	0	42,811,458	121,322,386	WA-5-L
Griffin	BHP Billiton	124,440	0	8,617	21,694,436	0	1,801,247	WA-10-L
Gudrun	Apache	54	0	4	118,719	75	7,740	TL/1
Harriet	Apache	11,066	2	4,184	8,181,756	60,035	1,484,787	TL/1
Hermes	Woodside	1,186,098	0	82,012	11,420,386	0	755,101	WA-16-L
Hovea	AWE	35,750	1	3,013	1,168,642	251	98,136	L1
Jingemia	Origin	31,893	0	1,466	691,402	0	31,746	L14
John Brookes	Apache	0	155,814	2,605,403	0	577,878	9,116,895	WA-29-L
Laminaria East	Woodside	17,055	1,304	0	1,533,033	70,625	24,854	WA-18-L
Lee	Apache	0	25,462	194,741	0	92,585	585,207	TL/1
Legendre North	Apache	169,592	0	119,021	6,658,950	0	1,662,090	WA-20-L
Legendre South	Apache	39,025	0	259,428	849,248	0	998,449	WA-20-L
Little Sandy	Apache	3,749	1	892	88,148	444	11,708	TL/6
Lloyd	Buru Energy	244	0	0	30,124	0	0	L8

Table 1. 2009 Production by Field and Cumulative Production as at 31 December 2009

Field	Operator	2009 Production by Field			Cumulative Production			Permit
		Oil	Condensate	Gas	Oil	Condensate	Gas	
		kL	kL	10 ³ m ³	kL	kL	10 ³ m ³	
Mohave	Apache	745	1	360	141,595	108	18,358	TL/6
Mount Horner	AWE	2,499	0	0	296,431	0	0	L7
Mutineer	Santos	354,260	0	1,653	5,792,300	0	11,503	WA-26-L
North Alkimos	Apache	3,316	0	7,261	10,055	89	20,191	TL/6
North Rankin	Woodside	0	171,143	1,599,129	0	24,461,711	191,255,493	WA-1-L
Pedirka	Apache	13,253	4	4,128	314,560	1,204	30,638	TL/6
Perseus	Woodside	0	2,350,929	10,895,516	0	19,791,583	96,441,763	WA-1-L
Roller	Chevron	60,301	0	14,623	7,077,946	0	743,075	TL/7
Rose	Apache	0	10,075	64,173	0	199,355	957,123	TL/1
Saladin	Chevron	72,718	0	25,170	15,402,317	0	1,718,413	TL/4
Searipple	Woodside	0	383,079	374,219	0	755,966	741,020	WA-1-L
Simpson	Apache	13,517	282	4,204	835,012	6,525	80,605	TL/1
Skate	Chevron	0	0	19,609	266,950	8,873	156,181	TL/7
South Plato	Apache	5,929	8	3,555	697,544	883	50,635	TL/6
Stag	Apache	391,426	0	5,495	8,218,169	0	394,455	WA-15-L
Stybarrow	BHP Billiton	1,729,176	0	106,463	5,822,312	1	352,723	WA-32-L
Sundown	Buru Energy	2,838	0	0	70,539	0	0	L8
Tarantula	Origin	0	239	29,155	0	3,858	308,064	L11
Victoria	Apache	2,188	2	1,233	49,578	367	7,841	TL/6
Vincent	Woodside	1,052,176	0	376,113	1,594,845	0	586,900	WA-28-L
Wanaea	Woodside	611,685	0	143,135	38,703,478	0	8,297,150	WA-11-L
Wandoo	Vermillion	453,096	0	39,005	12,196,952	0	967,976	WA-14-L
West Cycad	Apache	17,309	15	8,337	193,180	225	23,691	TL/9
West Terrace	Buru Energy	783	0	0	38,516	0	0	L8
Wonnich	Apache	0	33,636	378,881	0	402,564	3,926,186	TL/8
Woodada	AWE	0	61	9,314	0	10,603	1,496,326	L4, L5
Woollybutt*	Eni	152,977	0	4,158	5,033,644	0	142,618	WA-25-L
Xyris	AWE	0	391	28,975	0	3,505	258,885	L1
Xyris South	AWE	0	54	4,015	0	116	7,183	L1
Yammaderry	Chevron	0	0	1,312	857,361	0	98,725	TL/4
Yardarino	AWE	0	0	204	1,567	771	143,783	L2
Zephyrus	Apache	1,133	1	223	62,490	27	3,034	TL/6
Cumulative production for developed fields currently not producing					13,062,034	3,257,169	17,633,324	
Total		9,576,799	7,419,704	34,122,762	250,933,218	105,696,561	510,495,480	

* includes Woollybutt South

Table 2a. Petroleum Reserves Estimates by Basin as at 31 December 2009 (metric units)

Basin	Oil		Sales Gas		Condensate	
	GL		Gm ³		GL	
Category 1	P50	P90	P50	P90	P50	P90
Bonaparte	0.00	0.00	23.23	11.09	5.89	3.93
Canning	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
Northern Carnarvon	58.90	26.60	1,021.90	721.20	88.60	61.60
Perth	1.41	0.88	0.33	0.17	0.004	0.002
Total	60.31	27.48	1,045.46	732.46	94.49	65.53
Category 2	P50	P90	P50	P90	P50	P90
Bonaparte	0.00	0.00	27.88	22.03	0.00	0.00
Browse	0.00	0.00	437.20	320.66	57.60	34.70
Northern Carnarvon	27.99	15.74	806.70	611.60	21.25	12.61
Total	27.99	15.74	1,271.78	954.29	78.85	47.31
Category 3	P50	P90	P50	P90	P50	P90
Bonaparte	0.00	0.00	13.42	10.00	0.00	0.00
Browse	0.00	0.00	559.62	300.34	86.00	57.00
Northern Carnarvon	35.37	9.56	845.46	467.16	30.24	13.57
Perth	0.00*	0.00*	5.50	4.00	0.00*	0.00*
Total	35.37	9.56	1,424.00	781.50	116.24	70.57
GRAND TOTAL	123.67	52.78	3,741.24	2,468.25	289.58	183.41

* too small to measure

Table 2b. Petroleum Reserves Estimates by Basin as at 31 December 2009 (field units)

Basin	Oil		Sales Gas		Condensate	
	MMbbl		Tcf		MMbbl	
Category 1	P50	P90	P50	P90	P50	P90
Bonaparte	0.00	0.00	0.82	0.39	0.21	0.14
Canning	0.00*	0.00*	0.00*	0.00*	0.00*	0.00*
Northern Carnarvon	370.42	167.29	36.09	25.47	557.21	387.40
Perth	8.87	5.53	0.01	0.01	0.03	0.01
Total	379.29	172.82	36.92	25.87	557.44	387.55
Category 2	P50	P90	P50	P90	P50	P90
Bonaparte	0.00	0.00	0.98	0.78	0.00	0.00
Browse	0.00	0.00	15.44	11.32	362.25	218.23
Northern Carnarvon	176.03	98.99	28.49	21.60	133.64	79.30
Total	176.03	98.99	44.91	33.70	495.89	297.53
Category 3	P50	P90	P50	P90	P50	P90
Bonaparte	0.00	0.00	0.47	0.35	0.00	0.00
Browse	0.00	0.00	19.76	10.61	540.85	358.47
Northern Carnarvon	222.44	60.12	29.86	16.50	190.18	85.34
Perth	0.00*	0.00*	0.19	0.14	0.00*	0.00*
Total	222.44	60.12	50.29	27.60	731.03	443.81
GRAND TOTAL	777.76	331.93	132.12	87.16	1,784.36	1,128.90

* too small to measure

NOTES

Category 1 comprises current reserves of those fields which are producing or have been declared commercial.

Category 2 comprises estimates of recoverable reserves which are held under Retention Leases and have not yet been declared commercially viable.

Category 3 comprises estimates of contingent resources which are held in other licences and have not yet been declared commercially viable.

Table 3. Seismic Surveys in Western Australia 2009–10 Fiscal Year — Statistical Summary

		2D (line km)	3D (km ²)
Bight Basin	Onshore		
	Offshore	4,443	
Bonaparte Basin	Onshore		
	Offshore	1,800	2,750
Browse Basin	Onshore		
	Offshore	4,101	5,519
Canning Basin	Onshore	103	223
	Offshore		
Carnarvon Basin	Onshore		
	Offshore	2,678	18,581(a)
Subtotal	Onshore	103	223
	Offshore	13,022	26,850
Total		13,125	27,073

The above table lists the quantity of 2D seismic (line km) and 3D seismic (km²) acquired during the fiscal year. For surveys that commenced before 1 July 2009 only acquisition after this date is included. In addition, 1,025 km aerial gravity data was collected in the Perth Basin, 21,583 km aeromagnetic data was collected in the Canning Basin, and 1,940 km ESR data was collected in the Eucla Basin.

(a) Includes km² from Eendracht and Foxhound 3D M.S.S. commenced first half 2009.

The attached listing of surveys operating in the fiscal year includes all data gathered prior to 30 June 2010.

Table 4. Petroleum Wells in Western Australia 2009–10 Fiscal Year — Statistical Summary

		NFW		EXT		DEV		Subtotal		Total	
		Wells	Metres	Wells	Metres	Wells	Metres	Wells	Metres	Wells	Metres
Bonaparte Basin	Onshore									4	12,888
	Offshore	3	9,626			1	3,262	4	12,888		
Browse Basin	Onshore									7	29,896
	Offshore	4	20,115(a)	3	9,781			7	29,896		
Canning Basin	Onshore	1	3,708(b)					1	3,708	1	3,708
	Offshore										
Carnarvon Basin	Onshore									51	168,315
	Offshore	32	82,793	14	31,201(c)	5(d)	54,321(e)	51	168,315		
Perth Basin	Onshore	5(f)	15,031(g)			1	2,600	6	17,631	6	17,631
	Offshore										
Subtotal	Onshore	39	112,534	17	40,982	6	57,583	62	211,099	69	232,438
	Offshore	6	18,739			1	2,600	7	21,339		
Total		45	131,273	17	40,982	7	60,183	69	232,438		

The above table lists the number of wells spudded and metres drilled (subsurface) during the 2009–10 fiscal year. For wells spudded before 1 July 2009, only metres drilled during the fiscal year are included in the above table.

(a) Includes Burnside 1 spudded 2008–09.

(b) Includes Sally May 2 spudded 2008–09.

(c) Includes Coniston 3 spudded 2008–09.

(d) Included Water Injection Wells.

(e) Included 18 Pyrenees, Pluto and Enfield wells spudded prior to reporting period.

(f) Includes Kaloorup Roads 2 Coal Bed Methane well.

(g) Includes Apium North 1 spudded 2008–09.

Table 5. Seismic Surveys in Western Australia Operating 2009–10 Fiscal Year

Survey Name	Class	On Off	Title	Operator	Commenced	Completed	2D/aerial line km @ 30/06/2010	3D km ² @ 30/06/2010
Bight Basin								
Bremer Basin 2D M.S.S.	2D	Off	WA-379-P, WA-380-P	Arcadia	12/9/2009	1/20/2010	4,443	
Bonaparte Basin								
Penguin 2010 2D M.S.S.	2D	Off	WA-313-P R1	Eni	3/19/2010	3/25/2010	394	
RIL 2D 09/10 M.S.S.	2D	Off	WA-405-P	RIL	12/4/2009	12/17/2009	1,406	
RIL 3D 09/10 M.S.S.	3D	Off	WA-405-P	RIL	12/24/2009	1/16/2010		2,750
Browse Basin								
Koolama 2D M.S.S.	2D	Off	WA-415-P, WA-416-P, WA-417-P	Woodside	5/24/2010	6/26/2010	4,101	
Adele Trend 2008 Q3D Multiclient 3D M.S.S.	3D	Off	2SL/09-0	Western Geco	9/29/2009	10/29/2009		925
Poseidon 3D M.S.S.	3D	Off	WA-314-P, WA-315-P, WA-389-P	Conoco Phillips	10/11/2009	3/3/2010		3,141
Zeemeermin 3D M.S.S.	3D	Off	1SL/09-0	Fugro	11/15/2009	12/15/2009		1,453
Canning Basin								
Paradise 2009 2D S.S.	2D	On	EP 371 R1, EP 428	Buru	9/17/2009	9/24/2009	103	
Bunda 3D S.S.	3D	On	EP 129 R5, L 6 R1, L 8 R1	Buru	8/14/2009	9/13/2009		223
Bedout Sub-Basin Aeromagnetic Survey	AEROMAG	Off	WA-435-P, WA-436-P, WA-437-P, WA-438-P	Finder	4/29/2010	5/19/2010	21,583	
Carnarvon Basin								
Quiberon Non-Exclusive 2D M.S.S.	2D	Off	3SL/09-0	Searcher Sismic	11/4/2009	11/29/2009	2,678	
Agrippina 3D M.S.S.	3D	Off	WA-366-P, WA-439-P	Chevron	1/27/2010	3/3/2010		1,729
Claudius 2009 3D M.S.S.	3D	Off	WA-434-P	Woodside	10/22/2009	1/27/2010		3,771
Eendracht 3D M.S.S.	3D	Off	6SL/08-9	Fugro	6/8/2009			6,853
Foxhound 3D Non-Exclusive M.S.S.	3D	Off	7SL/08-9	Searcher Sismic	4/13/2009	8/7/2009		7,440
Laverda 3D M.S.S.	3D	Off	WA-271-P R2, WA-28-L, WA-36-R	Woodside	5/17/2010	6/28/2010		144
Schiele 3D M.S.S.	3D	Off	WA-362-P, WA-363-P	OMV	4/21/2010			4,159
Eucla Basin								
Balladonia ESR Survey	ESR	On	SPA 4/09-0	Southern Sky	07/06/2010	30/06/2010	1,940	
Perth Basin								
Lockier Airborne 3D Full Tensor Gradiometry	GRAVITY	Off	EP 368 R3	Westbranch	9/10/2009	9/11/2009	400	
Xanadu FTG Survey	GRAVITY	Off	TP/15 R1	Norwest Energy	9/4/2009	9/9/2009	625	

Class - Classification

2D - 2D Reflection, 3D - 3D Reflection, AEROMAG - Aeromagnetic Survey, GRAVITY - Airborne Gravity, ESR - Electron Spin Resonance

Table 6. Petroleum Wells in Western Australia Operating 2009–10 Fiscal Year

Well Name	Class	On Off	Title	Operator	Latitude		
Bonaparte Basin							
Blacktip P 1	DEV	OFF	WA-33-L	Eni	13	53	41.84
Fu Niu 1	NFW	OFF	WA-406-P	CNOOC	10	42	53.71
Hong Niu 1	NFW	OFF	WA-406-P	CNOOC	10	49	2.32
Jin Niu 1	NFW	OFF	WA-406-P	CNOOC	10	49	45.92
Browse Basin							
Concerto 2	EXT	OFF	WA-371-P	Shell	13	40	53.11
Cornea 3	EXT	OFF	WA-342-P	Hawkestone Oil	13	41	53.28
Poseidon 2	EXT	OFF	WA-398-P	Conoco Phillips	13	40	7.14
Braveheart 1	NFW	OFF	WA-333-P	Hawkestone Oil	13	51	42.99
Burnside 1 ST1	NFW	OFF	WA-281-P R1	Santos	14	12	47.36
Crescendo 1	NFW	OFF	WA-371-P	Shell	13	30	16.17
Kontiki 1	NFW	OFF	WA-314-P	Conoco Phillips	13	24	44.02
Kronos 1	NFW	OFF	WA-398-P	Conoco Phillips	13	41	53.84
Canning Basin							
Fairwell 1	NFW	ON	L 8 R1	Buru	17	32	38.70
Sally May 2	NFW	ON	EP 429	Kingsway	19	48	5.00
Carnarvon Basin							
Crosby 3H	DEV	OFF	WA-12-R R1	BHPB	21	32	43.01
Crosby 4H	DEV	OFF	WA-12-R R1	BHPB	21	32	42.98
Crosby 5H	DEV	OFF	WA-12-R R1	BHPB	21	31	44.60
Crosby 6H	DEV	OFF	WA-12-R R1	BHPB	21	31	44.56
ENE 02	DEV	OFF	WA-28-L	Woodside	21	28	53.96
PLA 01 Re Entry	DEV	OFF	WA-34-L	Woodside	19	54	49.27
PLA 02	DEV	OFF	WA-34-L	Woodside	19	54	48.22
PLA 03 ST1	DEV	OFF	WA-34-L	Woodside	19	54	48.30
PLA 05	DEV	OFF	WA-34-L	Woodside	19	54	48.84
Ravensworth 3H	DEV	OFF	WA-12-R R1	BHPB	21	32	19.80
Ravensworth 4H	DEV	OFF	WA-155-P R4	BHPB	21	32	19.03
Ravensworth 5H	DEV	OFF	WA-155-P R4	BHPB	21	32	17.13
Ravensworth 6H	DEV	OFF	WA-155-P R4	BHPB	21	32	16.61
Ravensworth 7AH	DEV	OFF	WA-12-R R1	BHPB	21	31	48.10
Ravensworth 8H	DEV	OFF	WA-12-R R1	BHPB	21	31	46.24
VN-A 5H L1 ST1	DEV	OFF	WA-28-L	Woodside	21	26	22.00
VN-A 6H L2 ST1	DEV	OFF	WA-28-L	Woodside	21	26	23.21
Wanaea 11A	DEV	OFF	WA-11-L	Woodside	19	35	32.18
Chandon 2	EXT	OFF	WA-268-P R1	Chevron	19	32	59.09
Clio 3	EXT	OFF	WA-205-P R3	Chevron	20	18	29.06
Coniston 2H ST1	EXT	OFF	WA-35-L	Apache	21	20	37.81
Coniston 3	EXT	OFF	WA-255-P R2	Apache	21	19	20.23
Coniston 4 ST1	EXT	OFF	WA-35-L	Apache	21	20	4.21

Longitude			Gnd Elev/ Water Depth	RT/ KB	Spud Date	TD Date	Rig Release Date
128	29	2.84	51	48	15/07/2009	7/08/2009	4/09/2009
126	3	30.87	316	25	3/10/2009	16/10/2009	20/10/2009
126	9	21.04	193	25	12/09/2009	24/09/2009	30/09/2009
126	13	10.92	116	25	13/08/2009	5/09/2009	10/09/2009
123	21	31.31	268	25	4/04/2010		
124	29	39.73	82	25	11/12/2009	25/12/2009	28/12/2009
122	13	32.23	497	22	10/10/2009	7/12/2009	17/02/2010
124	5	45.63	116	25	29/12/2009	13/01/2010	18/01/2010
122	53	38.38	216	22	16/06/2009	31/07/2009	14/08/2009
123	30	50.04	260	25	8/07/2009	3/08/2009	9/08/2009
122	8	46.82	554	22	22/07/2009	25/09/2009	8/10/2009
122	11	29.96	512	22	19/02/2010	30/04/2010	3/06/2010
124	18	58.20	44	49	18/05/2010	17/06/2010	19/06/2010
124	27	27.00	229	230	27/06/2009	13/08/2009	15/08/2009
114	5	42.52	203	22	20/02/2009	28/10/2009	8/06/2010
114	5	40.43	203	22	21/02/2009	17/11/2009	8/06/2010
114	6	5.91	202	22	10/02/2009	13/08/2009	8/06/2010
114	6	3.79	201	22	16/02/2009	22/07/2009	8/06/2010
113	59	17.69	521	23	6/05/2010		
115	7	54.53	829	22	25/10/2008	5/08/2009	25/12/2009
115	7	54.10	829	22	20/10/2008	13/07/2009	25/12/2009
115	7	54.79	829	22	18/10/2008	24/07/2009	25/12/2009
115	7	56.57	829	22	22/10/2008	19/08/2009	25/12/2009
114	5	3.11	208	22	5/03/2009	8/05/2010	8/06/2010
114	5	3.47	209	22	21/03/2009	21/03/2010	8/06/2010
114	5	4.37	209	22	15/03/2009	27/02/2010	8/06/2010
114	5	4.39	231	22	11/03/2009	12/04/2010	8/06/2010
114	5	5.79	211	22	2/04/2009	25/12/2009	8/06/2010
114	5	7.01	209	22	28/03/2009	11/01/2010	8/06/2010
114	2	49.00	363	23	23/12/2009	8/03/2010	30/04/2010
114	2	47.28	363	23	28/12/2009	31/01/2010	30/04/2010
116	26	8.84	79	23	22/10/2009	23/11/2009	16/12/2009
114	7	47.79	1,168	22	27/11/2009	20/01/2010	3/02/2010
114	41	15.19	971	22	20/03/2010	16/04/2010	4/05/2010
114	3	13.43	407	25	8/08/2009	24/08/2009	5/09/2009
114	3	48.61	398	25	29/06/2009	3/07/2009	7/07/2009
114	4	58.25	373	25	16/09/2009	20/09/2009	23/09/2009

Table 6. Petroleum Wells in Western Australia Operating 2009–10 Fiscal Year

Well Name	Class	On Off	Title	Operator	Latitude		
Carnarvon Basin cont.							
Coniston 5 CH1	EXT	OFF	WA-35-L	BHPB	21	20	17.40
Coniston 6	EXT	OFF	WA-255-P R2	BHPB	21	19	50.28
Coniston 7	EXT	OFF	WA-35-L	BHPB	21	19	57.43
Coniston 9	EXT	OFF	WA-35-L	Apache	21	20	30.99
Geryon 2	EXT	OFF	WA-22-R R1	Chevron	19	57	12.44
Iago 5	EXT	OFF	WA-17-R R1	Chevron	19	50	45.63
Julimar SW 2	EXT	OFF	WA-356-P	Apache	20	9	15.99
Legendre South 3	EXT	OFF	WA-20-L	Apache	19	43	18.04
Novara 2	EXT	OFF	WA-35-L	Apache	21	20	47.60
Novara 3H	EXT	OFF	WA-35-L	Apache	21	20	47.60
Achilles 1	NFW	OFF	WA-374-P	Chevron	20	12	54.80
Acme 1	NFW	OFF	WA-205-P R3	Chevron	20	12	27.10
Balthazar 1	NFW	OFF	WA-356-P	Apache	20	5	26.28
Bath 1	NFW	OFF	TL/2 R1	Apache	21	19	15.79
Bravo 1	NFW	OFF	WA-390-P	Hess	20	3	51.72
Brederode 1	NFW	OFF	WA-364-P	Chevron	19	49	7.88
Camus 1	NFW	OFF	WA-404-P	Woodside	19	6	54.85
Chester 1	NFW	OFF	WA-390-P	Hess	20	28	44.22
Chutney 1	NFW	ON	WA-426-P	Apache	20	29	39.28
Crummock 1	NFW	OFF	WA-357-P	Apache	21	20	4.29
Dalia South 1	NFW	OFF	WA-348-P	Woodside	18	57	36.31
Dunlop 1	NFW	OFF	WA-390-P	Hess	20	5	40.12
Eris 1	NFW	OFF	WA-34-L	Woodside	19	55	41.33
Glenloth 1	NFW	OFF	WA-390-P	Hess	20	4	23.90
Hijinx 1	NFW	OFF	WA-390-P	Hess	20	13	30.96
Hine 1	NFW	OFF	WA-404-P	Woodside	19	1	34.70
Jeune 1	NFW	OFF	WA-390-P	Hess	20	6	32.18
Julimar SW 1	NFW	OFF	WA-356-P	Apache	20	9	15.99
Keto 1	NFW	OFF	WA-205-P R3	Chevron	20	35	8.36
Larsen 1	NFW	OFF	WA-404-P	Woodside	19	24	12.27
Larsen Deep 1	NFW	OFF	WA-404-P	Woodside	19	24	12.76
Laurel 1	NFW	OFF	TP/7 R3	Apache	21	12	50.70
Lightfinger 1	NFW	OFF	WA-390-P	Hess	20	11	41.59
Mentorc 1 CH1	NFW	OFF	WA-390-P	Hess	20	26	10.38
Noblige 1	NFW	OFF	WA-404-P	Woodside	19	23	54.89
Pelion 1	NFW	OFF	WA-34-L	Woodside	19	59	38.56
Rimfire 1	NFW	OFF	WA-390-P	Hess	20	3	51.72
Sappho 1	NFW	OFF	WA-392-P	Chevron	20	37	41.83
Satyr 1	NFW	OFF	WA-374-P	Chevron	20	25	21.24
Tiberius 1	NFW	OFF	WA-434-P	Woodside	20	9	13.21
Toporoa 1	NFW	OFF	WA-390-P	Hess	19	55	20.93

Longitude			Gnd Elev/ Water Depth	RT/ KB	Spud Date	TD Date	Rig Release Date
114	4	3.88	386	25	1/12/2009	5/12/2009	12/12/2009
114	2	32.99	434	25	24/09/2009	28/09/2009	3/10/2009
114	3	19.95	410	25	12/12/2009	15/12/2009	19/12/2009
114	2	49.05	415	25	20/12/2009	26/12/2009	28/12/2009
114	52	43.64	1,219	22	5/02/2010	6/03/2010	18/03/2010
115	19	41.57	171	22	29/12/2009	25/01/2010	2/02/2010
115	2	19.04	175	25	13/02/2010	21/02/2010	25/02/2010
116	41	29.58	56	38	5/05/2010	14/05/2010	19/05/2010
114	5	0.93	365	25	9/07/2009	13/07/2009	7/08/2009
114	5	0.93	365	25	17/07/2009	26/07/2009	7/08/2009
114	32	13.71	1,151	22	24/07/2009	17/09/2009	4/10/2009
114	49	8.94	877	22	18/06/2010		
115	9	45.76	134	25	31/12/2009	13/01/2010	20/01/2010
115	7	46.18	17	39	23/05/2010	5/06/2010	9/06/2010
113	35	59.41	1,064	29	28/08/2009	5/09/2009	18/10/2009
112	22	14.96	1,387	22	17/05/2010	31/05/2010	14/06/2010
114	16	23.12	1,348	32	27/03/2010		
113	55	39.32	1,121	29	20/06/2010		
114	57	21.71	104	25	27/02/2010	12/03/2010	20/03/2010
114	4	58.25	373	25	7/09/2009	12/09/2009	23/09/2009
113	41	3.00	1,314	32	30/04/2010	26/05/2010	9/06/2010
113	57	24.50	1,124	29	24/07/2009	1/08/2009	9/08/2009
115	14	55.64	180	22	24/10/2009	4/11/2009	11/11/2009
113	46	46.26	1,117	29	20/02/2010	15/04/2010	8/05/2010
113	41	36.87	1,115	29	14/11/2009	2/12/2009	1/01/2010
114	33	25.23	1,348	32	5/04/2010	19/04/2010	27/04/2010
113	43	29.42	1,114	29	13/05/2010	6/06/2010	17/06/2010
115	2	19.04	175	25	20/01/2010	7/02/2010	25/02/2010
114	36	36.44	715	22	15/02/2010	10/03/2010	23/03/2010
114	15	13.93	1,279	32	26/12/2009	1/02/2010	18/03/2010
114	14	59.41	1,243	26	19/03/2010		
115	7	22.04	22	38	12/06/2010		
113	43	50.26	1,116	29	11/08/2009	17/08/2009	26/08/2009
113	44	46.90	1,129	29	21/10/2009	29/10/2009	12/11/2009
114	19	58.65	1,312	29	5/01/2010	27/01/2010	18/02/2010
115	7	51.30	234	22	4/10/2009	15/10/2009	22/10/2009
113	35	59.41	1,064	29	12/09/2009	6/10/2009	18/10/2009
114	28	48.78	819	22	25/03/2010	5/05/2010	11/05/2010
114	20	33.87	1,073	22	5/10/2009	31/10/2009	20/11/2009
111	35	41.47	1,658	32	16/06/2010		
113	58	48.68	1,081	29	1/07/2009	10/07/2009	21/07/2009

Table 6. Petroleum Wells in Western Australia Operating 2009–10 Fiscal Year

Well Name	Class	On Off	Title	Operator	Latitude		
Carnarvon Basin cont.							
Yellowglen 1	NFW	OFF	WA-268-P R1	Chevron	19	41	37.23
Crosby 7WI	WIW	OFF	WA-12-R R1	BHPB	21	29	57.63
ENC 01 RD2	WIW	OFF	WA-28-L	Woodside	21	29	14.87
ENC 05	WIW	OFF	WA-28-L	Woodside	21	29	15.92
Ravensworth 9WI	WIW	OFF	WA-12-R R1	BHPB	21	30	9.55
Stickle 7WI	WIW	OFF	WA-12-R R1	BHPB	21	30	9.28
Perth Basin							
Kaloorup Road 2	CBM	ON	DR 10	Red Mountain Energy	33	42	13.00
Jingemina 12	DEV	ON	L 14	Origin Energy	29	20	22.91
Apium North 1	NFW	ON	L 1 R1	AWE	29	17	12.56
Gingin West 1	NFW	ON	EP 389 R1	Empire Oil	31	10	50.31
Redback 2	NFW	ON	L 11	Origin Energy	29	27	27.34
Redback South 1	NFW	ON	L 11	Origin Energy	29	27	28.05
Woodada Deep 1	NFW	ON	L 5 R1	AWE	29	50	6.20

Classification*DEV* Development Well*EXT* Extension Well*NFW* New Field Wildcat*WIW* Water Injector Well

Longitude			Gnd Elev/ Water Depth	RT/ KB	Spud Date	TD Date	Rig Release Date
113	55	4.88	1,231	22	21/11/2009	10/12/2009	21/12/2009
114	7	36.33	198	22	20/09/2009	2/10/2009	8/06/2010
113	58	30.70	550	29	8/03/2005	4/09/2009	21/09/2009
113	58	31.39	550	23	25/06/2009	21/07/2009	7/08/2009
114	5	43.14	213	22	14/04/2009	3/02/2010	8/06/2010
114	8	41.59	191	22	19/04/2009	31/05/2010	8/06/2010
115	14	40.00	20	21	16/02/2010	9/03/2010	11/03/2010
114	59	18.83	6	14	18/07/2009	30/07/2009	9/08/2009
115	3	45.44	103	110	21/06/2009	4/07/2009	8/07/2009
115	49	35.96	187	195	18/11/2009	19/12/2009	24/12/2009
115	9	41.77	65	73	23/04/2010	16/06/2010	
115	9	43.51	65	72	25/08/2009	22/09/2009	27/09/2009
115	8	35.49	41	46	31/03/2010	18/04/2010	19/04/2010

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT 2006 Exploration Permit			
Title	Registered Holders (* denotes Nominee)		
WA-1-P R7	Apache Northwest Pty Ltd Santos Limited		Bow Energy Ltd
WA-18-P R6	Bonaparte Gas & Oil Pty Limited GDF SUEZ Bonaparte Pty Ltd Santos Limited		Strike Energy Limited
WA-28-P R7	BHP Billiton Petroleum (North West Shelf) Pty Ltd BP Developments Australia Pty Ltd CNOOC NWS Private Limited Chevron Australia Pty Ltd Japan Australia LNG (MIMI) Pty Ltd Shell Development (Australia) Proprietary Limited Woodside Energy Ltd	WA-264-P R1	Tap (Shelfal) Pty Ltd Beach Petroleum Limited Kufpec Australia Pty Ltd * Santos Offshore Pty Ltd
WA-155-P R5	Apache Permits Pty Ltd BHP Billiton Petroleum (Australia) Pty Ltd INPEX Alpha Ltd	WA-268-P R1	Chevron (TAPL) Pty Ltd Chevron Australia Pty Ltd Mobil Australia Resources Company Pty Limited Shell Development (Australia) Proprietary Limited
WA-191-P R5	Kufpec Australia Pty Ltd Nippon Oil Exploration (Dampier) Pty Ltd Santos Limited Tap (Shelfal) Pty Ltd	WA-269-P R1	Japan Australia LNG (MIMI) Pty Ltd Total E&P Australia Woodside Energy Ltd
WA-192-P R5	Kufpec Australia Pty Ltd * Apache Northwest Pty Ltd	WA-271-P R2	Mitsui E&P Australia Pty Limited * Woodside Energy Ltd
WA-202-P R3	Apache Northwest Pty Ltd	WA-274-P R1	Chevron Australia (WA-274-P) Pty Ltd INPEX Browse Ltd * Coveyork Pty Limited
WA-205-P R3	Chevron (TAPL) Pty Ltd Shell Development (Australia) Proprietary Limited * Chevron Australia Pty Ltd	WA-275-P R2	BHP Billiton Petroleum (North West Shelf) Pty Ltd BP Developments Australia Pty Ltd Chevron Australia Pty Ltd Shell Development (Australia) Proprietary Limited Woodside Energy Ltd
WA-208-P R3	Apache Northwest Pty Ltd Beach Energy Limited Eni Australia Limited Mosaic Oil NL Santos Limited Santos Offshore Pty Ltd	WA-279-P R1	Eni Australia B.V.
WA-209-P R3	Santos Offshore Pty Ltd * Apache Northwest Pty Ltd	WA-281-P R1	Beach Energy Limited Chevron Australia (WA-281-P) Pty Ltd INPEX Browse Ltd * Santos Offshore Pty Ltd
WA-214-P R3	Santos (BOL) Pty Ltd * Apache Northwest Pty Ltd	WA-285-P R1	INPEX Browse Ltd Total E&P Australia
WA-246-P R2	Kufpec Australia Pty Ltd Pan Pacific Petroleum (South Aust) Pty Ltd Santos Offshore Pty Ltd Tap (Harriet) Pty Ltd * Apache Northwest Pty Ltd	WA-286-P R1	ARC (Offshore PB) Limited AWE Oil (Western Australia) Pty Ltd Cieco Energy Australia Pty Ltd Roc Oil (WA) Pty Limited
WA-253-P R2	Chevron (TAPL) Pty Ltd * Chevron Australia Pty Ltd	WA-290-P R1	Nippon Oil Exploration (Dampier) Pty Ltd Santos Offshore Pty Ltd Tap (Shelfal) Pty Ltd * OMV Australia Pty Ltd
WA-254-P R2	Apache Northwest Pty Ltd First Australian Resources Limited Pan Pacific Petroleum NL Sun Resources NL Victoria Petroleum NL	WA-302-P R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd
WA-255-P R2	Woodside Energy Ltd * BHP Billiton Petroleum (Australia) Pty Ltd	WA-313-P R1	Eni Australia B.V.
WA-261-P R2	Apache Northwest Pty Ltd	WA-314-P	ConocoPhillips (Browse Basin) Pty Ltd Karoon Gas Browse Basin Pty Ltd
		WA-315-P	ConocoPhillips (Browse Basin) Pty Ltd Karoon Gas Browse Basin Pty Ltd
		WA-320-P	Tap (Shelfal) Pty Ltd * OMV Australia Pty Ltd
		WA-323-P	Strata Resources NL * Octanex NL
		WA-329-P	United Oil & Gas Pty Ltd
		WA-330-P	Strata Resources NL * Octanex NL
		WA-332-P	Braveheart Energy Pty Ltd Braveheart Oil & Gas Pty Ltd

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

	Braveheart Petroleum Pty Ltd		Exmouth Exploration Pty Ltd
	Braveheart Resources Pty Ltd		Octanex NL
	Browse Petroleum Pty Ltd		Strata Resources NL
WA-333-P	Braveheart Energy Pty Ltd		* OMV Australia Pty Ltd
	Braveheart Oil & Gas Pty Ltd	WA-363-P	Eni Australia Limited
	Braveheart Petroleum Pty Ltd		Exmouth Exploration Pty Ltd
	Braveheart Resources Pty Ltd		Octanex NL
	Browse Petroleum Pty Ltd		Strata Resources NL
WA-334-P R1	Tap (Harriet) Pty Ltd		* OMV Australia Pty Ltd
	* Apache Northwest Pty Ltd	WA-364-P	Chevron Australia (WA-364-P) Pty Ltd
WA-335-P	BHP Billiton Petroleum (North West Shelf) Pty Ltd		Shell Development (Australia) Proprietary Limited
	Kufpec Australia Pty Ltd	WA-365-P	Chevron Australia (WA-365-P) Pty Ltd
	* Apache Northwest Pty Ltd		Shell Development (Australia) Proprietary Limited
WA-341-P	INPEX Browse Ltd	WA-366-P	Chevron Australia (WA-366-P) Pty Ltd
	Total E&P Australia		Shell Development (Australia) Proprietary Limited
WA-342-P	Coldron Pty Ltd	WA-367-P	Chevron Australia (WA-367-P) Pty Ltd
	Cornea Energy Pty Ltd		Shell Development (Australia) Proprietary Limited
	Cornea Oil & Gas Pty Ltd	WA-368-P	ARC (Offshore PB) Limited
	Cornea Petroleum Pty Ltd		Nexus Energy Australia NL
	Cornea Resources Pty Ltd	WA-369-P	Japan Australia LNG (MIMI) Pty Ltd
WA-343-P	INPEX Browse Ltd		Total E&P Australia
	Total E&P Australia		* Woodside Energy Ltd
WA-344-P	INPEX Browse Ltd	WA-370-P	Japan Australia LNG (MIMI) Pty Ltd
	Total E&P Australia		Total E&P Australia
WA-346-P R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd		* Woodside Energy Ltd
WA-347-P	Kansai Electric Power Australia Pty Ltd	WA-371-P	Shell Development (Australia) Proprietary Limited
	Tokyo Gas Pluto Pty Ltd	WA-374-P	Mobil Australia Resources Company Pty Limited
	Woodside Burrup Pty Ltd		Shell Development (Australia) Proprietary Limited
WA-348-P	Woodside Burrup Pty Ltd		* Chevron Australia (WA-374-P) Pty Ltd
WA-350-P R1	Kansai Electric Power Australia Pty Ltd	WA-375-P	Goldsborough Energy Pty Ltd
	Tokyo Gas Pluto Pty Ltd	WA-376-P	Goldsborough Energy Pty Ltd
	Woodside Burrup Pty Ltd	WA-377-P	Nexus Energy WA377P Pty Ltd
WA-351-P R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd	WA-378-P	Mitsui E&P Australia Pty Limited
	Roc Oil (WA) Pty Limited		Toyota Tsusho Gas E&P Browse Pty Ltd
	Tap (Shelfal) Pty Ltd		Woodside Energy Ltd
WA-353-P	Woodside Burrup Pty Ltd	WA-379-P	Arcadia Petroleum Limited
WA-354-P	Apache Northwest Pty Ltd		Cathay Petroleum International Limited
WA-355-P	Apache Northwest Pty Ltd	WA-380-P	Arcadia Petroleum Limited
WA-356-P	Apache Julimar Pty Ltd		Cathay Petroleum International Limited
	Kufpec Australia (Julimar) Pty Ltd	WA-381-P	Emphazise Pty Ltd
WA-357-P	INPEX Alpha Ltd		Lempika Pty Ltd
	* Apache Northwest Pty Ltd		Westralian Petroleum Pty Ltd
WA-358-P	OMV Australia Pty Ltd	WA-382-P	Emphazise Pty Ltd
WA-359-P	Cue Exploration Pty Ltd		Lempika Pty Ltd
	Exoil Limited		Westralian Petroleum Pty Ltd
WA-360-P	Cue Exploration Pty Ltd	WA-383-P	Shell Development (Australia) Proprietary Limited
	North West Shelf Exploration Pty Ltd		* Chevron Australia (WA-383-P) Pty Ltd
	Rankin Trend Pty Ltd	WA-384-P	Shell Development (Australia) Proprietary Limited
WA-361-P	Cue Exploration Pty Ltd	WA-385-P	Shell Development (Australia) Proprietary Limited
	Gascorp Australia Ltd	WA-386-P	Eni Australia Limited
	Mineralogy Pty Ltd		Exmouth Exploration Pty Ltd
	North West Shelf Exploration Pty Ltd		* OMV Australia Pty Ltd
WA-362-P	Eni Australia Limited		

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

WA-387-P	Eni Australia Limited	WA-420-P	Goldsborough Energy Pty Ltd
	Exmouth Exploration Pty Ltd	WA-421-P	Goldsborough Energy Pty Ltd
	* OMV Australia Pty Ltd	WA-422-P	National Oil Corporation Pty Ltd
WA-388-P	Bharat PetroResources Limited	WA-423-P	Diamond Resources Australia Pty Ltd
	Gujarat State Petroleum Corporation Limited		PTTEP Australia Offshore Pty Ltd
	Hindustan Petroleum Corporation Ltd		* Murphy Australia Oil Pty Ltd
	Oilex Limited	WA-424-P	Nexus Energy VICP56 Pty Ltd
	Sasol Petroleum Australia Ltd	WA-425-P	SK Energy Co., Ltd
	Videocon Industries Ltd		* Hunt Oil Australia Permit 425 Holding Company Pty Ltd
WA-389-P	Cue Exploration Pty Ltd	WA-426-P	Apache Northwest Pty Ltd
WA-390-P	Hess Exploration Australia Pty Limited	WA-427-P	Apache Northwest Pty Ltd
WA-391-P	OMV Australia Pty Ltd		Kufpec Australia Pty Ltd
WA-392-P	Chevron Australia (WA-392-P) Pty Ltd	WA-428-P	Mitsui E&P Australia Pty Limited
	Mobil Australia Resources Company Pty Limited		Woodside Energy Ltd
	Shell Development (Australia) Proprietary Limited	WA-429-P	Mitsui E&P Australia Pty Limited
WA-394-P	Shell Development (Australia) Proprietary Limited		Woodside Energy Ltd
WA-396-P	Mitsui E&P Australia Pty Limited	WA-430-P	Mitsui E&P Australia Pty Limited
	Toyota Tsusho Gas E&P Browse Pty Ltd		Woodside Energy Ltd
	Woodside Energy Ltd	WA-431-P	SK Energy Co., Ltd
WA-397-P	Mitsui E&P Australia Pty Limited		* Hunt Oil Australia Permit 431 Holding Company Pty Ltd
	Toyota Tsusho Gas E&P Browse Pty Ltd	WA-432-P	Mitsui E&P Australia Pty Limited
	Woodside Energy Ltd		Woodside Energy Ltd
WA-398-P	ConocoPhillips (Browse Basin) Pty Ltd	WA-433-P	Mitsui E&P Australia Pty Limited
	Karoon Gas Browse Basin Pty Ltd		Woodside Energy Ltd
WA-399-P	Carnarvon Petroleum Limited	WA-434-P	Woodside Energy Ltd
	Rialto Energy Limited	WA-435-P	Carnarvon Petroleum Limited
WA-400-P	Apache Northwest Pty Ltd		Finder Exploration Pty Ltd
WA-401-P	Hess Australia (Exmouth) Pty Ltd	WA-436-P	Carnarvon Petroleum Limited
	Woodside Energy Ltd		Finder Exploration Pty Ltd
WA-402-P	Total E&P Australia	WA-437-P	Carnarvon Petroleum Limited
WA-403-P	Total E&P Australia		Finder Exploration Pty Ltd
WA-404-P	Hess Exploration (Carnarvon) Pty Limited	WA-438-P	Carnarvon Petroleum Limited
	* Woodside Energy Ltd		Finder Exploration Pty Ltd
WA-405-P	Reliance Exploration & Production DMCC	WA-439-P	Chevron Australia (WA-439-P) Pty Ltd
WA-406-P	CNOOC Australia E&P Pty Ltd		Shell Development (Australia) Proprietary Limited
WA-407-P	Goldsborough Energy Pty Ltd	WA-440-P	Goldsborough Energy Pty Ltd
WA-408-P	Total E&P Australia	WA-441-P	Goldsborough Energy Pty Ltd
WA-409-P	Cue Exploration Pty Ltd	WA-442-P	Ansbachall Pty Limited
	Rankin Trend Pty Ltd		DVM International Limited
WA-410-P	Chevron Australia (WA-410-P) Pty Ltd	WA-443-P	Carnarvon Petroleum Limited
	INPEX Browse Ltd	WA-444-P	Chevron Copernicus Pty Ltd
	Santos Offshore Pty Ltd		Mobil Australia Resources Company Pty Limited
WA-411-P	Beach Energy Limited		Shell Development (Australia) Proprietary Limited
	INPEX Browse Ltd	WA-445-P	Finder No 2 Pty Limited
	Santos Offshore Pty Ltd	WA-446-P	Finder No 1 Pty Limited
WA-412-P	Japan Energy E&P Australia Pty Ltd	WA-447-P	Mitsui E&P Australia Pty Limited
WA-413-P	Hunt Oil Australia Permit 413 Holding Company Pty Ltd		Woodside Energy Ltd
WA-414-P	Hunt Oil Australia Permit 414 Holding Company Pty Ltd	WA-448-P	Japan Australia LNG (MIMI) Pty Ltd
WA-415-P	Woodside Energy Ltd		Woodside Energy Ltd
WA-416-P	Woodside Energy Ltd	WA-449-P	Mitsui E&P Australia Pty Limited
WA-417-P	Woodside Energy Ltd		Woodside Energy Ltd
WA-418-P	Finder Exploration Pty Ltd	WA-450-P	Finder No 4 Pty Limited
WA-419-P	Emerald Gas Pty Ltd		

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT 2006 Infrastructure Licence			
Title	Registered Holders (* denotes Nominee)		
WA-1-IL	Kansai Electric Power Australia Pty Ltd		Shell Development (Australia) Proprietary Limited
	Tokyo Gas Pluto Pty Ltd		* Woodside Energy Ltd
	Woodside Burrup Pty Ltd	WA-11-PL	Apache Northwest Pty Ltd
			Santos (BOL) Pty Ltd
		WA-12-PL	ARC (Offshore PB) Limited
			AWE Oil (Western Australia) Pty Ltd
			Cieco Energy Australia Pty Ltd
			Roc Oil (WA) Pty Limited
		WA-13-PL	BHP Billiton Petroleum (North West Shelf) Pty Ltd
			BP Developments Australia Pty Ltd
			Chevron Australia Pty Ltd
			Japan Australia LNG (MIMI) Pty Ltd
			Shell Development (Australia) Proprietary Limited
			Woodside Energy Ltd
		WA-14-PL	BHP Billiton Petroleum (North West Shelf) Pty Ltd
			BP Developments Australia Pty Ltd
			Chevron Australia Holdings Pty Ltd
			Japan Australia LNG (MIMI) Pty Ltd
			Shell Development (Australia) Proprietary Limited
			Woodside Energy Ltd
		WA-15-PL	Eni Australia B.V.
		WA-16-PL	Kansai Electric Power Australia Pty Ltd
			Tokyo Gas Pluto Pty Ltd
			Woodside Burrup Pty Ltd
		WA-17-PL	Kansai Electric Power Australia Pty Ltd
			Tokyo Gas Pluto Pty Ltd
			Woodside Burrup Pty Ltd
		WA-18-PL	Apache Northwest Pty Ltd
			Santos Offshore Pty Ltd
OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT 2006 Pipeline Licence		OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT 2006 Production Licence	
Title	Registered Holders (* denotes Nominee)	Title	Registered Holders (* denotes Nominee)
WA-1-PL	BHP Billiton Petroleum (North West Shelf) Pty Ltd	WA-1-L R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	BP Developments Australia Pty Ltd		BP Developments Australia Pty Ltd
	Chevron Australia Pty Ltd		CNOOC NWS Private Limited
	Japan Australia LNG (MIMI) Pty Ltd		Chevron Australia Pty Ltd
	Shell Development (Australia) Proprietary Limited		Japan Australia LNG (MIMI) Pty Ltd
	* Woodside Energy Ltd		Shell Development (Australia) Proprietary Limited
WA-2-PL	BHP Billiton Petroleum (North West Shelf) Pty Ltd		Woodside Energy Ltd
	BP Developments Australia Pty Ltd	WA-2-L R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	Chevron Australia Pty Ltd		BP Developments Australia Pty Ltd
	Japan Australia LNG (MIMI) Pty Ltd		CNOOC NWS Private Limited
	Shell Development (Australia) Proprietary Limited		Chevron Australia Pty Ltd
	* Woodside Energy Ltd		Japan Australia LNG (MIMI) Pty Ltd
WA-3-PL	INPEX Alpha Ltd		Shell Development (Australia) Proprietary Limited
	Mobil Exploration & Producing Australia Pty Ltd		Woodside Energy Ltd
	* BHP Billiton Petroleum (Australia) Pty Ltd	WA-3-L R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd
WA-4-PL	BHP Billiton Petroleum (North West Shelf) Pty Ltd		BP Developments Australia Pty Ltd
	BP Developments Australia Pty Ltd		CNOOC NWS Private Limited
	Chevron Australia Pty Ltd		Chevron Australia Pty Ltd
	Japan Australia LNG (MIMI) Pty Ltd		Japan Australia LNG (MIMI) Pty Ltd
	Shell Development (Australia) Proprietary Limited		Shell Development (Australia) Proprietary Limited
	* Woodside Energy Ltd		Woodside Energy Ltd
WA-5-PL	Apache East Spar Pty Limited		
	Apache Kersail Pty Limited		
	Santos (BOL) Pty Ltd		
	* Apache Oil Australia Pty Ltd		
WA-6-PL	Apache Northwest Pty Ltd		
	Santos (GLOBE) Pty Ltd		
	Santos Offshore Pty Ltd		
WA-7-PL	Apache Northwest Pty Ltd		
	Santos Limited		
WA-8-PL	ConocoPhillips Pipeline Australia Pty Ltd		
	Eni Gas & Power LNG Australia B.V.		
	INPEX DLNGL Pty Ltd		
	Santos Timor Sea Pipeline Pty Ltd		
	TEPCO Darwin LNG Pty Ltd		
	Tokyo Gas Darwin LNG Pty Ltd		
WA-9-PL	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		
	Chevron Australia Pty Ltd		
	Japan Australia LNG (MIMI) Pty Ltd		
	Shell Development (Australia) Proprietary Limited		
	* Woodside Energy Ltd		
WA-10-PL	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		
	Chevron Australia Pty Ltd		
	Japan Australia LNG (MIMI) Pty Ltd		

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

	BP Developments Australia Pty Ltd		Woodside Energy Ltd
	CNOOC NWS Private Limited	WA-17-L	ConocoPhillips Australia Gas Holdings Pty Ltd
	Chevron Australia Pty Ltd		* Mobil Australia Resources Company Pty Limited
	Japan Australia LNG (MIMI) Pty Ltd	WA-18-L	Talisman Oil & Gas (Australia) Pty Ltd
	Shell Development (Australia) Proprietary Limited	WA-20-L	Apache Northwest Pty Ltd
	Woodside Energy Ltd		Santos Limited
WA-5-L R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd	WA-22-L	Mobil Australia Resources Company Pty Limited
	BP Developments Australia Pty Ltd		Tap West Pty Ltd
	CNOOC NWS Private Limited		* Eni Australia Limited
	Chevron Australia Pty Ltd	WA-23-L	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	Japan Australia LNG (MIMI) Pty Ltd		BP Developments Australia Pty Ltd
	Shell Development (Australia) Proprietary Limited		CNOOC NWS Private Limited
	Woodside Energy Ltd		Chevron Australia Pty Ltd
WA-6-L R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd		Japan Australia LNG (MIMI) Pty Ltd
	BP Developments Australia Pty Ltd		Shell Development (Australia) Proprietary Limited
	CNOOC NWS Private Limited		Woodside Energy Ltd
	Chevron Australia Pty Ltd	WA-24-L	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	Japan Australia LNG (MIMI) Pty Ltd		BP Developments Australia Pty Ltd
	Shell Development (Australia) Proprietary Limited		CNOOC NWS Private Limited
	Woodside Energy Ltd		Chevron Australia Pty Ltd
WA-8-L	Kufpec Australia Pty Ltd		Japan Australia LNG (MIMI) Pty Ltd
	Tap (Shelfal) Pty Ltd		Shell Development (Australia) Proprietary Limited
	* Santos Limited		Woodside Energy Ltd
WA-9-L	BHP Billiton Petroleum (North West Shelf) Pty Ltd	WA-25-L	Mobil Australia Resources Company Pty Limited
	BP Developments Australia Pty Ltd		Tap West Pty Ltd
	CNOOC NWS Private Limited		* Eni Australia Limited
	Chevron Australia Pty Ltd	WA-26-L	Kufpec Australia Pty Ltd
	Japan Australia LNG (MIMI) Pty Ltd		Nippon Oil Exploration (Dampier) Pty Ltd
	Shell Development (Australia) Proprietary Limited		Woodside Energy Ltd
	Woodside Energy Ltd		* Santos Limited
WA-10-L	INPEX Alpha Ltd	WA-27-L	Kufpec Australia Pty Ltd
	Mobil Exploration & Producing Australia Pty Ltd		Nippon Oil Exploration (Dampier) Pty Ltd
	* BHP Billiton Petroleum (Australia) Pty Ltd		Woodside Energy Ltd
WA-11-L	BHP Billiton Petroleum (North West Shelf) Pty Ltd		* Santos Limited
	BP Developments Australia Pty Ltd	WA-28-L	Mitsui E&P Australia Pty Limited
	CNOOC NWS Private Limited		* Woodside Energy Ltd
	Chevron Australia Pty Ltd	WA-29-L	Apache Northwest Pty Ltd
	Japan Australia LNG (MIMI) Pty Ltd		Santos (BOL) Pty Ltd
	Shell Development (Australia) Proprietary Limited	WA-30-L	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	Woodside Energy Ltd		BP Developments Australia Pty Ltd
WA-12-L	Mobil Australia Resources Company Pty Limited		CNOOC NWS Private Limited
	* BHP Billiton Petroleum (Australia) Pty Ltd		Chevron Australia Pty Ltd
WA-13-L	Apache East Spar Pty Limited		Japan Australia LNG (MIMI) Pty Ltd
	Apache Kersail Pty Limited		Shell Development (Australia) Proprietary Limited
	Santos (BOL) Pty Ltd		Woodside Energy Ltd
	* Apache Oil Australia Pty Ltd	WA-31-L	ARC (Offshore PB) Limited
WA-14-L	Vermilion Oil & Gas Australia Pty Ltd		AWE Oil (Western Australia) Pty Ltd
WA-15-L	Santos Offshore Pty Ltd		Cieco Energy Australia Pty Ltd
	* Apache Northwest Pty Ltd		Roc Oil (WA) Pty Limited
WA-16-L	BHP Billiton Petroleum (North West Shelf) Pty Ltd	WA-32-L	BHP Billiton Petroleum (Australia) Pty Ltd
	BP Developments Australia Pty Ltd		Woodside Energy Ltd
	CNOOC NWS Private Limited	WA-33-L	Eni Australia B.V.
	Chevron Australia Pty Ltd	WA-34-L	Kansai Electric Power Australia Pty Ltd
	Japan Australia LNG (MIMI) Pty Ltd		Tokyo Gas Pluto Pty Ltd
	Shell Development (Australia) Proprietary Limited		Woodside Burrup Pty Ltd

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

WA-35-L	Apache Permits Pty Ltd		Chubu Electric Power Gorgon Pty Ltd
	INPEX Alpha Ltd		Mobil Australia Resources Company Pty Limited
WA-36-L	Chevron (TAPL) Pty Ltd		Osaka Gas Gorgon Pty Ltd
	Chevron Australia Pty Ltd		Shell Development (Australia) Proprietary Limited
	Chubu Electric Power Gorgon Pty Ltd		Tokyo Gas Gorgon Pty Ltd
	Mobil Australia Resources Company Pty Limited	WA-6-R R2	Bonaparte Gas & Oil Pty Limited
	Osaka Gas Gorgon Pty Ltd		GDF SUEZ Bonaparte Pty Ltd
	Shell Development (Australia) Proprietary Limited		Origin Energy Bonaparte Pty Limited
	Tokyo Gas Gorgon Pty Ltd		Santos Limited
WA-37-L	Chevron (TAPL) Pty Ltd	WA-7-R R2	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	Chevron Australia Pty Ltd		BP Developments Australia Pty Ltd
	Chubu Electric Power Gorgon Pty Ltd		CNOOC NWS Private Limited
	Mobil Australia Resources Company Pty Limited		Chevron Australia Pty Ltd
	Osaka Gas Gorgon Pty Ltd		Japan Australia LNG (MIMI) Pty Ltd
	Shell Development (Australia) Proprietary Limited		Shell Development (Australia) Proprietary Limited
	Tokyo Gas Gorgon Pty Ltd		* Woodside Energy Ltd
WA-38-L	Chevron (TAPL) Pty Ltd	WA-9-R R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	Chevron Australia Pty Ltd		BP Developments Australia Pty Ltd
	Chubu Electric Power Gorgon Pty Ltd		CNOOC NWS Private Limited
	Mobil Australia Resources Company Pty Limited		Chevron Australia Pty Ltd
	Osaka Gas Gorgon Pty Ltd		Japan Australia LNG (MIMI) Pty Ltd
	Shell Development (Australia) Proprietary Limited		Shell Development (Australia) Proprietary Limited
	Tokyo Gas Gorgon Pty Ltd		Woodside Energy Ltd
WA-39-L	BP Exploration (Alpha) Ltd	WA-10-R R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	Chevron (TAPL) Pty Ltd		BP Developments Australia Pty Ltd
	Chevron Australia Pty Ltd		CNOOC NWS Private Limited
	Chubu Electric Power Gorgon Pty Ltd		Chevron Australia Pty Ltd
	Mobil Australia Resources Company Pty Limited		Japan Australia LNG (MIMI) Pty Ltd
	Osaka Gas Gorgon Pty Ltd		Shell Development (Australia) Proprietary Limited
	Shell Development (Australia) Proprietary Limited		Woodside Energy Ltd
	Tokyo Gas Gorgon Pty Ltd	WA-14-R R1	Chevron (TAPL) Pty Ltd
WA-40-L	BP Exploration (Alpha) Ltd		Chevron Australia Pty Ltd
	Chevron (TAPL) Pty Ltd		Chubu Electric Power Gorgon Pty Ltd
	Chevron Australia Pty Ltd		Mobil Australia Resources Company Pty Limited
	Chubu Electric Power Gorgon Pty Ltd		Osaka Gas Gorgon Pty Ltd
	Mobil Australia Resources Company Pty Limited		Shell Development (Australia) Proprietary Limited
	Osaka Gas Gorgon Pty Ltd		Tokyo Gas Gorgon Pty Ltd
	Shell Development (Australia) Proprietary Limited	WA-15-R R1	Chevron (TAPL) Pty Ltd
	Tokyo Gas Gorgon Pty Ltd		Chevron Australia Pty Ltd
WA-41-L	Apache Northwest Pty Ltd		Chubu Electric Power Gorgon Pty Ltd
	Santos Offshore Pty Ltd		Mobil Australia Resources Company Pty Limited
WA-42-L	Apache PVG Pty Ltd		Osaka Gas Gorgon Pty Ltd
	BHP Billiton Petroleum (Australia) Pty Ltd		Shell Development (Australia) Proprietary Limited
WA-43-L	Apache Permits Pty Ltd		Tokyo Gas Gorgon Pty Ltd
	BHP Billiton Petroleum (Australia) Pty Ltd	WA-16-R R1	Chevron (TAPL) Pty Ltd
	INPEX Alpha Ltd		Chevron Australia Pty Ltd
			Shell Development (Australia) Proprietary Limited
		WA-17-R R1	Chevron (TAPL) Pty Ltd
			* Chevron Australia Pty Ltd
		WA-19-R R1	Chevron (TAPL) Pty Ltd
			Chevron Australia Pty Ltd
			Chubu Electric Power Gorgon Pty Ltd
			Mobil Australia Resources Company Pty Limited
			Osaka Gas Gorgon Pty Ltd
			Shell Development (Australia) Proprietary Limited

OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT 2006
Retention Lease

Title	Registered Holders (* denotes Nominee)
WA-1-R R4	BHP Billiton Petroleum (North West Shelf) Pty Ltd * Esso Australia Resources Pty Ltd
WA-4-R R2	Santos Offshore Pty Ltd
WA-5-R R3	Chevron (TAPL) Pty Ltd Chevron Australia Pty Ltd

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

	Tokyo Gas Gorgon Pty Ltd		Chevron Australia Pty Ltd
WA-20-R R1	Chevron (TAPL) Pty Ltd		Shell Development (Australia) Proprietary Limited
	Chevron Australia Pty Ltd		* Woodside Energy Ltd
	Chubu Electric Power Gorgon Pty Ltd	WA-33-R R1	Apache Oil Australia Pty Ltd
	Mobil Australia Resources Company Pty Limited		Pan Pacific Petroleum (South Aust) Pty Ltd
	Osaka Gas Gorgon Pty Ltd		Santos (BOL) Pty Ltd
	Shell Development (Australia) Proprietary Limited		Tap (Shelfal) Pty Ltd
	Tokyo Gas Gorgon Pty Ltd		WM Petroleum Limited
WA-21-R R1	Chevron (TAPL) Pty Ltd	WA-34-R	Encana International (Australia) Pty Ltd
	Chevron Australia Pty Ltd		Eni Australia B.V.
	Chubu Electric Power Gorgon Pty Ltd		SK Energy Co., Ltd
	Mobil Australia Resources Company Pty Limited		Tap (Shelfal) Pty Ltd
	Osaka Gas Gorgon Pty Ltd	WA-35-R	Japan Australia LNG (MIMI) Pty Ltd
	Shell Development (Australia) Proprietary Limited		Woodside Energy Ltd
	Tokyo Gas Gorgon Pty Ltd	WA-36-R	Mitsui E&P Australia Pty Limited
WA-22-R R1	BP Exploration (Alpha) Ltd		* Woodside Energy Ltd
	Chevron (TAPL) Pty Ltd	WA-37-R	INPEX Browse Ltd
	Mobil Australia Resources Company Pty Limited		Total E&P Australia
	Shell Development (Australia) Proprietary Limited	WA-38-R	Apache Northwest Pty Ltd
	* Chevron Australia Pty Ltd		Santos Offshore Pty Ltd
WA-23-R R1	BP Exploration (Alpha) Ltd		
	Chevron (TAPL) Pty Ltd		
	Mobil Australia Resources Company Pty Limited		
	Shell Development (Australia) Proprietary Limited		
	* Chevron Australia Pty Ltd		
WA-24-R R1	BP Exploration (Alpha) Ltd		
	Chevron (TAPL) Pty Ltd		
	Mobil Australia Resources Company Pty Limited		
	Shell Development (Australia) Proprietary Limited		
	* Chevron Australia Pty Ltd		
WA-27-R R1	Bonaparte Gas & Oil Pty Limited		
	GDF SUEZ Bonaparte Pty Ltd		
	Santos Limited		
WA-28-R R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		
	Chevron Australia Pty Ltd		
	Shell Development (Australia) Proprietary Limited		
	* Woodside Energy Ltd		
WA-29-R R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		
	Chevron Australia Pty Ltd		
	Shell Development (Australia) Proprietary Limited		
	* Woodside Energy Ltd		
WA-30-R R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		
	Chevron Australia Pty Ltd		
	Shell Development (Australia) Proprietary Limited		
	* Woodside Energy Ltd		
WA-31-R R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		
	Chevron Australia Pty Ltd		
	Shell Development (Australia) Proprietary Limited		
	* Woodside Energy Ltd		
WA-32-R R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		

PETROLEUM (SUBMERGED LANDS) ACT 1982 Exploration Permit	
Title	Registered Holders (* denotes Nominee)
TP/7 R3	Apache Oil Australia Pty Ltd
	Pan Pacific Petroleum (South Aust) Pty Ltd
	Santos (BOL) Pty Ltd
	Tap (Shelfal) Pty Ltd
TP/8 R3	Apache Northwest Pty Ltd
	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
TP/9 R3	* Apache Northwest Pty Ltd
TP/15 R1	Westranch Holdings Pty Ltd
TP/23	Apache Northwest Pty Ltd
TP/24	Emerald Gas Pty Ltd

PETROLEUM (SUBMERGED LANDS) ACT 1982 Pipeline Licence	
Title	Registered Holders (* denotes Nominee)
TPL/1	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
TPL/2	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
TPL/3	Apache Oil Australia Pty Ltd
	Pan Pacific Petroleum (South Aust) Pty Ltd
	Santos (BOL) Pty Ltd
	Tap (Shelfal) Pty Ltd
TPL/4	Apache Oil Australia Pty Ltd
	Pan Pacific Petroleum (South Aust) Pty Ltd
	Santos (BOL) Pty Ltd
	Tap (Shelfal) Pty Ltd
TPL/5	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

TPL/6	Chevron (TAPL) Pty Ltd		Tokyo Gas Pluto Pty Ltd
	Mobil Australia Resources Company Pty Limited		Woodside Burrup Pty Ltd
	Santos Offshore Pty Ltd	TPL/20	Apache Northwest Pty Ltd
	* Chevron Australia Pty Ltd		Santos Offshore Pty Ltd
TPL/7 R1	Apache Oil Australia Pty Ltd	TPL/21	Chevron (TAPL) Pty Ltd
	Pan Pacific Petroleum (South Aust) Pty Ltd		Mobil Australia Resources Company Pty Limited
	Santos (BOL) Pty Ltd		Shell Development (Australia) Proprietary Limited
	Tap (Shelfal) Pty Ltd	TPL/22	Chevron (TAPL) Pty Ltd
TPL/8	Kufpec Australia Pty Ltd		Mobil Australia Resources Company Pty Limited
	Tap (Harriet) Pty Ltd		Shell Development (Australia) Proprietary Limited
	* Apache Northwest Pty Ltd		
TPL/9 R1	Chevron (TAPL) Pty Ltd		
	Mobil Australia Resources Company Pty Limited		
	Santos Offshore Pty Ltd		
	* Chevron Australia Pty Ltd		
TPL/10	INPEX Alpha Ltd		
	Mobil Exploration & Producing Australia Pty Ltd		
	* BHP Billiton Petroleum (Australia) Pty Ltd		
TPL/11	Chevron (TAPL) Pty Ltd		
	Mobil Australia Resources Company Pty Limited		
	Santos Offshore Pty Ltd		
	* Chevron Australia Pty Ltd		
TPL/12	Apache East Spar Pty Limited		
	Apache Kersail Pty Limited		
	Santos (BOL) Pty Ltd		
	* Apache Oil Australia Pty Ltd		
TPL/13	Apache East Spar Pty Limited		
	Apache Kersail Pty Limited		
	Apache Northwest Pty Ltd		
	Apache Oil Australia Pty Ltd		
	Kufpec Australia Pty Ltd		
	Santos (BOL) Pty Ltd		
	Tap (Harriet) Pty Ltd		
TPL/14	Kufpec Australia Pty Ltd		
	Tap (Harriet) Pty Ltd		
	* Apache Northwest Pty Ltd		
TPL/15	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		
	Chevron Australia Pty Ltd		
	Japan Australia LNG (MIMI) Pty Ltd		
	Shell Development (Australia) Proprietary Limited		
	* Woodside Energy Ltd		
TPL/16	BHP Billiton Petroleum (North West Shelf) Pty Ltd		
	BP Developments Australia Pty Ltd		
	Chevron Australia Pty Ltd		
	Japan Australia LNG (MIMI) Pty Ltd		
	Shell Development (Australia) Proprietary Limited		
	* Woodside Energy Ltd		
TPL/17	Apache Northwest Pty Ltd		
	Santos (BOL) Pty Ltd		
TPL/18	ARC (Offshore PB) Limited		
	AWE Oil (Western Australia) Pty Ltd		
	Cieco Energy Australia Pty Ltd		
	Roc Oil (WA) Pty Limited		
TPL/19	Kansai Electric Power Australia Pty Ltd		

PETROLEUM (SUBMERGED LANDS) ACT 1982	
Production Licence	
Title	Registered Holders (* denotes Nominee)
TL/1 R1	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
TL/2 R1	Apache Oil Australia Pty Ltd
	Pan Pacific Petroleum (South Aust) Pty Ltd
	Santos (BOL) Pty Ltd
	Tap (Shelfal) Pty Ltd
TL/3 R1	Chevron (TAPL) Pty Ltd
	Mobil Australia Resources Company Pty Limited
	Santos Offshore Pty Ltd
	* Chevron Australia Pty Ltd
TL/4	Chevron (TAPL) Pty Ltd
	Mobil Australia Resources Company Pty Limited
	Santos Offshore Pty Ltd
	* Chevron Australia Pty Ltd
TL/5	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
TL/6	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
TL/7	Chevron (TAPL) Pty Ltd
	Mobil Australia Resources Company Pty Limited
	Santos Offshore Pty Ltd
	* Chevron Australia Pty Ltd
TL/8	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
TL/9	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd

PETROLEUM (SUBMERGED LANDS) ACT 1982	
Retention Lease	
Title	Registered Holders (* denotes Nominee)
TR/1 R1	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
TR/2 R1	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
TR/3 R1	Apache Northwest Pty Ltd

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

TR/4 R1	Chevron (TAPL) Pty Ltd	EP 110 R4	Pancontinental Oil & Gas NL
	Mobil Australia Resources Company Pty Limited		Strike Energy Limited
	Santos Offshore Pty Ltd	EP 129 R5	Buru Energy Limited
	* Chevron Australia Pty Ltd	EP 307 R4	Kufpec Australia Pty Ltd
TR/5 R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd		Tap (Harriet) Pty Ltd
	BP Developments Australia Pty Ltd		* Apache Northwest Pty Ltd
	Chevron Australia Pty Ltd	EP 320 R3	ARC (Beharra Springs) Pty Ltd
	Shell Development (Australia) Proprietary Limited		* Origin Energy Developments Pty Limited
	* Woodside Energy Ltd	EP 321 R3	Latent Petroleum Pty Ltd
TR/6	Chevron (TAPL) Pty Ltd	EP 325 R3	Advent Energy Ltd
	Chevron Australia Pty Ltd		Bow Energy Ltd
	Mobil Australia Resources Company Pty Limited		Rough Range Oil Pty Ltd
	Santos Offshore Pty Ltd		Strike Energy Limited
PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967			
Access Authority to Deviated Well			
Title	Registered Holders (* denotes Nominee)		
ADW 8/90-1	Chevron (TAPL) Pty Ltd	EP 357 R3	Chevron (TAPL) Pty Ltd
ADW 10/92-3	Kufpec Australia Pty Ltd		Mobil Australia Resources Company Pty Limited
ADW 12/91-2	Kufpec Australia Pty Ltd		Santos Offshore Pty Ltd
ADW 8/90-1	Mobil Australia Resources Company Pty Limited		* Chevron Australia Pty Ltd
	Santos Offshore Pty Ltd	EP 358 R2	Apache Northwest Pty Ltd
ADW 10/92-3	Tap (Harriet) Pty Ltd		Kufpec Australia Pty Ltd
ADW 12/91-2	Tap (Harriet) Pty Ltd		Tap (Harriet) Pty Ltd
ADW 10/92-3	* Apache Northwest Pty Ltd	EP 359 R2	Lansvale Oil & Gas Pty Ltd
ADW 12/91-2	* Apache Northwest Pty Ltd		Pace Petroleum Pty Ltd
ADW 8/90-1	* Chevron Australia Pty Ltd		* Rough Range Oil Pty Ltd
PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967			
Drilling Reservation			
Title	Registered Holders (* denotes Nominee)	EP 363 R3	Kufpec Australia Pty Ltd
DR 9	Backreef Oil Limited		Tap (Harriet) Pty Ltd
DR 10	Red Mountain Energy Pty Ltd		* Apache Northwest Pty Ltd
DR 11	Westralian Gas and Power Limited	EP 368 R3	Westranch Holdings Pty Ltd
DR 12	Flamestar Corporation Pty Ltd	EP 371 R1	Buru Energy Limited
	Red Mountain Energy Pty Ltd	EP 381 R2	Whicher Range Energy Pty Ltd
DR 13	Flamestar Corporation Pty Ltd	EP 386 R2	Advent Energy Ltd
	Red Mountain Energy Pty Ltd	EP 389 R1	ERM Gas Pty Ltd
PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967			
Exploration Permit			
Title	Registered Holders (* denotes Nominee)		Empire Oil Company (WA) Limited
EP 61 R6	Chevron (TAPL) Pty Ltd		Wharf Resources PLC
	Mobil Australia Resources Company Pty Limited	EP 390 R2	Buru Energy Limited
	Santos Offshore Pty Ltd	EP 391 R2	Buru Energy Limited
	* Chevron Australia Pty Ltd	EP 406	Euro Pacific Energy Pty Ltd
EP 62 R7	Chevron (TAPL) Pty Ltd		* Victoria Diamond Exploration Pty Ltd
	Mobil Australia Resources Company Pty Limited	EP 407 R1	Latent Petroleum Pty Ltd
	Santos Offshore Pty Ltd	EP 408 R1	Whicher Range Energy Pty Ltd
	* Chevron Australia Pty Ltd	EP 412 R1	Bounty Oil & Gas NL
EP 104 R5	Arc Energy Limited		* Rough Range Oil Pty Ltd
	First Australian Resources Limited	EP 413 R2	Arc Energy Limited
	Gulliver Productions Pty Ltd		Geary, John Kevin
	Indigo Oil Pty Ltd		Norwest Energy NL
	Pancontinental Oil & Gas NL		Victoria Petroleum Offshore Pty Ltd
	Phoenix Resources PLC	EP 416 R1	Allied Oil & Gas Plc
			ERM Gas Pty Ltd
			Empire Oil Company (WA) Limited
		EP 417	Buru Energy Limited
			New Standard Onshore Pty Ltd
		EP 419	Exoma Energy Limited
		EP 424	Pancontinental Oil & Gas NL
			Strike Energy Limited
		EP 426	Allied Oil & Gas Plc
			ERM Gas Pty Ltd

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

	Empire Oil Company (WA) Limited	EP 458	Rey Resources Ltd
EP 427	Valadon Pty Ltd	EP 460	Falcore Pty Ltd
	* Grange Court Pty Ltd		Indigo Oil Pty Ltd
EP 428	Buru Energy Limited		Jurassica Oil & Gas Plc
EP 429	Kingsway Oil Limited		Longreach Oil Limited
EP 430	Empire Oil Company (WA) Limited		Rough Range Oil Pty Ltd
EP 431	Buru Energy Limited		Vigilant Oil Pty Ltd
EP 432	Allied Oil & Gas Plc	EP 461	Falcore Pty Ltd
	ERM Gas Pty Ltd		Indigo Oil Pty Ltd
	Empire Oil Company (WA) Limited		Jurassica Oil & Gas Plc
EP 433	Lansvale Oil & Gas Pty Ltd		Longreach Oil Limited
	Pace Petroleum Pty Ltd		Rough Range Oil Pty Ltd
EP 434	Pace Petroleum Pty Ltd		Vigilant Oil Pty Ltd
	Rough Range Oil Pty Ltd	EP 463	Emerald Gas Pty Ltd
	* Lansvale Oil & Gas Pty Ltd	EP 464	Exceed Energy (Australia) Pty Ltd
EP 435	Australian Oil Company No 3 Pty Limited	EP 465	Global International (Australia) Pty Ltd
	Bounty Oil & Gas NL	EP 466	Rough Range Oil Pty Ltd
	Rough Range Oil Pty Ltd	EP 467	ERM Gas Pty Ltd
EP 436	Buru Energy Limited	EP 468	Frontier Oil & Gas Pty Ltd
EP 437	CalEnergy Resources (Australia) Limited	EP 469	Warrego Energy Limited
EP 438	Gulliver Productions Pty Ltd	EP 470	Energetica Resources Pty Ltd
	Indigo Oil Pty Ltd		
	* Buru Energy Limited		
EP 439	Falcore Pty Ltd		
	Indigo Oil Pty Ltd		
	Jurassica Oil & Gas Plc		
	Longreach Oil Limited		
	Rough Range Oil Pty Ltd		
	Vigilant Oil Pty Ltd		
EP 440	Empire Oil Company (WA) Limited		
EP 441	Apache Northwest Pty Ltd		
EP 442	New Standard Exploration Pty Limited		
	* Buru Energy Limited		
EP 443	New Standard Exploration Pty Limited		
	* Buru Energy Limited		
EP 444	Rough Range Oil Pty Ltd		
EP 445	Red Mountain Energy Pty Ltd		
EP 447	GCC Methane Pty Ltd		
EP 448	Buru Energy Limited		
	Gulliver Productions Pty Ltd		
	Indigo Oil Pty Ltd		
	United Orogen Limited		
EP 449	Kingsway Oil Limited		
EP 450	New Standard Exploration Pty Limited		
	* Buru Energy Limited		
EP 451	New Standard Exploration Pty Limited		
	* Buru Energy Limited		
EP 453	Budside Pty Limited		
	Pobelo Pty Ltd		
EP 454	Empire Oil Company (WA) Limited		
EP 455	Westralian Gas and Power Limited		
	* Arc Energy Limited		
EP 456	New Standard Exploration Pty Limited		
	* Buru Energy Limited		
EP 457	Rey Resources Ltd		

PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967
Geothermal Exploration Permit

Title	Registered Holders (* denotes Nominee)
GEP 1	Green Rock Energy Limited
	The University of Western Australia
GEP 2	Green Rock Energy Limited
GEP 3	Green Rock Energy Limited
GEP 4	Green Rock Energy Limited
GEP 5	Granite Power Limited
GEP 6	Granite Power Limited
GEP 7	Geothermal Power Pty Ltd
GEP 8	Geothermal Power Pty Ltd
GEP 9	Geothermal Power Pty Ltd
GEP 10	BHP Billiton Worsley Alumina Pty Ltd
	Green Rock Energy Limited
GEP 11	BHP Billiton Worsley Alumina Pty Ltd
	Green Rock Energy Limited
GEP 12	BHP Billiton Worsley Alumina Pty Ltd
	Green Rock Energy Limited
GEP 13	New World Energy Limited
GEP 14	New World Energy Limited
GEP 15	New World Energy Limited
GEP 16	New World Energy Limited
GEP 17	New World Energy Limited
GEP 18	New World Energy Limited
GEP 19	New World Energy Limited
GEP 20	New World Energy Limited
GEP 21	New World Energy Limited
GEP 22	AAA Energy Pty Ltd
GEP 23	Green Rock Energy Limited
GEP 24	Green Rock Energy Limited
GEP 25	Green Rock Energy Limited
GEP 26	Green Rock Energy Limited

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

GEP 27	Green Rock Energy Limited
GEP 28	Green Rock Energy Limited
GEP 29	Geothermal Energy Pty Ltd
GEP 30	New World Energy Limited
GEP 31	New World Energy Limited
GEP 32	New World Energy Limited
GEP 33	New World Energy Limited
GEP 34	New World Energy Limited
GEP 35	New World Energy Limited
GEP 36	New World Energy Limited
GEP 37	Greenpower Energy Limited
GEP 38	Greenpower Energy Limited
GEP 39	Green Rock Energy Limited
GEP 40	Green Rock Energy Limited
GEP 41	Green Rock Energy Limited

PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967 Production Licence	
Title	Registered Holders (* denotes Nominee)
L 1 R1	APT Parmelia Pty Ltd
	Arc Energy Limited
	Origin Energy Developments Pty Limited
L 2 R1	Origin Energy Developments Pty Limited
	* Arc Energy Limited
L 4 R1	Arc Energy Limited
L 5 R1	Arc Energy Limited
L 6 R1	Buru Energy Limited
L 7 R1	Arc Energy Limited
L 8 R1	Buru Energy Limited
L 9 R1	BHP Billiton Petroleum (Australia) Pty Ltd
L 10 R1	Chevron (TAPL) Pty Ltd
	Mobil Australia Resources Company Pty Limited
	Santos Offshore Pty Ltd
	* Chevron Australia Pty Ltd
L 11	ARC (Beharra Springs) Pty Ltd
	* Origin Energy Developments Pty Limited
L 12	Chevron (TAPL) Pty Ltd
	Mobil Australia Resources Company Pty Limited
	Santos Offshore Pty Ltd
	* Chevron Australia Pty Ltd
L 13	Chevron (TAPL) Pty Ltd
	Mobil Australia Resources Company Pty Limited
	Santos Offshore Pty Ltd
	* Chevron Australia Pty Ltd
L 14	Arc Energy Limited
	Geary, John Kevin
	Norwest Energy NL
	Origin Energy Developments Pty Limited
	Roc Oil (WA) Pty Limited
	Victoria Petroleum Offshore Pty Ltd
L 15	Buru Energy Limited
	First Australian Resources Limited
	Gulliver Productions Pty Ltd
	Indigo Oil Pty Ltd
	Pancontinental Oil & Gas NL

L 1H R2	Chevron (TAPL) Pty Ltd
	Mobil Australia Resources Company Pty Limited
	Santos Offshore Pty Ltd
	* Chevron Australia Pty Ltd

PETROLEUM AND GEOTHERMAL ENERGY RESOURCES ACT 1967 Retention Lease	
Title	Registered Holders (* denotes Nominee)
R 1	Arc Energy Limited
	First Australian Resources Limited
	Gulliver Productions Pty Ltd
	Indigo Oil Pty Ltd
	Pancontinental Oil & Gas NL
	Phoenix Resources PLC
R 2 R1	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	BP Developments Australia Pty Ltd
	Chevron Australia Pty Ltd
	Shell Development (Australia) Proprietary Limited
	* Woodside Energy Ltd
R 3	Oil Basins Ltd
	Tap (Shelfal) Pty Ltd
R 5	Apache Oil Australia Pty Ltd
	OMV Australia Pty Ltd

PETROLEUM PIPELINES ACT 1969 Pipeline Licence	
Title	Registered Holders (* denotes Nominee)
PL 1 R1	APT Parmelia Pty Ltd
PL 2 R1	APT Parmelia Pty Ltd
PL 3 R1	APT Parmelia Pty Ltd
PL 5 R1	APT Parmelia Pty Ltd
PL 6 R3	Arc Energy Limited
PL 7 R1	Buru Energy Limited
PL 8 R1	Mitsui Iron Ore Development Pty Ltd
	Nippon Steel Australia Pty Limited
	North Mining Limited
	Sumitomo Metal Australia Pty Ltd
	* Robe River Mining Co Pty Ltd
PL 12	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
PL 14	Apache Oil Australia Pty Ltd
	Pan Pacific Petroleum (South Aust) Pty Ltd
	Santos (BOL) Pty Ltd
	Tap (Shelfal) Pty Ltd
PL 15	Chevron (TAPL) Pty Ltd
	Mobil Australia Resources Company Pty Limited
	Santos Offshore Pty Ltd
	* Chevron Australia Pty Ltd
PL 16	BHP Petroleum (Ashmore Operations) Pty Ltd
PL 17	Kufpec Australia Pty Ltd
	Tap (Harriet) Pty Ltd
	* Apache Northwest Pty Ltd
PL 18	ARC (Beharra Springs) Pty Ltd

Table 7. Western Australia List of Petroleum Titles and Holders as at 1 July 2010

	* Origin Energy Developments Pty Limited	PL 54	Western Power Corporation
PL 19	BHP Petroleum (Ashmore Operations) Pty Ltd		* APT Pipelines (WA) Pty Limited
PL 20	INPEX Alpha Ltd	PL 55	Talisman Wodgina Pty Ltd
	Mobil Exploration & Producing Australia Pty Ltd	PL 56	Epic Energy (WA) One Pty Ltd
	* BHP Billiton Petroleum (Australia) Pty Ltd	PL 57	Australian Gold Reagents Pty Ltd
PL 21	Chevron (TAPL) Pty Ltd	PL 58	BHP Billiton Petroleum (North West Shelf) Pty Ltd
	Mobil Australia Resources Company Pty Limited		BP Developments Australia Pty Ltd
	Santos Offshore Pty Ltd		Chevron Australia Pty Ltd
	* Chevron Australia Pty Ltd		Japan Australia LNG (MIMI) Pty Ltd
PL 22	Epic Energy (Pilbara Pipeline) Pty Ltd		Shell Development (Australia) Proprietary Limited
PL 23	APT Parmelia Pty Ltd		* Woodside Energy Ltd
PL 24	Alinta DEWAP Pty Ltd	PL 59	Esperance Pipeline Co. Pty Limited
	Southern Cross Pipelines (NPL) Australia Pty Ltd	PL 60	Gas Transmission Services WA (Operations) Pty Ltd
	* Southern Cross Pipelines Australia Pty Limited	PL 61	APT Parmelia Pty Ltd
PL 25	Southern Cross Pipelines Australia Pty Limited	PL 62	Kufpec Australia Pty Ltd
PL 26	Southern Cross Pipelines Australia Pty Limited		Tap (Harriet) Pty Ltd
PL 27	Southern Cross Pipelines Australia Pty Limited		* Apache Northwest Pty Ltd
PL 28	Southern Cross Pipelines (NPL) Australia Pty Ltd	PL 63	Gas Transmission Services WA (Operations) Pty Ltd
PL 29	Apache East Spar Pty Limited	PL 64	Arc Energy Limited
	Apache Kersail Pty Limited		Origin Energy Developments Pty Limited
	Santos (BOL) Pty Ltd	PL 65	Dalrymple Resources NL
	* Apache Oil Australia Pty Ltd		LionOre Australia (Wildara) NL
PL 30	Apache East Spar Pty Limited	PL 67	Hamersley Iron Pty Ltd
	Apache Kersail Pty Limited	PL 68	Gas Transmission Services WA (Operations) Pty Ltd
	Santos (BOL) Pty Ltd	PL 69	DBNGP (WA) Nominees Pty Limited
	* Apache Oil Australia Pty Ltd	PL 70	ARC (Offshore PB) Limited
PL 31	Epic Energy (Pilbara Pipeline) Pty Ltd		AWE Oil (Western Australia) Pty Ltd
PL 32	APT Pipelines (WA) Pty Limited		Cieco Energy Australia Pty Ltd
PL 33	APT Pipelines (WA) Pty Limited		Roc Oil (WA) Pty Limited
PL 34	Newmont Yandal Operations Pty Ltd	PL 72	EDL NGD (WA) PTY LTD
PL 35	Plutonic Operations Limited	PL 73	Redback Pipelines Pty Ltd
PL 36	Australian Pipeline Limited	PL 74	EDL LNG (WA) PTY LTD
PL 37	Norilsk Nickel Cawse Pty Ltd	PL 75	EIT Neerabup Power Pty Ltd
PL 38	Epic Energy (Pilbara Pipeline) Pty Ltd		ERM Neerabup Pty Ltd
PL 39	Origin Energy Pipelines Pty Limited	PL 76	APA Group
PL 40	DBNGP (WA) Nominees Pty Limited	PL 77	Sino Iron Pty Ltd
PL 41	DBNGP (WA) Transmission Pty Limited	PL 78	Hamersley Iron Pty Ltd
PL 42	Apache East Spar Pty Limited	PL 80	Latent Petroleum Pty Ltd
	Apache Kersail Pty Limited	PL 81	Apache Northwest Pty Ltd
	Apache Northwest Pty Ltd	PL 82	Epic Energy (Pilbara Pipeline) Pty Ltd
	Apache Oil Australia Pty Ltd	PL 83	WA Gas Networks Pty Ltd
	Kufpec Australia Pty Ltd	PL 84	Chevron (TAPL) Pty Ltd
	Santos (BOL) Pty Ltd		Mobil Australia Resources Company Pty Limited
	Tap (Harriet) Pty Ltd		Shell Development (Australia) Proprietary Limited
PL 43	Western Power Corporation	PL 85	Chevron (TAPL) Pty Ltd
	* APT Pipelines (WA) Pty Limited		Mobil Australia Resources Company Pty Limited
PL 44	APT Parmelia Pty Ltd		Shell Development (Australia) Proprietary Limited
PL 45	APT Parmelia Pty Ltd		
PL 46	APT Parmelia Pty Ltd		
PL 47	DBNGP (WA) Transmission Pty Limited		
PL 48	Energy Generation Pty Ltd		
PL 52	APT Parmelia Pty Ltd		
PL 53	APT Parmelia Pty Ltd		

Please consult DMP's online Petroleum and Geothermal Register for the most current information on Titles and Holdings.

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