

THE GOLDEN TOUCH

Tropicana gold mine officially open

PROSPECT





With Western Australia's annual iron ore sales forecast to rise to 777 million tonnes by 2017–18, the need for an additional export capacity to ship the commodity out of the State is clearer than ever.

Therefore, it was with great pleasure that I, on behalf of the Western Australian Government, signed a native title agreement with the Ngarluma people of the Pilbara over land intended for the Anketell Port project (story page 3). Located 30km east of Karratha, the proposed multi-user deep water port and strategic industrial area will complement Port Hedland and Dampier ports, and have capacity to export 350 million tonnes per annum.

Under such agreements it is important that the interests of Indigenous groups are protected, and I'm pleased that the opportunities provided by the Anketell project will extend to the Ngarluma people.

During April, I travelled to China to meet senior representatives from Chinese businesses with interests in Western Australia and was encouraged by the productive discussions we had (story page 9).

Mines and Petroleum Minister Bill Marmion was similarly busy, embarking on trips to China and Japan (stories pages 2 and 6), where he spent five days travelling with Department of Mines and Petroleum Director General Richard Sellers, flying the flag for Western Australia.

The confirmation in March that a long-term finance deal – the biggest in world mining history – had been finalised for the Roy Hill project (story page 13) is a credit to everyone involved. This announcement, together with the opening of the Tropicana gold mine around the same time (story page 4), points to a resources sector that still has much to offer.

Colin Barnett
PREMIER OF WESTERN AUSTRALIA & MINISTER FOR STATE DEVELOPMENT

Bill Marmion
MINISTER FOR MINES AND PETROLEUM

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Cover photo: The Tropicana processing plant. © Philip Gostelow

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The Western Australian delegation meets with representatives from China's Ministry of Land Resources (MLR). L-R MLR Foreign Affairs Officer Fei Yue, MLR Central Geological Exploration Fund Management Center Division Director Lei Yan, Department of Mines and Petroleum (DMP) Mineral Promotion Senior Manager Gaomai Trench, MLR Director General Jiang Jianjun, WA Mines and Petroleum Minister Bill Marmion, DMP Director General Richard Sellers, Minister Marmion's Chief of Staff Colin Edwardes and WA Trade Office Regional Director Nathan Backhouse.

FLYING THE FLAG IN CHINA

The China leg of the recent north-east Asia tour by Mines and Petroleum Minister Bill Marmion and Department of Mines and Petroleum (DMP) Director General Richard Sellers was spent flying the Western Australian flag in Hong Kong.

Their first stop was a visit to the DMP booth at Mines and Money Hong Kong 2014, the Asia-Pacific region's premier networking event for mining investment and capital raising.

The market for liquefied natural gas (LNG) was one of the key topics when the team attended an official function at the Australian Embassy in Beijing, the day after arriving in mainland China's capital.

"Clearly the growth in China, while not exponential, is very steep," Mr Sellers said.

"As they address air pollution, they will have to cut back on coal or make their coal power stations cleaner.

"They are building their nuclear energy capability. However, the main focus to reduce greenhouse gas emissions is to expand the use of LNG, which is good."

The following day, the massive magnetite development at Cape Preston near Karratha was the main topic of

conversation during the team's visit to CITIC Pacific Mining.

The Sino Iron project is the largest magnetite mining and processing operation in Australia and promises to deliver significant economic benefits to Western Australia.

The team received a warm welcome at a meeting later that afternoon with the Ministry of Land and Resources.

"We always get a very good hearing at the Ministry," Mr Sellers said.

"We have a long relationship with its Director General and officers. Our Geological Survey of Western Australia (GSWA) team meets with them regularly and we have built a strong working relationship over a number of years."

The Director General said that DMP's good relationship with the Ministry involved a great deal of close cooperation.

"An excellent example is our geoscience cooperation project with the China Geological Survey (CGS)," Mr Sellers said.

GSWA is now in the third year of a four-year project with CGS involving cooperative research based on geological surveys in the Archean Yalgoo-Singleton greenstone belt in the Mid West region of

Western Australia, and the Niujuanzi region in China's Gansu Province.

The project's aim is to develop field mapping and laboratory-based geoscience skills, and map production techniques.

"We see this relationship as incredibly important and the visit by the Minister can only strengthen it," Mr Sellers said.

The Karara project was at the forefront of talks with Ansteel, one of China's biggest steel makers and iron ore miners.

Karara is the first major magnetite operation in the Mid West and is a joint venture between Ansteel and Gindalbie Metals.

The final stop on the tour was a meeting with the China National Offshore Oil Corporation (CNOOC), the third-largest national oil company in China.

"They have been active in Western Australia for 40-plus years," the Director General said.

"It was a really positive meeting where they were quite bullish about further discoveries in oil and gas."

Mr Sellers said the CNOOC meeting ended a highly successful mission on an appropriately optimistic note.



Photo: Ngarluma Aboriginal Corporation

HISTORIC LAND USE AGREEMENT FOR ANKETELL

Premier Colin Barnett, senior elder Violet Samson, Chair of the NAC Board Warren Walker, NAC CEO Paul Stenson, and senior elder Pansy Hicks.

The Western Australian Government has signed a native title agreement with the Ngarluma people of the Pilbara, over land intended for the Anketell Port project.

The Indigenous Land Use Agreement for the site was signed by the Premier Colin Barnett at a ceremony at Cleaverville, 30km east of Karratha, in April, with Traditional Owners in attendance.

“I congratulate the Ngarluma people for the commitment they have demonstrated throughout the negotiation process,” Mr Barnett said.

“This agreement offers an opportunity for the Ngarluma people to continue their journey towards a sustainable and independent future.

“The agreement also provides further certainty to a potential port builder and future users, and is imperative in ensuring that this site can be developed as quickly as required.”

The agreement provides secure tenure over 4,300 hectares of coastal land, where the State Government is planning a multi-user deep water port with an ultimate capacity of at least 350 million tonnes per annum (Mtpa), along with an associated industrial area.

The Premier said that, once fully operational, Anketell’s capacity of at least 350Mtpa will be more than 20 per cent higher than total shipments out of Port Hedland in 2012–13.

“It will be a massive boost to the State and particularly to the Karratha-Roebourne area.”

“During this decade, the iron ore industry is reaching its maturity. I suspect that Anketell Port will be the last major new port built in the Pilbara.”

From the ceremony site, attendees could overlook the land intended for the port precinct and also Dixon Island, which was removed from port plans due to its significance to the Ngarluma people.

Ngarluma Aboriginal Corporation (NAC) chairman Warren Walker thanked the State Government for amending the port plans to preserve culturally significant areas.

“It’s good that we’ve worked with the State to protect this land and look after it. We’ve minimised the footprint [of the port] so anyone can get the use of the country.”

An Aboriginal heritage survey is currently underway, the findings of which will help inform and shape the final plans for the port and industrial area.

NAC chief executive Paul Stenson said the agreement was a milestone for the Ngarluma people and the development of the State.

Under the terms of the agreement, future port builders and users will be required to work with NAC to maximise employment, training and contracting opportunities for Ngarluma people.

Master plan for Anketell Port revealed

The Western Australian Government has released the Anketell Port Master Plan, unveiling details for a major, multi-user and multi-commodity deep water port in the Pilbara.

“Development of Anketell Port will help to unlock the potential of the West Pilbara by aiding further development of the State’s natural resources,” Mr Barnett said.

“This Master Plan is a clear guide for proponents who are seeking additional routes to bring ore to market.”

The Master Plan includes provisions for a substantial infrastructure corridor and more than 800 hectares of industrial land to support port activities and future mining operations.

The Master Plan has been jointly developed by the Department of State Development and the Dampier Port Authority, who will continue to work collaboratively as the project progresses.

To view the Master Plan, go to www.dsd.wa.gov.au/8381.aspx

MINES MINISTER ATTENDS TROPICANA OFFICIAL OPENING



AngloGold Ashanti Chairman Sipho Pityana, AGA Independent Non-Executive Director Rod Ruston, Independence Group Non-Executive Chairman Peter Bilbe and Minister Bill Marmion with the plaque commemorating the official opening of Tropicana on March 6, 2014.

Mines and Petroleum Minister Bill Marmion recently attended the official opening of the remote AngloGold Ashanti and Independence Group Tropicana gold mine, 330km east-northeast of Kalgoorlie-Boulder.

After its discovery in 2005, it took eight years before Tropicana poured its first gold last September.

The A\$845 million project employs 450 fly-in, fly-out workers and should produce 500,000oz this year, ranking among the top five producing mines in Australia.

Minister Bill Marmion hailed the Tropicana mine as Australia's most significant gold discovery in a decade during the official opening.

"I am hoping the fall in the Australian dollar and gold price picking up mean

that 2014 will be a good year for the mining industry," he said.

AngloGold holds a 70 per cent stake in the project, alongside Independence which had pegged the ground when it listed on the Australian Securities Exchange in 2002.

The project has been a successful recipient of the State Government's Exploration Incentive Scheme (EIS) Co-funded Drilling Program.

"The program provides incentives to drill in underexplored areas to ensure the continued economic prosperity of the State's resources industry, particularly in the current financial environment," Mr Marmion said.

Under the Co-funded Drilling Program refunds of up to 50 per cent of direct

drilling costs are offered to explorers who have been successful in the competitive application process.

The State Government's commitment to explorers under the EIS is expected to reach approximately A\$130 million by 2016-17.

Co-funding is capped at A\$150,000 for general multi-hole applications, A\$200,000 for a single deep hole application and A\$30,000 for a prospector application.

Established five years ago, the competitive program offers two rounds of co-funding a year and, besides success at East Tropicana, has already assisted various discoveries, including the Oxley potash, Nova nickel, and Handpump gold deposits.



Rio Tinto chief executive Sam Walsh, Prime Minister Tony Abbott, Japanese Prime Minister Shinzo Abe, Premier Colin Barnett, and Rio Tinto Iron Ore chief executive Andrew Harding at the West Angelas mine.

JAPANESE PRIME MINISTER VISITS THE PILBARA

Western Australian Premier Colin Barnett welcomed Japanese Prime Minister Shinzo Abe and his wife, Mrs Akie Abe, to Western Australia for the first time in July, celebrating Japan's long-standing economic ties with the State.

Mr Abe, Australian Prime Minister Tony Abbott and Mr Barnett visited the West Angelas iron ore mine in the Pilbara, a site of significant Japanese investment in Western Australia, owned by the Robe River joint venture of Rio Tinto and two major Japanese companies.

"Japanese investment played a vital role in helping to establish Western Australia's resources industry both through its early support of the iron industry and as a foundation customer of the North West Shelf liquid natural gas project," Mr Barnett said.

"Japan remains a very active long term investor in Western Australia, with the Robe

River joint venture currently working to expand the capacity of West Angelas from 29 million to 35 million tonnes per year."

The West Angelas expansion represents an investment of \$640 million (\$US599 million) and will create around 290 construction jobs and 200 new operational jobs. The West Angelas mine is located approximately halfway between Newman and Tom Price. The Robe River joint venture is comprised of Rio Tinto, Mitsui & Co, and Nippon Steel & Sumitomo Metal Corporation.

Japan is Western Australia's second largest export market, with exports totalling \$22.8 billion in 2013; or 48.5 per cent of Australia's total exports to Japan.

Three quarters of the State's LNG by volume went to Japan in 2013, while iron ore exports rose four per cent to 78 million tonnes. This year marks the 25th anniversary of the first LNG shipment to Japan from the North West Shelf.

Japan Australia LNG (MIMI) holds a one sixth share in the North West Shelf project. MIMI is a joint venture between Mitsubishi Corporation and Mitsui & Co.

The relationship between Western Australia and Japan has been underpinned by a longstanding Sister State relationship with Hyogo Prefecture, established in 1981. The Western Australian Government also operates two trade and investment offices in Japan, one in Tokyo and one in Kobe, the capital city of Hyogo Prefecture.

"I also expect that the Japan Australia Economic Partnership Agreement between Australia and Japan will create new and exciting opportunities for WA, not only in minerals and energy, but especially in agriculture and I enjoyed discussing those sorts of opportunities with Mr Abe during his time in WA," Mr Barnett said.

MINISTERIAL TOUR REINFORCES TRADING RELATIONSHIPS IN NORTH ASIA



Left: Mr Shigehisa, Chairman of JGC Corporation, engages in discussion with Minister Marmion over lunch at the Ambassador's residence. Right: Director General Sellers and Minister Marmion at the Mitsui & Co. Headquarters.

Mines and Petroleum Minister Bill Marmion and Department of Mines and Petroleum (DMP) Director General Richard Sellers were doing a lot more than being good neighbours on their recent official visit to Japan and China – they were taking care of business.

Over five hectic days last month they talked to top-level industry and government representatives during 17 separate official occasions.

“It’s hard to overstate the importance of the Minister making this trip early in his tenure,” Mr Sellers said.

“Japan and China, along with Korea, are Western Australia’s major trading partners and the aim of visits such as this one is not only to build on already well established relationships, but encourage further investment.

“We knocked on a lot of industry and government doors doing just that.”

Mr Sellers said that DMP officers travelled to the three nations regularly.

DMP’s annual target in China is the China Mining Conference, a Chinese Government sponsored event held in Tianjin in late October or early November.

“A department officer visits at least another one or two times a year for

other events to generate investment opportunities,” Mr Sellers said.

“Sometimes in association with the mining conference, either before or after, we’ve gone to another province or a series of provinces to hold investment seminars.

“Our focus is on relaying information about investment opportunities across the spectrum of Western Australia’s mineral and energy resources. We also outline regulations, policies and how they can get further information – particularly regarding exploration.”

DMP officers travel to Japan about once a year, usually to run seminars in conjunction with other Australian states, and to Korea either annually or every second year.

The itinerary for this year’s Ministerial trip included meetings with senior Chinese and Japanese officials across commerce, industry and government.

Mr Sellers said he was greatly encouraged by the upbeat and optimistic views expressed by Japanese corporations such as Mitsubishi (Japan’s largest), Sojitz and Marubeni, and China’s national oil and gas company, China National Offshore Oil Corporation.

“Sojitz is a great investor in Western Australia and their overall mood was optimism,” he said.

“They continue to look for further investment opportunities and are obviously happy with the relationship.”

Mr Sellers said Mitsubishi was enthusiastic about its joint venture in the Canning Basin with Buru Energy and was very pleased by early exploration success.

“Marubeni was clearly optimistic about Western Australia,” Mr Sellers said of the corporation that picked up about 15 per cent of the financing of the Roy Hill project.

“Roy Hill is incredibly important to Western Australia’s iron ore industry,” he said. “It’s a project worth approximately A\$10 billion, plus financing costs, and that level of investment is great news for the WA economy.

“Marubeni have put a lot of money into Western Australia and they’re very keen on other investment opportunities here.

“Obviously we also promoted onshore gas and uranium, and we talked about the different steel making additives we produce here such as vanadium, nickel, magnesium and manganese.

“It was a very positive meeting and one of the highlights of the trip.”

Optimism was also high at the Ministerial team’s next stop, the Japan Bank for

International Cooperation (JBIC), a policy-based financial institution that conducts lending, investment and guarantee operations.

“They did a lot of behind-the-scenes investment work on Roy Hill,” Mr Sellers said.

The Director General said that JBIC was one of a number of Japanese Government and corporate institutions that pointed out the need for a direct flight to Tokyo.

“Many people told us that it would be so much easier to do business when you can fly direct to Tokyo and not have to go through Hong Kong or Singapore,” Mr Sellers said.

Much of the discussion with JBIC was around energy issues that have arisen because of the Fukushima disaster.

“The expansion of coal as an option to meet future energy demands has its own set of complexities and issues,” he said.

“And that’s where the opportunities arise for uranium and shale gas from Western Australia.

“The pragmatic view is that Japan is likely to keep some of its nuclear capacity. However, gas is going to be a big part of their energy mix well into the future.”

Talks with the Japan Oil, Gas and Metals National Corporation (JOGMEC) were also fruitful and addressed the focus on Australia’s eastern seaboard.

“If JOGMEC is not looking as much in Western Australia as we would like, that has a flow-on effect,” Mr Sellers said.

“It means the trading houses are less likely to be looking for commodities we can provide.”

Mr Sellers said that DMP was working on strategies to get JOGMEC more involved in Western Australia.

One such strategy was to recommend opening a JOGMEC office in Perth.

“Perth is an important global hub for the resources industry. If they had an office in Perth I have no doubt such a presence would be mutually beneficial for Western Australia and for JOGMEC,” Mr Sellers said.

The Director General said JOGMEC should not be underestimated and neither should the role played by the Ministry of Economy, Trade and Industry (METI).

“METI sets resources and industry portfolio policy and JOGMEC uses that policy to look for opportunities,” Mr Sellers said.

“METI has the equivalent of our Geological Survey, plus policy makers, and it works with business people.

“The major resource companies in Japan don’t invest in greenfields projects or new developments without some oversight or input from these two organisations, so whenever we go to Japan we make sure we visit them.”

Mr Sellers said that an official lunch with representatives of Japan’s steel mills confirmed that they viewed Western Australia as having a competitive advantage.

“That could end up being good news for stalled projects in Western Australia requiring investment capital,” Mr Sellers said.

IGU PREDICTS AUSTRALIA TO BE MAJOR GLOBAL GAS SUPPLIER

Australia is poised for a rapid rise up the ladder as one of the great gas supply nations of the 21st century, according to the International Gas Union (IGU) – one of the world’s most influential energy organisations.

“The success of Australian explorers, producers and marketers of natural gas has placed the country in a prime supply position for the future,” IGU President Mr Jérôme Ferrier recently said.

“Also, the IGU and Australia will focus on the need to improve the general understanding of the benefits of natural gas because it will remain part of the long-term world energy mix.”

French-based Mr Ferrier, also Senior Vice President of Total, was speaking at the first Australian Executive Committee meeting in the 83-year history of the 125-member IGU.

Established in 1931, IGU is the most effective and independent non-profit organisation serving as the worldwide spokesperson for the gas industry.

Mr Ferrier said the IGU had in recent years witnessed the growing importance of Australia for the global gas market, with the country’s emerging potential as a global LNG exporter high among those achievements.

“Natural gas can help to address the challenge of reducing carbon emissions,” he said.

“Sustainable energy has to be accessible for all, while also ensuring that it is provided in an efficient manner and does not cause adverse environmental and socio-economic impacts.

“Gas has a pivotal role to play in this context.”

Mr Ferrier singled out the Asia-Pacific region as the engine of growth in the world’s total energy demand.

“About a third of the total increase in world gas consumption is coming from the Asia-Pacific region, and China, Japan, South Korea and India are the main consumers,” he said.

“China and India have important environmental targets to meet and natural gas is going to be the substitute for oil and coal in this regard.

“Increased natural gas consumption will also assist the energy security of the region as it embraces a greater reliance on gas while its constituents grapple with the issue of more or less nuclear power as a base load energy source.”

He said the IGU believed that natural gas imports into the Asia Pacific, mainly in the form of LNG and pipeline, will continue to rise to meet this increasing gas dependency.

“About two thirds of the world’s total LNG imports already go into the Asia-Pacific region and as that volume is maintained, Australia can expect to emerge as a key supplier,” he said.

Australia will host the world’s largest LNG event, the LNG 18 Conference and Exhibition, in Perth in April 2016.



Photo: Department of Agriculture and Food

WA Agriculture and Food Minister Ken Baston, Department of Agriculture and Food Director General Rob Delane, and Consul General of the People's Republic of China Dr Huang Qingguo.

AGRICULTURAL OPPORTUNITIES IN THE SPOTLIGHT

The inaugural Western Australia – China Agribusiness Cooperation Conference was held in early April and provided an important forum for key stakeholders from China and Western Australia to network, gain knowledge and identify key trade and investment opportunities in the agricultural sector.

With strong links already formed through mineral resources trade, Western Australia and China have turned their attention to the agricultural industry. Supported by WA's proven reputation as a producer of high-quality, safe food, there are numerous avenues for agricultural investment that are still to be explored. The conference proved the perfect setting to investigate these opportunities.

More than 300 delegates attended the event, including some 160 representing various business interests in China who were supported by provincial governments. The areas of focus included beef, sheep, wine, dairy, grains and fodder, horticulture, premium food and fisheries.

The conference was hosted by the Department of Agriculture and Food and supported by the InvestWest Agribusiness Alliance, the Chamber of Commerce and Industry, the Australia-China Business Council, the Department of State

Development, the Department of Regional Development and the Consulate General of the People's Republic of China in Perth.

Coinciding with the conference was the signing of Memoranda of Understanding (MOU) by Western Australian exporters and Chinese company representatives. The agreement was an integral step towards trial shipments of live cattle from the State to China.

Under the MOU, both parties have agreed to work towards clarifying Australian and Chinese animal health welfare protocols, paving the way for the export of slaughter-ready cattle from Western Australia. Agriculture and Food Minister Ken Baston was on hand to witness the signing of the MOU at the conference, and spoke with optimism about the prospects of agricultural exports.

"WA has a long and proud history of producing premium-quality, safe agricultural products and exporting them around the world," Mr Baston said.

"Our ability to grow more food than required by our domestic market has led to producers looking to develop new markets overseas. In recent times, China has been our number one export destination for agriculture and food products, and in

2012–13 WA agrifood exports to China and Hong Kong were worth more than A\$1 billion. We look forward to increasing that value."

The foundations for the MOU were laid in October 2013 when Premier and State Development Minister Colin Barnett witnessed the signing of a cooperative agreement with Western Australia's Sister State Zhejiang Province.

As well as beef and live cattle trade, another industry that looks set for significant growth is dairy. On the back of higher levels of income and the growing acceptance of dairy as a staple in the Chinese diet, there are major opportunities for Western Australian producers to tap into a surging market.

Located in the rich pastures of the south-west of the State, WA's dairy industry is an efficient producer of quality fresh milk and extended shelf life milk, and enjoys high consumer confidence worldwide. As with all facets of Western Australia's agriculture and food production, this deserved reputation stems largely from the fact that the industry is free from many of the pests and diseases that are found elsewhere in the world.

As part of the conference, delegates were invited to attend site visits to key regional areas, including the South West and Wheatbelt.

KEY DEVELOPMENTS AT AUSTRALIA WEEK IN CHINA

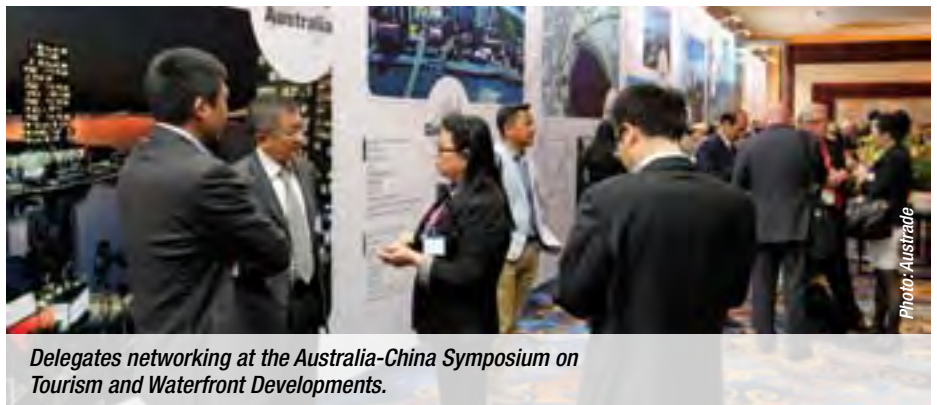
Premier and State Development Minister Colin Barnett met a number of senior business and government figures during a visit to China in April, which coincided with the inaugural Australia Week in China.

The Premier took part in a series of high-level meetings before joining Prime Minister Tony Abbott's delegation in Shanghai. Federal Trade Minister Andrew Robb, fellow State Premiers and Chief Ministers and Australian business leaders were also part of the group.

One of the biggest promotions of Australia ever held in China, Australia Week promoted opportunities for trade, investment, tourism and education partnerships. The event attracted more than 700 representatives from 564 organisations.

Mr Barnett met senior representatives from Chinese businesses with significant interests in Western Australia on the sidelines of Australia Week, including Mr Wu Puingai, Chairman and President of the Zhongfu Group. The Shanghai-based company's subsidiary, Kimberley Agricultural Investment, is working to develop irrigated land for sugar cultivation as part of the Ord East Kimberley Development.

The Premier also had constructive discussions with CITIC Group Chairman Mr Chang Zhenming about CITIC's existing investments in Australia as well as the



Delegates networking at the Australia-China Symposium on Tourism and Waterfront Developments.

Oakajee project, an integrated port, rail and industrial estate to support the development of the resources sector in the region.

"I was heartened to learn of CITIC Group's interest in taking a lead role in coordinating the Oakajee project at China's end, and I'm optimistic that we may see some progress in the medium-term," Mr Barnett said.

Another focus of Australia Week was the opportunities for Western Australia to build on the trade and business ties that already exist with China by looking outside the mining industry.

"The rise of China's middle class and the resulting shift towards Western dietary patterns presents significant opportunities for Western Australian agricultural producers," the Premier said.

The Western Australian Government has been working with its Sister State, Zhejiang, to develop a live cattle trade with China. A trial shipment of 1000 head of cattle is expected to be sent to Zhejiang province.

"Work on a trial shipment has been developed quickly over the past six months and an agreement around a trial shipment was signed in Perth last month," he said. "We look forward to working with the Chinese Federal Government, through Zhejiang, on the necessary approvals.

"There is still a bit of work to do but Zhejiang is confident of receiving Beijing's approval for a trial."

The two governments are negotiating strict export and vaccination protocols and it is expected that extra abattoirs will be built in Zhejiang to accommodate the rise in numbers.

Latest news
from WA's
international
offices

Western Australia's Trade Office in Indonesia has moved. It is now located at:
Suite 48.12-14
Level 48, Wisma 46 Jalan Jenderal
Sudirman Sudirman Kavling 1
JAKARTA Pusat 10220 Indonesia

The new office at the iconic Wisma 46 building offers a more convenient location for business connections in Jakarta, including the finance and banking sectors. Western Australia's Regional Director in Indonesia, Kellie-Jane Pritchard, heads the team, which works closely with Western Australia's representatives in agriculture and tourism.

Q&A WITH NATHAN BACKHOUSE – REGIONAL DIRECTOR, CHINA



Can you describe your role?

My role is similar to other regional directors with one added difference, which is that China is WA's largest trading partner. In terms of key responsibilities, the way that we break up this role is first of all ministerial visits, and over the last five months we've effectively had one visit per month. The second area would be strategic projects, and one example of this would be what this office has done, together with the Department of Agriculture and Food, driving the live cattle strategy. The third area is, in essence, relationship management. What that means is helping clients who want to invest in large scale projects in WA and ensuring they carry out their due diligence and work with the right partners to give their project the best chance of success.

What do you think are the key opportunities for WA businesses in the regions in which you operate?

Opportunities for businesses obviously come in established sectors such as iron ore, cement, coal for energy generation, and LNG. They are and will continue to be, I think, the key prospects in China. What has been added as China has developed and grown wealthier is a need

for what I call 'soft commodities', which encompasses things like agriculture, beef, dairy, sheep, and grains. There are some other areas coming to the fore which are more related to entrepreneurship, which include infrastructure; technology in a whole range of areas, such as computer technology, mining software, and services technologies; and tourism and education.

And similarly, what are businesses in your region seeking from WA?

The key area is still resources, particularly for government and state-owned enterprises, but that's changing. When I first came here two years ago we were handling ten mining or mining-related projects to one agriculture project, but now, that ratio has basically reversed. Companies such as Kimberley Agricultural Investment, which aren't state-owned enterprises, have seen new opportunities in agriculture. Areas such as beef processing, live cattle, even processed wheat and noodles, were barely talked about two years ago but now represent some of the key interests for Chinese investment. The need to source clean, green products from Western Australia and Australia is at the forefront of Chinese investors' minds.

What are some of the most common enquiries you receive about WA?

Of greater importance than the enquiries we receive, I think, are the messages we send about WA. I think part of the battle is really educating people and promoting and marketing Western Australia as a multi-tiered market which is more than just a mining location. Of course there are large mining projects, but we also have a massive Wheatbelt in the interior and a clean Mediterranean climate in the south that offer a lot of different opportunities.

How important was an event like Australia Week in China for assisting Australian businesses become familiar with conditions in the country?

I think that Australia Week in China was a huge success because for the first time it really had a 'team Australia' approach to the Chinese audience, led by the

Prime Minister. Its effect in terms of the symbolism was incredibly important, and what it said is that Australia is open for business, we care about China, and we want to develop the Chinese market. A key issue we need to address, though, is getting businesses project-ready for China, because there are some very strong distinctions between the China market and those in other countries. That's why it's so important to have overseas offices in different markets.

If successfully negotiated, what benefits could a Free Trade Agreement bring?

I was working in the Department of Foreign Affairs and Trade in China when the negotiations first started in 2005 so it's been a long time in the making, and the key thing to note when free trade agreements are being negotiated is that all sectors and all tariff lines are included. As minerals already have very low tariffs in the China market I don't think the major wins will come in that sector, but I think they will come in agriculture and in services. I think the Free Trade Agreement will be a huge benefit to Australia.

In your experience, how does Western Australia differ to other states in the development of and approach to its business relationship with China?

I think that Western Australia is different to other states in that we were really able to benefit from that first stage of Chinese investment in the early 2000s by having such enormous iron ore deposits. Queensland is perhaps comparable as it has large coal and coal seam gas projects. Other states like New South Wales and Victoria are traditionally manufacturing bases in Australia, and while it's difficult to compete with China in that area, there is the potential to tap into the market for high-end manufacturing. Victoria has also traditionally been a large agriculture state, particularly for dairy, but in the future I think we'll see a much more competitive environment in terms of securing investment from mainland China.

INTERNATIONAL EXPERT BOLSTERS REFORMS



DMP staff attend workshops run by Professor Malcom Sparrow – left of DMP DG Richard Sellers.

Internationally renowned regulatory expert Professor Malcolm Sparrow from Harvard University visited Perth to conduct workshops with Department of Mines and Petroleum (DMP) staff on risk-based regulation.

DMP Resources Safety Executive Director Simon Ridge, who approached Professor Sparrow to visit Perth while in Australia for other business, said the workshops will assist with ongoing reforms to the State's resources sector.

"Professor Sparrow's visit came at a very opportune time for the department with our safety and environment legislation currently being transitioned to a best practice risk-based regulatory framework," Mr Ridge said.

"His workshops focused on a common conundrum for regulators – how to simultaneously deliver regulations that

provide better protection for society and a better business environment."

Professor Sparrow discussed how traditional key performance indicators, such as the number of safety inspections conducted each year, do not truly reflect the value of work being done to control risk.

"Accounting for the performance of a risk control regulator is more about reporting *how* targets were chosen, *what* approach was adopted for projects and *how* success was assessed," Mr Ridge said.

The workshops also focused on the journey to achieving regulatory excellence in risk control.

Professor Sparrow examined the possible meanings of 'risk-based regulation' and explored the relationship between reforms

of law, such as red-tape reduction, and reforms of regulatory strategy and practice.

"Professor Sparrow believes governments should be vigilant and quick to spot emerging threats, nimble enough to organise around those threats and skilful enough to suppress the threats before they do much harm," he said.

"Ultimately, our work as a regulator should help the resources industry eliminate, reduce, mitigate, prevent or suppress a threat or harm."

Professor Sparrow conducted workshops with regulatory staff and senior executives from 19 to 22 May.

Professor Malcolm Sparrow is a Professor of the Practice of Public Management at Harvard's John F. Kennedy School of Government. He is faculty Chair of the School's executive program, Strategic Management of Regulatory and Enforcement Agencies.



Photos: Lynas Corp Ltd.

Mt Weld open pit and ore stockpiles with percentage of rare earth oxides.

AUSTRALIA-FRANCE RARE EARTH SYMPOSIUM PREDICTS BRIGHT FUTURE

A continued spirit of cooperation between Australia and France was predicted by Minister for Mines and Petroleum, Bill Marmion, at the recent rare earth symposium. *Prospect* takes a look at this emerging industry and expectations of establishing processing facilities in the future.

During his opening address at the Australian-France Rare Earth Symposium Minister Marmion said he believed the symposium would create many positive outcomes, including the establishment of independent supply chains and joint venture research programs to assist in the development of rare earth processing in Western Australia.

Western Australia has Australia's only operating rare earth elements (REE) mine at Mt Weld and shipments of ore by operator Lynas Corporation to its processing plant in Malaysia began in December 2012.

"While at this stage we only account for two per cent of global REE resources, the known resource base continues to grow with on-going exploration and development, particularly at Browns Range and Hastings-Brockman," Mr Marmion said.

Western Australia is highly prospective for the discovery of other REE deposits and has many opportunities for rare earths exploration and research capabilities, and the establishment of processing facilities.

"The relationship between Australia and France in this industry has successfully worked in the past, and continues to work today," Mr Marmion said.

"Around 30 years ago Western Australia supplied approximately 25 per cent of the world's rare earths through the export of by-product monazite and xenotime, from heavy mineral sand mining, to Rhone Poulenc, in La Rochelle, France where it was processed to produce separated rare earths."

REE are in high demand for use in advanced technologies such as smartphones, LCD screens, permanent magnets, hybrid cars, wind turbines and even defence hardware – all growing industries.

"The State Government is acutely aware of these growth opportunities and is actively supporting the developing REE industry," Minister Marmion said.

The Department of Mines and Petroleum's (DMP) Geological Survey of Western Australia (GSWA) distributes geological information on the State's REE deposits.

This Information focusses on the geological setting and origin of REE mineralisation, and the application of this knowledge in assessing the prospectivity of the State for other REE deposits.

The symposium, held in May, also considered downstream rare earth

processing in Western Australia, and the use of rare earths in developing efficient power supply systems.

Australia presently has no facility for extracting REE for ore minerals, a very specialised process involving complicated, multi-stage chemical processes that must be tailored to the particular REE ore type.

"So any movement to establish such a new industry is supported by the State Government as demand for REE continues with on-going technological developments," Mr Marmion said.

"This is further enhanced as an opportunity considering that China, which supplies 85 per cent of the global total, has made a recent decision to reduce export quotas and raise import tariffs for REE.

"This has created global concern about the security of supply to market, particularly for heavy REE, and therefore a push to find new resources, and providing new opportunities."

The event was organised by the Western Australian Chamber of Minerals and Energy (CME), Curtin University and the French Embassy in Australia.



Photos: Roy Hill

Construction of the Point Stanley Wharf at South West Creek in Port Hedland.

FUNDING PACKAGE SEWN UP

A major milestone in the development of the A\$10 billion Roy Hill iron ore project was reached in March, with completion of a long-term funding package.

The A\$7.9 billion debt package involves a consortium of 19 international banks and five export credit agencies. Significant support from a number of other financial institutions also underpinned the funding.

Premier and State Development Minister Colin Barnett welcomed the development, saying the Roy Hill project represented a substantial vote of confidence in the future of the State's resources sector.

"This is great news for workers in mining and construction and shows there are still opportunities out there despite recent reports of a slowing of growth," he said.

The Roy Hill project comprises an open pit mine, a processing plant, 344km of heavy haul railway and export facilities at Port Hedland. It is expected to generate a peak construction workforce of 3,600 workers and once operational is likely to create 2,000 permanent jobs.

"With a nameplate capacity of 55 million tonnes per annum, the Roy Hill project is set to be the biggest iron ore project under construction in the world," Mr Barnett said.

"The State Government has worked closely with the project proponents to progress the Roy Hill project to this point, including the negotiation and

implementation of a State Agreement, and all primary approvals are now in place."

The iron ore industry is already a major pillar of the Western Australia economy, employing thousands of workers and contributing around A\$4.3 billion in royalties in 2013.

Containing an estimated resource of 2.4 billion tonnes of iron ore, the mine life of the site has been calculated at more than 20 years and, once completed, will be the biggest single-pit iron ore mining project in Australia. It is expected to deliver royalties to the State of up to A\$400 million a year.

As detailed in the March edition of *Prospect* magazine, there has been a strong focus on creating opportunities for local suppliers during the construction phase of the Roy Hill project, with more than A\$6 billion to date spent on, or committed to, local content.

Western Australian businesses have been heavily involved in the building of several facilities, including accommodation villages, the Ginbata airport and accompanying roads, and the recently completed company headquarters and remote operations centre in Perth.

First exports from the project are expected to occur in September 2015.



An aerial view of construction of Roy Hill's Port Rail Loop and Stockyard facilities.

PILBARA MARINE HEALTH CHECK



Left: Christmas Tree Worms on a Porites coral head off Montobello Island. Middle: Acropora Coral off Sholl Island. Right: Coral bleaching on a Porites Coral Head off Montobello Island.

A health and wellbeing check of World Heritage-listed reef ecosystems in the Pilbara region of Western Australia will provide a critical baseline of marine conditions to government, industry and researchers.

The five-year, A\$12 million Pilbara Marine Conservation Partnership will survey a 300km swathe of coastline, including two major marine parks as well as areas under development for ports, and oil and gas extraction and processing.

A joint venture between CSIRO's Wealth from Oceans Flagship and the University of Western Australia, the partnership will be the first whole of ecosystem study for the region's unique marine environment.

"Our research will help government and industry balance the environmental sustainability of the Pilbara with its increasing broad sector use," CSIRO lead scientist Dr Russ Babcock said.

"Over the next five years we want to find out everything we can about the health and makeup of the region, as well as observe and evaluate any localised changes, so we can give the best possible advice to future use managers on how they can act sustainably."

Dr Babcock and his team have recently returned from their first exploratory tour of the region, where they were scouting survey sites.

The University of Western Australia's Professor Shaun Collin said the study would set a baseline for future development in the Pilbara.

"This study will develop a greater understanding of the dynamics of coral and fish communities in the region, which in turn will provide us with the ecological indicators of potential human impacts," Professor Collin said.

"With it, we can provide a research baseline for decision making in the region that will strike the right balance between environmental conservation and industry development."

The study is funded by the Gorgon Project's Net Conservation Benefit Fund, which is administered by the Western Australia Department of Parks and Wildlife.

\$200 MILLION UPGRADE FOR ESPERANCE PORT

A multi-user iron ore facility worth A\$200 million is to be built at the Esperance Port following a State Government announcement in January 2012 that the southern port would be a gateway for iron ore exports from the Yilgarn region.

The port is preparing for a major dredging operation which will see 68,000m³ of material cleared from the shipping channel as part of the development of the multi-user facility.

Esperance Ports Sea and Land (EPSL) have received the required Federal and State approvals for the dredging to start.

Yilgarn Esperance Solution Limited, a consortium led by Asciano, has been named the preferred proponent to design, build and operate the multi-user facility.



The Esperance Port is set for a \$200 million upgrade.

Plans have also been developed for an A\$11.5 million upgrade of roads within the precinct to accommodate a realignment of truck movements following completion of the transport access corridor.

Running of the Esperance, Albany and Bunbury Ports will soon come under the jurisdiction of the new Southern Ports Authority.

PREMIER CELEBRATES COMPLETION OF THE BUNGAROO WATER PROJECT

Premier Colin Barnett officially opening the Bungaroo Water Project.

The State Government and Rio Tinto have celebrated a successful partnership to boost water supplies in the Pilbara with the official opening of the Bungaroo Water Project in the State's north.

The Bungaroo Water Project will supply water to Rio Tinto's coastal operations, as well as freeing up capacity in the West Pilbara Water Scheme for supply to Pilbara towns like Karratha, Roebourne and Dampier.

The project was officially opened in April at Rio Tinto's Cape Lambert port operations with Premier Colin Barnett and Water Minister Mia Davies in attendance along with representatives from Rio Tinto and its joint venture partners, the Water Corporation, Department of State Development, and Traditional Owners.

Mr Barnett said the project was a great example of how the State Government is working with industry to deliver positive outcomes for regional communities.

"From the State Government point of view it is a very elegant solution. It's a win for Rio Tinto, it's a win for the Water Corporation and for the people of the Pilbara too," Mr Barnett said.

"Rio Tinto has now got its own water supply, and the Millstream resource is now free to be used by the Water Corporation in supporting towns in the West Pilbara."

The original West Pilbara Water Supply Scheme was built in the 1960s by mining companies Hamersley Iron and Robe River, with water sourced from the Millstream aquifer.

The Scheme was handed to the State to operate in 1976, with both iron ore projects retaining entitlements to draw water for their operations from the Millstream aquifer.

But as the population of the West Pilbara has grown, so has demand on the region's water supply.

Development of the Bungaroo water source has enabled Rio Tinto to relinquish its Millstream entitlements, freeing up water for Karratha and other towns serviced by the West Pilbara Water Supply Scheme.

The project also allowed Rio Tinto to meet its secondary processing obligations through an alternative project under the *Iron Ore (Mount Bruce) Agreement Act 1972*.

Ms Davies said the project formed an important part of ensuring the State Government's Pilbara Cities vision was realised.

"This solution frees up 10 billion litres, or almost four and a half thousand Olympic swimming pools worth of water, for the West Pilbara towns; 10 billion litres of water that can now be used for drinking, agriculture and industry as the West Pilbara continues to be developed," she said.

"One of the biggest winners from this solution is Millstream, with the wetlands and surrounding environment to benefit from less pressure on the water source."

Ms Davies also said the project had alleviated the need for the State

Government to build and maintain a new desalination plant to cope with the pressure on supply, which resulted in significant savings for taxpayers.

Warwick Smith, then Acting Chief Executive for Rio Tinto Iron Ore, said the project secured a vital independent water supply for the company's rapidly growing Pilbara operations.

Rio Tinto invested A\$330 million in the project, including the development of a borefield in the Bungaroo Valley near Pannawonica and the construction of an 87km pipeline to connect the new source to the Water Corporation's Millstream facilities. The Water Corporation also spent A\$78 million upgrading existing water infrastructure.

"One of the most pleasing aspects of this project was the spirit of collaboration, with a partnership that saw many stakeholders come together. In particular I'd like to thank and acknowledge the support of the traditional owners, Department of State Development and of course the Water Corporation," Mr Smith said.



Premier Colin Barnett shakes hands with traditional owner Cyril Locker as Rio Tinto's Warwick Smith looks on.

Photos: Rio Tinto



MRIWA Chair Peter Lilly, Mines and Petroleum Minister Bill Marmion, CME Chief Executive Reg Howard-Smith and MRIWA CEO Mark Woffenden

NEW DIRECTION FOR WESTERN AUSTRALIAN MINERALS RESEARCH INSTITUTE

After more than 30 years since it first started operating, Western Australia's Minerals and Energy Research Institute (MERIWA), has been re-established and relaunched as the Minerals Research Institute of Western Australia (MRIWA).

The new Institute was officially launched by Mines and Petroleum Minister Bill Marmion at a function hosted by the Chamber of Minerals and Energy in Perth in June this year.

The State Government initiative aimed at boosting international competitiveness in the State's resources sector established the new Institute under new contemporary legislation with additional funding of A\$7.5 million over three years.

In his address Minister Marmion said MRIWA plays a vital role in establishing Western Australia as an international centre of excellence for minerals research.

"This research is increasing our knowledge and our ability to unlock Western Australia's mineral wealth," the Minister said.

"It is organisations like MRIWA that help ensure Western Australia's reputation for world-class research and development in the minerals industry continues to be recognised across the globe."

The Institute will continue the work started by MERIWA in 1987 by investing in priority research needs for WA's mineral resources, both now and for the longer-term. Since it

was established, the Institute has published more than 300 research reports.

A new board for the Minerals Research Institute of Western Australia was appointed earlier this year.

Minister Marmion announced the seven new board members, saying the combined expertise of the new team gives fresh impetus to crucial areas of pre-competitive research.

Board directors are:

- **Chair, Dr Peter Lilly** – has 35 years of varied industry and research experience;
- **Michelle Andrews** – Department of Mines and Petroleum Deputy Director General, Strategic Policy 25 years' experience in resource and environment roles across Government;
- **Helen Cook** – 20 years' corporate and commercial experience;
- **Stedman Ellis** – Australian Petroleum Production and Exploration Association (APPEA) Chief Operating Officer Western Region with 25 years' experience across government and industry;
- **Dr Phillip Lockyer** – 50 years' minerals industry experience and a Member of the MERIWA Board since 2006;
- **James McClements** – Fund Manager and co-founded Resource Capital Funds; and
- **Dr Andrew Shook** – has 25 years mining and processing industry experience.

For more information about MRIWA, the board members and its research funding and scholarship program visit www.mriwa.wa.gov.au

Research Scholarships

The inaugural Odwyn Jones Awards recognising valuable research for Western Australia's minerals industry were presented in June by the Hon Bill Marmion on behalf of the Minerals Research Institute of Western Australia (MRIWA).

The Awards will provide up to 15 annual scholarships for students to progress their fourth year research project. Eight awards valued at \$2,000 each were presented at the first awards event.

Murdoch University recipients were Jonathan Adams, Edwyne Mutai, and Joshua Vinicombe, while Curtin University recipients included Justin Brent, Aiden Green, Holly Kiely, Shane Reynolds and Kelsey Roberts.

The 2014 Odwyn Jones Awards are the first of the new MRIWA scholarships program which replaced the Minerals and Energy Research Institute of Western Australia (MERIWA) scholarships awarded to PhD students since 1991.

EXPLORATION SCHEME CONTINUES TO SUPPORT INVESTMENT ATTRACTION

The Western Australian Government has continued its commitment to the Exploration Incentive Scheme (EIS) with A\$10 million a year for the next three years committed in recent forward estimates to 2016–17.

Minister for Mines and Petroleum Bill Marmion said the EIS initiative aimed to encourage exploration in Western Australia for the long-term sustainability of the State's resources sector.

"A key component of the EIS program is the highly successful co-funded exploration

drilling program which will account for up to A\$5.8 million of the A\$10 million," he said.

"The EIS has been funded for a total of A\$100 million since 2009 and has resulted in a step-wise increase in exploration information being made available to explorers in Western Australia."

The Minister said Sirius' Nova Deposit was a shining example of the success of the EIS program.

"Sirius' Nova deposit, discovered using a combination of the Geological Survey of

Western Australia generated geophysical and geochemical information, and supported with a co-funded drilling grant, is now moving towards the mine development phase," Mr Marmion said.

"Achievements like this one have made a strong contribution to improving the perceptions of WA's resources investment climate and in Western Australia being judged the world's top investment destination in the 2013 Fraser Institute Survey of Mining Companies, released in March this year."

New exploration incentive to build on WA success

The State Government is optimistic that more exciting Western Australian discoveries will flow from the Exploration Development Incentive (EDI) announced in the Federal Budget.

Mines and Petroleum Minister Bill Marmion said the A\$100million national EDI would boost smaller companies' greenfields exploration, complementing the State Budget's A\$30 million support for WA's successful Exploration Incentive Scheme (EIS).

"The A\$100million we've invested in EIS since 2009 has already resulted in major discoveries, and the new Federal Government EDI lifts that potential for junior miners, through tax offsets for investors."

"The combination of these State and Federal incentive schemes will help maintain WA's recent rating as the world's top investment destination in the Fraser Institute Survey of Mining Companies."

MINING EXPLORATION SCIENCE BOOSTED

Research funding of A\$2.58 million over three years was recently awarded as the first grant by the Minerals Research Institute of Western Australia (MRIWA).

The project will research the technical challenges of exploring for minerals in some of the extremely complex geological environments that exist in WA.

The A\$2.58 million will contribute to funding a team of researchers from the Centre for Exploration Targeting at the University of Western Australia, Applied Geology at Curtin University and the Discovery team of CSIRO.

When announcing the funding Minister for Mines and Petroleum Bill

Marmion said supporting the Institute would help secure the significant revenues generated for the State by the minerals industry.

"The Government needs to facilitate investment in minerals research to ensure the State's mining operations are competitive with operations in lower-cost jurisdictions," he said.

"WA was recently ranked number one in the world for investment attractiveness by the Fraser Institute, but we must continue to work on ensuring we remain number one. Research such as this plays an important role in achieving this goal."



Miner's Research Institute of Western Australia
Miner's Research Institute of Western Australia

ROYALTY REVIEW TICKING ALONG

In the 2012–13 State Budget, the Western Australian Government announced a review of the State's royalty system, to be conducted jointly by the departments of State Development (DSD) and Mines and Petroleum (DMP). In August 2013, Government approved the Terms of Reference of this Mineral Royalty Rate Analysis (MRRA), available on DSD's website. The departments are currently consulting stakeholders on their views of ways to improve the State's royalty system.

The MRRA is examining the efficacy and appropriateness of the current royalty system and assessing alternative systems. The MRRA will not consider wholesale changes and will continue with an *ad valorem* system.

The Terms of Reference require the MRRA to consider the equity and efficiency of any proposed changes to royalty rates, the economic viability of commodity sectors, and royalty arrangements in other jurisdictions. The MRRA cannot make recommendations that would have a detrimental effect on Western Australia's revenue base.

Nineteen submissions were received during the public submissions period. The central themes of those submissions were:

- The appropriateness of the 10 per cent benchmark which underpins the current three-tier structure of *ad valorem* royalties

- The efficiency and equity of the current royalty regime
- Cost structures
- Sovereign risk
- Profitability and economic conditions
- International competitiveness and investment attraction

As well as receiving written submissions, staff working on the MRRA have met companies, industry groups, academia and community groups. An Industry Reference

Group comprising the Chamber of Minerals and Energy, the Association of Mining and Exploration Companies, DSD and DMP, meets regularly to discuss technical and policy issues. MRRA staff would like to acknowledge the extensive time and effort of all stakeholders involved and their constructive contribution to the MRRA.

The MRRA is due to report by December 2014.

Western Australia's mineral royalties system

A royalty is a payment made to the Government for the extraction of a resource owned by the community. It is a purchase price, not a tax.

The Government calculates royalty payments for most commodities using an *ad valorem* system. In 1981, the Western Australian government completed a detailed review of mineral royalties, which proposed a principle that royalties are to return approximately 10 per cent of the mine head value of the mineral. The mine head is the first point the mineral can be stockpiled once extracted.

This 10 per cent principle is applied to the sale price using three *ad valorem* rates:

- Bulk materials (crushed and screened): 7.5 per cent
- Mineral concentrates: 5 per cent
- Metallic form: 2.5 per cent

Specific royalty rates apply to low value, bulk materials such as limestone, construction materials and salt. The royalty is charged as a fixed rate, escalated annually, for each tonne produced.

WA INNOVATION SHOWCASED IN DESALINATION PROJECT

Research into using geothermal heat as a power source to desalinate groundwater is an example of Western Australian innovation addressing local and global water and energy challenges, according to Water Minister Mia Davies.

In recognition of the UN World Water Day (March 22) theme of Energy and Water, Ms Davies was shown a working prototype demonstrating how geothermal heat can desalinate water.

Researchers from the University of Western Australia (UWA) said their prototype – funded by the National Centre of Excellence in Desalination Australia (NCEDA) – had the potential to provide cheap, energy-efficient desalinated water for industrial use and possibly drinking supplies.

"It is globally accepted that one of the major challenges for increasing fresh water supplies through water treatment is the cost of energy. In many areas the energy is not available or the cost of producing the energy is high," the Minister said.

Across the State there are significant brackish and saline groundwater resources which, if desalinated, have potential for productive use.

The research project looks at the feasibility of using the, patent pending, geothermal powered desalination technology in regional WA with a commercial feasibility pilot planned for Dongara, in the State's Mid West, in the near future.

"This technology has the potential to service industry, tourist precincts, small towns, remote Aboriginal communities and large residential and commercial operations such as mine sites or agriculture," she said.

"It continues a tradition of Western Australians adapting to their environment to produce innovative solutions to meet their water needs."

The UWA-led study into the feasibility of geothermal desalination is funded by NCEDA and supported by CSIRO, Department of Regional Development's Pilbara Cities office, Department of Water and the Water Corporation.



Photo: The University of Western Australia

Assistant Professor Scott Draper, PhD student Qin Zhang and Professor David White inspect the O-Tube.

WA RESEARCH WINS TOP GONG

A joint research project between the University of Western Australia and major players in the oil and gas industry has won the 2014 AIRG Medal for Australasian Major Industry Technological Innovation. The award is given annually for outstanding Australasian industrial research conducted during the previous year.

The medal was presented for the development of the O-Tube program, a world-first facility which rapidly circulates 60 tonnes of water to simulate underwater conditions during tropical cyclones.

In presenting the award to the STABLEpipe Joint Industry Project (JIP), the Australasian Industrial Research Group (AIRG) said the cutting edge program – developed and funded with the support of the project – had resulted in significantly improved designs of offshore oil and gas pipelines while ensuring cost savings for the industry.

The STABLEpipe JIP participants are Woodside Energy Ltd, Chevron Australia Pty Ltd, Wood Group Kenny Pty Ltd, Atteris Pty Ltd and UWA, which is the lead researcher.

A UWA in-house technical team led by Winthrop Professor Liang Cheng, of the School of Civil, Environmental and Mining Engineering, and Winthrop Professor David White, of the Centre for Offshore Foundation Systems, designed and built

the program's large and mini O-Tubes. Together, the two tubes are revolutionising research on pipeline stability design and sediment transport.

Winthrop Professor John Dell, Dean of UWA's Faculty of Engineering, Computing and Mathematics, said the faculty was proud its partnership with industry had been recognised with the award.

"The O-Tube program uses engineering solutions to optimise the competitiveness of industry while ensuring the safety of our offshore infrastructure," Professor Dell said.

"It is not only a great example of how UWA's research innovation changes how companies globally do engineering, but also of our work for the wider community and the environment. These are the kinds of partnerships that benefit everyone."

Established in 2009 and the recipient of a number of awards prior to its latest accolade, the program has pioneered improvements in engineering design, promoted safety and reduced risks to both humans and the environment.

The large O-Tube can create cyclonic conditions in a controlled experimental environment, demonstrating how seabed sediment, pipelines, other infrastructure and flora interact with the marine environment.

The mini O-Tube, at 1:5 scale of the large O-Tube, allows for rapid turnaround on smaller scale experiments and has been instrumental in studying in-situ soil erosion.

Winthrop Professor David White, who holds a Shell-funded professorship in Offshore Engineering at UWA, said the research has created a new paradigm in pipeline stability design.

"Our research has quantified how the seabed becomes mobile during cyclones and strong tides," he said. "This mobility causes self-burial of subsea pipelines, sheltering them from the destabilising hydrodynamic forces. By banking this beneficial effect, we can assure the stability of pipelines while reducing the requirement for additional protection, such as rock dumping, which is costly and environmentally disruptive. We're very proud that our O-Tube technology – which is a homegrown UWA invention – has led to national recognition through the AIRG Medal".

The UWA researchers are now working with Norway's leading offshore verification agency, Det Norske Veritas, to transfer the STABLEpipe JIP research into a new industry guideline, allowing this Western Australian innovation to be rolled out into global oil and gas engineering practice.



Miami University Geobiologist Pam Reid with a cross section of an ancient stromatolite from Hamelin Pool.

PROFESSOR FINDS HOLY GRAIL AT HAMELIN POOL

Marine Geoscience Professor Pam Reid spent two decades in the Bahamas studying stromatolites before she found the holy grail of her calling – Hamelin Pool.

The Miami University Geobiologist explained during one of her annual pilgrimages that the remote spot in Shark Bay on the northern coast of Western Australia is “really the big time”.

“You know, I spent 20 years in the Bahamas and I feel like it was just training for Hamelin,” she said.

Pam isn’t just interested in those strange, pale descendants of earth’s earliest life forms found billions of years ago during the pre-Cambrian period, she’s crazy about them.

“They’re just magnificent, absolutely fabulous and the diversity and extent of the stromatolites at Hamel is unparalleled in the world today,” she said.

It’s a passion shared by former Department of Mines and Petroleum (DMP) Geological Survey Director, Dr Phil Playford who discovered the Hamelin Pool stromatolites in 1954 and was largely responsible for Shark Bay’s World Heritage listing.

Not surprisingly, Phil has been an inspiration to Pam, a friend and colleague she reveres.

“Phil’s very involved in our project, we simply couldn’t have done it without him,” she said of her three-year project funded by oil companies to research and map the Shark Bay stromatolites,” she said.

“The entire project was initiated with Phil and collaboration has been close and ongoing.”

Pam’s relationship with DMP includes regular visits to the Core Library in Carlisle.

She and members of her regular team of up to five scientists and academics also have a strong friendship with former DMP Chief Paleontologist Kath Grey.

This is the third consecutive year Pam and her colleagues have visited to conduct two months of field work at Shark Bay.

Like all geologists, she loves the field work, but that time in the water and the hut they turn into a mini laboratory each year, has once again drawn to a close. Now it’s time to start writing reports.

“This year is the year of the papers, we had the fun in the field and now it’s time for the hard work,” Pam explained.

The papers will be pored over by fellow scientists and academics, and the oil companies who have funded the project.

Pam acknowledges her good fortune and is thankful she was lucky enough to

be funded by the companies interested in microbial deposits such as stromatolites.

“Microbial deposits are ‘hot’ with oil companies right now,” she said.

“I’ve been doing geo-microbiology for 25 years, but all of a sudden there’s a huge amount of oil company interest and a lot of meetings with other geologists – it’s really great.”

“I started with one student and now there’s a team of about four or five.

“Plus it’s not just students and visiting microbiologists, but other scientists such as a woman from the University of Florida who just received NASA funding.

“We have a researcher from Stanford University, a PhD student also linked to NASA, recording high resolution imagery by flying a quadcopter from our boat over Hamelin Pool.

“We probably have the highest resolution underwater dataset that exists anywhere in the world.”

When asked why oil companies are so interested in stromatolites, Pam explains that oil companies want models for prediction of reservoirs and source rocks.

Stromatolites are a modern example of source material and reservoirs that may be rich in oil and gas when found in ancient rocks.

GEOLOGY MEETS HISTORY IN CARLISLE



Drill core material and racks at the Carlisle Core Library.

Department of Mines and Petroleum Core Library librarian Paul Stephenson knows exactly what the Beatles were wearing when they arrived in Australia 50 years ago – he read about it at work.

“They were all wearing masks, for some reason,” he remembered.

The Fab Four’s arrival at Sydney Airport on 11 June 1964 was recorded in a front page picture in *The West Australian*, which is wrapped around a sample of core that Paul’s team exhumed from one of the tall storage racks at the library.

“We didn’t have bubble wrap back then, so Perth’s daily paper was the wrap of choice,” he said.

The huge library at Carlisle archives State and Commonwealth drill samples crucial to new exploration research, but it is almost full as explorers take advantage of the West Australian Exploration Incentive Scheme’s Co-Funded Drilling Program.

Samples include rocks many millions of years old that could be the key to the next big mineral discovery in Western Australia.

With only 19 per cent capacity left and demand for space growing, \$4.8 million in the 2014 State Government Budget was critical.

The funding will increase the library’s storage capacity by about 50 per cent, or 3500 square metres.

Minister for Mines and Petroleum, Bill Marmion praised the facility as one of the most important resources in Western Australia for petroleum companies to do pre-analysis before moving to expensive drill holes.

“The data we make available to them is crucial to exploration because it reduces the technical and financial risk to potential investors,” he said.

Companies are required to submit cores, cuttings and sidewall core material obtained during drilling as part of the legislative requirements for petroleum and geothermal exploration.

The samples become available to the public after a strict confidentiality period.

“Companies are reducing exploration costs significantly because they can look at our samples,” Mr Stephenson said.

“Core from one offshore well could be worth from \$30m to \$90m in terms of how much it cost to drill.”

Like a gigantic IKEA warehouse, the library is packed with tall storage racks holding

about 7000 pallets of samples that have to be moved by fork lift.

“Some geologists might need to get a quick reminder of the characteristics of a specific ore zone so they walk straight up to the section they want to look at, but others will log every centimetre with great care,” Paul said.

“They may spend up to a week logging just one rack of samples.”

As technology changes, resources that have been drilled and passed over may suddenly become commercially viable.

The current interest in shale and tight gas has sparked a new wave of investigation of old core.

The library is a mecca not only for mineral and petroleum geologist, but also for biologists and other scientists who want to tap into its stored secrets.

Former Chief Paleontologist at DMP, Kath Grey said some fossils within the core samples were about 800 million years old.

She said the study of ancient fossil rocks, along with stromatolites found at Hamelin Pool in Shark Bay, was vital for petroleum exploration research.



On the ground at Toro's Wiluna Project.

DOING THE RIGHT THING

Following on from the last edition of *Prospect* we take a look at how uranium projects in Western Australia are progressing and some of the challenges they face.

The key players – Toro, Cameco, EMA and Paladin – know they need community support and they're paying close attention to community engagement, public safety and environmental awareness.

Toro is positioned to be the first company to start production at its site 30km south of Wiluna.

Dr Guthrie is proud that her company was among the first to congratulate the Wiluna and Tarlpa groups last year when their Native Title claims were determined by the Federal Court.

Toro representatives attended the formal court ceremony, held on country, at the invitation of the two groups – a testament to more than four years of patient and

open dialogue that included addressing concerns for protection of the heritage and cultural values of the region.

"The Traditional Owners asked us to help them understand in particular how radiation may affect their people and their land," Dr Guthrie said.

"Toro responded by arranging for some of the Traditional Owners to visit an operating uranium mine in South Australia and a mineral sands mine in Western Australia so they could see for themselves how radiation issues can be managed to protect their people and their land."

Toro hopes to provide 350 jobs during construction of the Wiluna mine and to have an operational workforce of 170.

These workers will be trained and monitored regularly under stringent WA safety regulations.

Toro's aim is for radiation exposure to Wiluna employees to not exceed 50 per cent of occupational exposure limits.

Wiluna uranium concentrate will be trucked south on the Goldfields Highway to Norseman, using the eastern bypass at Kalgoorlie, then on the Eyre Highway into South Australia for transfer to ship at Port Adelaide.

At maximum production, the Wiluna mine will require five shipping containers per month in one transport movement to carry product to the port of export from Australia.

At all times, a minimum of two trucks will travel together between the mine site and Adelaide.

A round trip will require total travel time, including load/unload, of 90 hours for a dual-driver combination travelling at an average speed of 80km per hour to complete a journey of 5461km.

This includes fatigue management rest breaks and one overnight break at the Toro accommodation camp. There will be no prolonged stop-overs beyond the mine site.

Toro has also committed to progressive rehabilitation of its Wiluna mine.

The mine will be a shallow open-cut surface mine to a maximum depth of 15 metres. As sections of the Wiluna pits are exhausted, they will be backfilled and rehabilitated to elevations and slopes similar to the original landscapes.

Wiluna is the only current Western Australian uranium mine proposal to receive both Western Australian and Federal Government environmental approvals.

Toro is developing an Operational Mining Proposal and Mine Closure and Rehabilitation Plan that will be available for stakeholder input.

The company is also currently engineering a tailings cap that will ensure radiation releases are contained within naturally occurring background levels.

The storage construction is of a design in which radioactive material left after processing remains within the tailings facility and does not leach into the surrounding environment.

Cameco's Kintyre project is expected to deliver significant economic benefits to WA, particularly the people of the East Pilbara.

It is anticipated the project will employ up to 450 people, with priority given to hiring and training local people, including Traditional Owners, the Martu.

Cameco has considerable experience in the management of radiation during mining and milling operations.

As part of the planning for the Kintyre project, Cameco has completed radiation modelling and emissions and dispersion studies to understand any potential risks to the public, workers and the environment.

"These studies have shown that only very low levels of radiation will occur outside of the immediate mine site," Mr Reilly said.

Mr Reilly said that uranium concentrate had been safely transported by road within Australia for more than 30 years.

As for the Toro project, uranium concentrate produced at Kintyre will be sealed in 200-litre steel drums and then stowed in shipping containers and secured using a Kevlar-based strapping system.

Each drum will be registered and recorded before the shipping container is sealed.

The containers will then be locked and will not be opened, unless for official inspections, until they reach their overseas destination.

EMA's Julian Tapp said the company expected that about 200 full time jobs would be created once production started, hopefully towards the end of 2016.

"More would be employed during the anticipated construction phase from mid-2015 to the end of 2016," he said.

Mr Tapp said attention to the safety of future employees was a paramount issue.

"We expect the drying and packaging stage to be fully automated to limit human exposure to associated dust," he said.

Mr Tapp said that EMA planned to undertake progressive rehabilitation of the mine.

"We will be putting tailings back into the mining void and then backfilling with 30m of new overburden material," he said.

Paladin's John Borshoff believes in significant involvement with all aspects of the local community, throughout all activity phases including exploration, development, operations and closure.

"Communities near Manyingee, such as Onslow, will be kept updated on the progress of the project so that they are in a position to maximise the economic benefit from the project," Mr Borshoff said.

"While Manyingee is in a relatively remote and isolated area, it is expected that there will be employment opportunities available

to locals including the local traditional owners and, to a lesser extent, economic benefits to the local pastoralists," he said.

"This is already the case to a certain extent during the initial exploration phase.

"Local pastoralists are being contracted to clear areas, maintain tracks and dig sumps for drilling."

Mr Borshoff believes there is little danger in transporting uranium concentrate and points to the industry's outstanding global safety record.

Planning for mine closure is an integral part of Paladin's proposed mine development and operations.

"The contents of the closure plan will be as prescribed in the 2011 DMP and EPA Guidelines for Preparing Mine Closure Plans," Mr Borshoff said.

The outlook

The key players in Western Australia are now waiting for the price of uranium to rise to turn their plans into action.

Ironically, Japan may be the country that triggers a revival of the global uranium industry.

Prime Minister Shinzo Abe's government has unveiled a pro-nuclear energy plan that could open the door to restarting some of Japan's 48 idled reactors as soon as this year.

Japan's biggest neighbour, China, has 28 reactors under construction and five of them will be ready to be connected to the grid this year.

And Japan's next door neighbour, South Korea, has given the green light for the construction of two new reactors to begin this year.

All WA uranium explorer eyes seem to be on the east at the moment as the waiting game continues.



The Kintyre site.

SAFETY REPORT WARNS INDUSTRY ON FATAL TRENDS

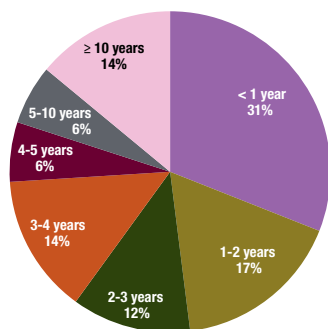


Figure 1: Duration of deceased person in role as a percentage of total fatalities [sample size = 49]

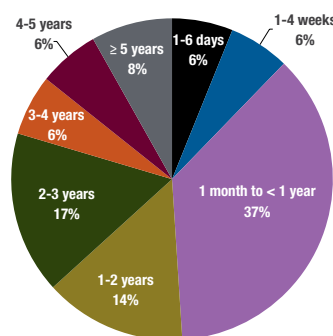


Figure 2: Duration of deceased person at the mine as a percentage of total fatalities [sample size = 49]

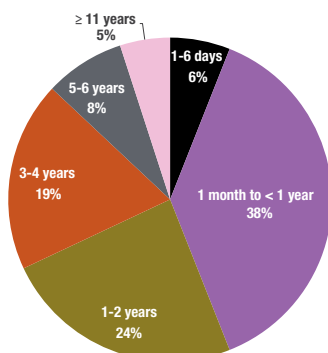


Figure 3: Duration of person undertaking supervisor's role as a percentage of total fatalities [sample size = 37]

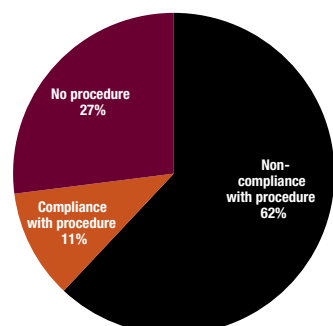


Figure 4: Availability of procedure and procedural compliance as a percentage of total fatalities [sample size = 52]

Trends in mining-related fatalities that will help raise awareness and improve safety performance within the industry were identified in a recent mines safety report released by the Department of Mines and Petroleum (DMP).

DMP Resources Safety Executive Director Simon Ridge says the report analysed 52 fatal mining accidents that occurred in Western Australia from 2000 to 2012.

"In the 13-year period reviewed, the mining workforce rapidly increased from 40,000 people to 100,000," Mr Ridge said.

"Despite this, the number of fatalities per year showed a downward trend from seven in 2000 to zero in 2012, when the State recorded its first fatality free year in more than a century of recorded history.

"If we had a 100,000-strong workforce back in the 1950s, the average number of fatalities per year would have been around 200, so we have certainly come a long way, but our ultimate goal moving forward is to become a 'zero-harm' industry."

The report revealed the most common reason for a workplace situation resulting in a fatality was workplace hazards not being identified.

Mr Ridge said he hoped sharing the results of the report with industry would help to reduce worker exposure to hazards and situations which could potentially be fatal.

"The report revealed that almost half of the fatal accidents occurred when the deceased person had been working at a mine site for less than a year," he said.

"It also revealed that the most common 'trigger actions' for a fatal accident were equipment not being restrained or isolated and the incorrect use of safety harness equipment.

"Fatigue was another contributing factor in the review, with the most common time of day for a fatal accident to occur being the last two hours of a typical day shift when a worker is more likely to lose concentration."

Mr Ridge said these findings reinforced the importance of a robust safety induction program, a positive safety culture and the effective implementation of fatigue management plans.

View the full report on DMP's website at www.dmp.wa.gov.au/documents/Reports/RP_FatalAccidentsMINING_2000-12.pdf

RESOURCES SAFETY MINISTERIAL ADVISORY PANEL ESTABLISHED

A new Ministerial Advisory Panel (MAP) has been established to develop and implement major safety legislation amendments at Resources Safety as part of the continued consultative process at the Department of Mines and Petroleum (DMP).

The panel is made up of representatives from government, industry groups and unions with the aim of increasing stakeholder engagement and face-to-face briefings to ensure all stakeholders are informed and have the opportunity to provide input to the process of legislative changes.

The panel will provide advice to the Minister of Mines and Petroleum Bill Marmion on the safety legislation reform process, and also feed information back to their respective organisations.

The first MAP meeting was held in March with former BHP Billiton External Affairs Vice-president Ian Fletcher appointed as the Independent Chairperson.

It is anticipated that the panel will operate until December 2014 and that meetings will be held bi-monthly.

Resources Safety Executive Director Simon Ridge said the objective of the panel was to deliver a best practice safety regulatory



Members of the Ministerial Advisory Panel for Resources Safety

regime for the Western Australian resources sector based on practical risk management.

“This will take due account of current reforms in occupational health and safety regulation which are part of the Council of Australian Governments (COAG) Business Regulation and Competition reforms,” Mr. Ridge said.

“Our aim is to deliver a best practice legislative model based on cost recovery thereby ensuring efficient service delivery to industry.”

Advice to the Minister will focus on the following:

- Legislative reform and the development of guidance material to support these changes.
- Strategies which will increase the safety capabilities of both industry and the regulator.
- Performance reporting criteria and appropriate governance arrangements.
- Communication and implementation of safety reforms, to ensure a common understanding.

Ministerial Advisory Panel members

- **Mr Ian Fletcher** Independent Chairperson
- **Mr Simon Ridge** Executive Director, Resources Safety Division, Department of Mines and Petroleum (DMP)
- **Mr Greg Stagbouer** Director, Australian Drilling Industry Association (ADIA)
- **Mr Kevin Wolfe** Business Development Manager, Monadelphous (representing Australian Pipeline Industry Association – APIA)
- **Ms Karin Lee** Manager Safety and Risk Services, Chamber of Commerce and Industry WA (CCI WA)
- **Ms Miranda Jane Taylor** Senior Policy Adviser, Australian Petroleum Production and Exploration Association (APPEA)
- **Mr Richard Kern** Regional Manager Asia Pacific Newmont (representing Chamber of Minerals and Energy WA – CMEWA)
- **Mr Justin Fromm** Senior Policy Officer, Association of Mining and Exploration Companies (AMEC)
- **Mr Stephen Price** Secretary, Australian Workers Union
- **Mr Glenn McLaren** State Organiser, OHS Adviser, Australian Manufacturing Workers’ Union (AMWU)
- **Mr Gary Wood** Secretary, Construction Forestry Mining and Energy Union (CFMEU) Mining and Energy Division WA District
- **Mr Chris Oughton** Director, Kwinana Industries Council (KIC)
- **Mr Michael Tooma** Partner, Norton Rose Fulbright
- **Mr Nick Zovko** Regulatory Policy Manager, Plastics and Chemicals Industries Association (PACIA)
- **Mr Lew Pritchard** General Manager Business Development, DMP
- **Ms Jennifer Shelton** Principal Policy Officer, DMP

HISTORY, DESTINY AND DMP

It's as if Bill Marmion's tenure as the Minister for Mine and Petroleum was simply meant to be.

His great-grandfather was Western Australia's first Minister for Mines and Lands as a member of Sir Andrew Forrest's Cabinet.

William Edward Marmion served in the Legislative Council from 1870 until 1890, when he moved into the Legislative Assembly.

His great-grandson remembered him fondly in his maiden speech to the State Parliament in November 2008.

"William Marmion had a reputation for being honest and clear-sighted," Bill said.

"He was an outspoken supporter of Fremantle as a gateway to the State and he was not afraid to stand up on behalf of his constituents.

"From the 1870s through to the 1890s, when Albany's King George Sound and other hubs threatened Fremantle's position as Western Australia's major port, William Marmion fought hard alongside other Fremantle businessmen to get the Government to build a much-improved longer jetty, thereby assuring Fremantle's place as the State's premier port facility.

"He also argued for the retention of the railway workshops in Fremantle rather than moving them to Midland Junction."

The history of the Marmion family stretches back to the early days when Fremantle and Perth were fledgling communities.



Western Australia's first Mines Minister William Marmion.

Bill's great-great-grandfather came to WA from Ireland as a young man to make his way in the world.

"I am reminded that great men and women who built this State ... had a vision and were not afraid to step out to create that vision," he told Parliament.

"I am here today because my great-great-grandfather was such a man.

"His name was Patrick Marmion, and in 1841, at the ripe old age of 25, he migrated from Northern Ireland to Fremantle.

"Although Fremantle and Perth had been settled for only 12 years before Patrick arrived, his energy, drive and commercial nous must have suited the times.



Minister Marmion has a strong family connection to WA's resources sector.

"Officially, ship's records list his occupation as a clerk, with one historian suggesting that he arrived as an indentured servant.

"Even so, he managed to develop a successful merchant business in Fremantle, along with a whaling station up the coast, close to where the suburb of Padbury is now located.

"He died in 1855, leaving his wife, Charlotte, and son William Edward Marmion, to continue the family business.

"William went on to make his mark in other ways."

And the rest, as they say, is history.



SAVE THE DATE

The Department of Mines and Petroleum's Golden Gecko Awards recognising environmental excellence and leadership in the WA resources sector, will be held at the Duxton Hotel, Perth on 9 October 2014.

This year's event will be staged in two parts, a brief seminar where finalists will present on their submissions, followed by a cocktail networking event where the Golden Gecko award/s will be announced by the Minister for Mines and Petroleum, Bill Marmion.

Tickets will be on sale shortly.

Please visit www.dmp.wa.gov.au/goldengecko or phone Richard Smetana on (08) 9222 3639 for more information.



KIMBERLEY SEISMIC SURVEY UNDER WAY



Coastal Seismic Survey base camp mechanical work trailer.

Much needed data and a greater geological understanding of the Kimberley region's Canning Basin will be obtained through a seismic survey which got underway at the end of May this year.

Mines and Petroleum Minister Bill Marmion said understanding the Earth's basic structure would allow the responsible and informed search for natural resources, including groundwater.

"It represents one of a series of surveys across Australia as part of the National GeoTransect Program to build a three-dimensional image of the Australian continent, and its evolution," he said.

The project, funded by the State Government's Exploration Incentive Scheme (EIS), involves a 700km seismic survey along the Great Northern Highway and the Gibb River Road, from 150km north of Port Hedland to 120km east of Derby.

Funded by the EIS, this latest seismic survey will link up with the deep crustal surveys conducted by the Department of Mines and Petroleum (DMP) in the Kimberley under the A\$3m Kimberley Science and Conservation Strategy.

DMP's Geological Survey of WA (GSWA) Executive Director Dr Rick Rogerson said understanding the structure of the old pieces of crust that have amalgamated as the Australian continental plate would assist geological understanding of the region.

"We're trying to establish the subsurface geology of the Canning Basin and the extent and nature of its sub-basins and troughs as well as identify any regional faults, folds and other major structural elements," Dr Rogerson said.

"There are a number of major fractures in the Earth's crust between the crystalline basement rocks of the north (Kimberley) and the crystalline basement of the Pilbara that are of particular interest."

He said understanding the basic structure of the Earth allows for more informed exploration for natural resources, including ground water.

Seismic reflection data are generated by vibrating the ground using a number of large, specialised Vibroseis trucks. The seismic waves which are generated

travel down through the Earth and are reflected back from geological strata and fault structures that mark changes in rock type.

"Geophones that are spread out along the survey line record the return of the reflected seismic waves. The seismic waves take longer to return from deeper reflectors so the depth of each layer can easily be determined," Dr Rogerson said.

"As the survey progresses an image is built up that is a vertical slice through the crust. Listening for up to 20 seconds at each recording point allows us to image to the base of the crust and possibly even into the Earth's mantle."

Wherever possible, the survey was conducted along the road verge to minimise disruption to traffic and prevent any possible damage to the road surface during the six to eight-week survey period.

The survey is an important collaborative research project between the Australian Government's Geoscience Australia (GA) and DMP's GSWA.

AGRICULTURE

East Kimberley – Ord – Ord/East Kimberley Expansion Project

WA STATE GOVERNMENT

The Ord East Kimberley Expansion Project is a good example of the Commonwealth and State Government working closely together to deliver economic and Indigenous participation opportunities and much-needed infrastructure to a regional community of Western Australia. The State Government committed \$322m to increase the existing amount of irrigated land in the Kununurra region by releasing approximately 15,000ha of additional Ord farm lands. This funding has enabled the construction of irrigation channels, roads and off-farm infrastructure to service the future needs of the region's growing population and sustain economic growth. The State Government has signed a Development Agreement with Kimberley Agricultural Investment (KAI) for the lease and development of 13,400ha of irrigation land in the Goomig and Knox Plain areas. KAI, a subsidiary of China's Shanghai Zhongfu Group, proposes to establish a sugar industry in the Kununurra region. During 2014 the State is working towards the release of approximately 5,000ha of Ord West Bank and Mantinea lands via a Request for Proposal process. The Commonwealth Government has invested \$195m for construction of social and common use infrastructure in the East Kimberley region through the East Kimberley Development Package (EKDP) National Partnership Agreement (NPA). The Yawoorroong Miriuwung Gajerrong Yirgeeb Noong Dawang Aboriginal Corporation (MG Corporation) building and the Department of Housing transitional housing projects have been successful nominations for the Australian Institute of Architects 2013 Western Australian Architectural Awards. The transitional housing project has also achieved a 2013 Premier's Award for Improving Indigenous Outcomes.

Expenditure: \$517m.

Employment: Construction: 761

GOLD

Boddington – Gold Mine

NEWMONT BODDINGTON GOLD PTY LTD

Newmont Boddington Gold (NBG), a major gold and copper mine in the south-east of Western Australia, 120km from Perth, commenced operations in 2009 after a \$3b expansion of the original Boddington Gold Mine, a joint venture which had been in care and maintenance for several years. NBG is now 100 per cent owned and operated by United States global miner Newmont Mining Corporation. First gold was poured in September 2009 and 18 months later the operation achieved its first one-million-ounce milestone. An estimated 700,000-750,000 ounces of gold per annum is expected to be produced for the life of the mine, which is officially more than 24 years, however it is possible the mine life could be further extended with a decision likely by the end of 2014. NBG also produced 67Mlbs of copper in 2013 and a similar amount is expected to be produced in 2014.

Employment: Operation: 650

Kalgoorlie – Tropicana Gold

ANGLOGOLD ASHANTI/INDEPENDENCE GROUP JOINT VENTURE

The Tropicana Joint Venture gold mine was opened ahead of schedule in 2013, within budget. It received State EPA approval on 24 September 2010. FID was approved November 2010. Commonwealth EPBC Act approval was obtained on 13 December 2010 with environmental offset conditions. The construction of a 225km road, bore field, pipelines, airstrip, accommodation village, power station and mine plant have been completed. In September 2013, the Tropicana Joint Venture project reached a significant milestone with its first gold pour. On 6 March 2014, the Minister for Mines and Petroleum officially opened the Tropicana Gold Mine.

Expenditure: \$700m.

Employment: Construction: 700; Operation: 400

INFRASTRUCTURE

South West Region – Kemerton (HUILS – Heavy Use Industrial Land Strategy)

WA STATE GOVERNMENT

Kemerton Industrial Park (KIP), located 17km north of Bunbury, is the main strategic industrial area in the South West region and the nearest regional heavy industrial site to Perth. It is designed to supplement the Kwinana Industrial Area, only 90 minutes away by road. The estate comprises 7,543ha of land, including 2,019ha of industrial core, 293ha of support industry area and 5,231ha of buffer areas. It is accessible to the Port of Bunbury by road and a rail link is being planned. The estate is serviced by major road links to the metropolitan area. The KIP currently includes a silicon smelter, a titanium dioxide plant, a chlor-alkali plant, two peak load power stations and a wastewater treatment plant. Under the Heavy Use Industrial Land Strategy, the Government is progressing Kemerton towards project ready status by undertaking environmental, heritage and planning approvals for the estate. Work towards progressing approvals commenced in 2009 and is anticipated to be completed in 2014-15, by which time the structure plan and zoning adjustments will also have been completed.

IRON ORE

Pilbara – BHPB – Port Blending and Rail Yard Facilities

BHP BILLITON IRON ORE PTY LTD

BHP Billiton WA Iron Ore's Port Blending and Rail Yard Facilities project has enhanced the efficiency of its supply chain. The project handled first ore in the December 2013 quarter, as planned.

Expenditure: \$1.25b.

Employment: Construction: 2100; Operation: 720

FORTESCUE METALS GROUP LTD

Fortescue Metals Group operates four iron ore mines across its two mining hubs, Chichester and Solomon, in the Pilbara. In March 2014, Fortescue officially celebrated the completion of its \$9 billion expansion, which lifted production capacity to 155Mtpa. The expansion included the construction of the greenfields Solomon Hub in the Hamersley Ranges, comprised of Kings Valley and the nearby 20Mtpa Firetail mine; an expansion of the Christmas Creek mine to 50Mtpa; and major extensions of Fortescue's port and rail facilities. Eighty-six per cent of the money spent on the Kings Valley project was spent with Australian suppliers.

Expenditure: \$9b.

Employment: Construction: 7000; Operation: 6000

Pilbara – Port Hedland – Atlas Iron

ATLAS IRON LTD

Atlas Iron Ltd is an iron ore explorer and miner focused on developing a number of projects in the Pilbara region of Western Australia. Atlas commenced exporting in December 2008 from its Pardoo mine, east of Port Hedland. Atlas' second mine, Wodgina, commenced operations in 2010. Atlas' third mine, Mt Dove, was opened in December 2012 followed by its Abydos mine in 2013. The first phase of the Mt Webber mine has commenced, with haulage expected to begin in June 2014. Atlas aims to export between 9.8Mt and 10.3Mt in the 2014 financial year. Atlas plans to progressively expand its exports, targeting 15Mtpa by 2015 and 46Mtpa during the 2017 calendar year. Atlas operates its current mines on the basis of road haulage to Port Hedland. For the longer-term developments and production beyond 15Mtpa, rail haulage will be preferable due to the scale and distance to port. Atlas is engaging with a number of infrastructure owners and developers with the intent of unlocking the value of Atlas' Horizon 2 assets.

Expenditure: \$950m.

Employment: Operation: 700

OIL & GAS DEVELOPMENTS

Pilbara – Macedon Domestic Gas Project

BHP BILLITON PETROLEUM (AUSTRALIA) PTY LIMITED

BHP Billiton Petroleum (Australia) Pty Ltd and Apache Energy Limited have commissioned a domestic gas plant for Western Australia at the Ashburton North Strategic Industrial Area near Onslow. The development involves four sub-sea gas wells, a wet gas pipeline, an onshore gas processing plant 11km south-west of Onslow and a sales gas pipeline connected to the Dampier-to-Bunbury Natural Gas Pipeline. Daily gas production capacity is 200TJ.

Expenditure: \$1.5b.

Employment: Construction: 700; Operation: 14

AMMONIUM NITRATE

Kwinana – Ammonium Nitrate Facility Expansion

CSBP LIMITED

CSBP is currently expanding its ammonium nitrate production facility at Kwinana from its current capacity of 520,000tpa to 780,000tpa. The construction of an additional nitric acid plant and ammonium nitrate plant, together with an upgrade of the existing prilling plant and other infrastructure work, has been completed. Commissioning is underway and full operation is expected in the second quarter of 2014.

Expenditure: \$550m.

Employment: Construction: 500; Operation: 10

Pilbara – Burrup Industrial Estate Site D – Yara Pilbara Nitrates

YARA INTERNATIONAL ASA

Yara, Orica and Apache have formed a joint venture – Yara Pilbara Nitrates Pty Ltd (YPNPL). YPNPL has executed an Engineering, Procurement and Construction (EPC) contract for the construction of a circa 350,000tpa Technical Ammonium Nitrate (TAN) plant to be located on the Burrup Peninsula. Ammonia feedstock will be supplied from Yara Pilbara Fertilisers Pty Ltd (YPFPL), which operates its facility directly adjacent to the proposed location for the new TAN plant. YPNPL will be the operator of the TAN plant and Orica will manage the product sales and distribution. Yara and Orica each have a 45 per cent interest in the joint venture and Apache the remaining 10 per cent. It is expected that all manufactured product will be sold into the Pilbara region. Work on the project has commenced and it is expected that the new plant will be commissioned during the third quarter of 2015.

Expenditure: \$800m.

Employment: Construction: 600; Operation: 65

HEAVY MINERAL SANDS

Keysbrook – Heavy Mineral Sands Mine

MZI RESOURCES LTD

MZI is proceeding to develop a mineral sands mine located near the township of Keysbrook, approximately 70km south of Perth. The project has received environmental approval from the Minister for Environment, as well as development approvals and extractive industry licences from the Shires of Murray and Serpentine-Jarrahdale. Keysbrook has a mineral resource of 78.9Mt at an average grade of 2.5 per cent total heavy mineral (THM) and an ore reserve of 670,000t of THM, which underpins the first five-and-a-half years of operations. Based on the total mineral resource estimate, the potential mine life could be more than 15 years. Approximately 110,000tpa of heavy mineral concentrate from Keysbrook will be trucked 120km south to Doral's mineral separation plant in Picton, near Bunbury, where it will be toll treated under a processing agreement. MZI plans to commence construction in late June 2014, with first production scheduled for the third quarter of 2015. The project is expected to produce 67,500tpa of leucoxene products and 28,700tpa of zircon concentrate, which will be exported from the Bunbury Port.

Expenditure: \$70m.

Employment: Construction: 100; Operation: 50

INFRASTRUCTURE

Pilbara – Ashburton North Strategic Industrial Area

WA STATE GOVERNMENT

The State Government is developing the Ashburton North Strategic Industrial Area (ANSIA) as a hydrocarbon precinct in the Shire of Ashburton, 11km south-west of Onslow, to enable the development of natural gas projects and associated industries to exploit the gas reserves in the Carnarvon Basin and Exmouth Gulf. The ANSIA includes three larger sites for major gas processing proponents, secondary processing sites, areas for general support industries and supply base operations, a port with common user facilities to be managed by the Dampier Port Authority and common user access and infrastructure corridors. Two foundation proponents, BHP Billiton Petroleum and Chevron Australia, have taken up land allocations within the ANSIA. Chevron Australia commenced construction in late 2011 with first LNG exports scheduled for late 2016. BHP Billiton Petroleum has commissioned a domestic gas plant, with production capacity of 200TJ per day.

IRON ORE

Pilbara – BHP Billiton Iron Ore – Shiploaders 1 and 2

BHP BILLITON IRON ORE PTY LTD

During the December 2013 quarter, BHP Billiton approved an investment of US\$301 million (BHP Billiton share) to replace shiploaders 1 and 2 at the company's Nelson Point operations in Port Hedland. The two new shiploaders will increase the reliability of its inner harbour port facilities and create additional port capacity that will be utilised as a series of debottlenecking initiatives to increase the capacity of the supply chain to approximately 260Mtpa to 270Mtpa (100% basis), at a low capital cost. Commissioning of the two replacement shiploaders is scheduled for the second half of the 2014 calendar year.

Expenditure: \$380m

Employment: Construction: 500

Pilbara – Roy Hill Iron Ore Mine & Infrastructure ROY HILL HOLDINGS PTY LTD

Roy Hill Holdings is a private company which is majority-owned by Hancock Prospecting Pty Ltd, and has key international investment partners with strategic steel-making interests. It is developing the Roy Hill iron ore project located 115km north of Newman. This project is expected to come into production in 2015 and will produce 55Mtpa of iron ore for 20 years following ramp-up. The project includes mine development, mine processing infrastructure, a new heavy-haul railway, and significant new port facilities at Port Hedland's inner harbour. Environmental approval for Roy Hill mine Stage 1 was received in December 2009 and environmental approval for Stage 2 was received in March 2010. In July 2011, Roy Hill Infrastructure was granted a Special Railway Licence to develop a 344km railway from its mine in the eastern Pilbara to Port Hedland. All primary approvals have been secured and major project works commenced in late 2012. Dredging of the new berth areas at South West Creek was finished ahead of schedule, the airstrip and internal mine roads have been completed, and the rail construction, mine and port accommodation villages are completed and being utilised. As of late April 2014, over 2700 construction workers were engaged across the project. In addition, the new Corporate HQ and Remote Operations Centre at the Perth International Airport business precinct are now completed. Considerable works are already underway on port, rail and mine construction with the 34 per cent completion stage being reached in late April 2014. The debt financing package for a mining project of US\$7.2b was secured in March 2014.

Expenditure: \$9.9b.

Employment: Construction: 3600; Operation: 2000

IRON ORE PROCESSING

Pilbara – Cape Preston – Sino Iron CITIC PACIFIC

The Sino Iron project is located at Cape Preston, 100km south-west of Karratha. Construction of the largest magnetite mining and processing project in Australia is at an advanced stage, with limited production from the first and second of six lines commencing in 2013. On completion, the project will comprise of in pit crushers, six autogenous and six ball mills, concentrators, 6Mtpa pellet plant, 25km slurry pipeline, combined cycle 450MW power station, new port and trans-shipment facilities, and a 51GL desalination plant. At full production the project will export up to 21.6Mtpa of magnetite concentrate and 6Mtpa of high grade pellets. The first shipment of ore occurred on 2 December 2013.

Expenditure: \$5.2b.

Employment: Construction: 4000; Operation: 500

OIL & GAS DEVELOPMENTS

Carnarvon Basin – Greater Western Flank Phase 1**WOODSIDE ENERGY**

The Greater Western Flank Phase 1 Project will develop the Goodwyn GH and Tidepole fields, via a subsea tie-back to the existing Goodwyn A Platform. Engineering, procurement and fabrication activities are progressing to plan. The project remains on budget and on schedule for start-up in early 2016.

Expenditure: \$2.5b.

Carnarvon Offshore Basin – Barrow Island – Gorgon Project**GORGON JOINT VENTURE**

The Gorgon Joint Venture (GJV) made its final investment decision on the Gorgon Project in mid-September 2009. The Foundation Project on Barrow Island is a three train LNG development with a nameplate capacity of 15.6Mtpa and includes a domestic gas plant capable of delivering at least 300TJ/d of gas to the mainland. Cost estimates for the project construction have been reassessed at \$61b (US\$54) following a cost and schedule review conducted by Chevron in December 2013. The project involves the processing of gas from both the Gorgon and Jansz/lo gas fields and includes potentially the largest commercial CO₂ geosequestration project in the world. The project obtained State and Commonwealth environmental approvals in August 2009. On-island activity started in late 2009 and the major construction work for the processing plant commenced in 2011. Plant start-up and first gas is planned for mid-2015, with the provision of domestic gas by 31 December 2015.

Expenditure: \$61b.

Employment: Construction: 6250; Operation: 300

Pilbara – Wheatstone LNG Development**CHEVRON AUSTRALIA PTY LTD**

Chevron Australia Pty Ltd is currently constructing an LNG plant, domestic gas plant and port facilities at the Ashburton North Strategic Industrial Area near Onslow for its Wheatstone project. The project will initially have two LNG trains with a combined capacity of 8.9Mtpa, expandable to five or six trains with a total capacity of 25Mtpa, and a 250Mcf per day domestic gas plant connected to the Dampier-to-Bunbury Natural Gas Pipeline. The first export of LNG is scheduled for late 2016.

Expenditure: \$29b.

Employment: Construction: 6500; Operation: 400

AMMONIA/UREA

Shotts Industrial Park – Collie Coal to Urea PERDAMAN CHEMICALS AND FERTILISERS PTY LTD

Perdaman Chemical and Fertilisers Pty Ltd is proposing to develop a \$3.5b coal to urea plant at the new Shotts Industrial Park, near Collie. The plant will use proven coal gasification and fertiliser production technologies. Around 2.7Mtpa of coal will be used to produce approximately 2Mtpa of urea, primarily for export. The urea will be transported to Bunbury Port by rail. A 20-year off take agreement has been signed with Incitec Pivot. The coal supply contract is yet to be finalised. The company has received all its environmental and all other approvals from both the Western Australian and Commonwealth governments. Construction is on hold as the company is still looking for a reliable domestic coal supply prior to achieving its financial investment decision.

Expenditure: \$3.5b.

Employment: Construction: 2000; Operation: 200

HEAVY MINERAL SANDS

Shark Bay – Coburn Zircon Project**GUNSON RESOURCES LIMITED**

Gunson proposes to develop the Coburn zircon project, located south of Shark Bay and approximately 250km north of Geraldton. It contains total ore reserves of 308Mt at an average grade of 1.2 per cent heavy minerals, all of which lie within the portion of the project area that has received government environmental approvals for mining. At a mining rate of 23.4Mtpa, the project is expected to produce 49,500tpa of zircon, 109,000tpa of chloride ilmenite and 23,500tpa of a mixed rutile-leucoxene over its 19 year mine life.

Expenditure: \$202m.

Employment: Construction: 170; Operation: 110

INFRASTRUCTURE

Dampier Peninsula – Browse LNG Precinct WA STATE GOVERNMENT

The State Government is developing the Browse Liquefied Natural Gas (LNG) Precinct approximately 60km north of Broome. By focussing development at a suitable location, the Precinct will minimise the environmental footprint of gas processing and any social impacts in the region while maximising opportunities for the local community to benefit from development of the Browse Basin gas fields. The Precinct will have the capacity to accommodate at least two LNG processing operations, with a combined capacity of up to 50Mtpa. The State Government has acquired the land for the Precinct and will secure all relevant approvals to ensure the Precinct is 'project ready.'

Pilbara – Anketell – Anketell Port and SIA (Strategic Industrial Area)**WA STATE GOVERNMENT**

The Anketell project involves the establishment of a multi-user, multi-commodity deep water port and associated strategic industrial area (SIA) at Anketell, located 30km east of Karratha on the Pilbara coast. The port and associated infrastructure will be a proponent-funded but State owned Port which will be managed and operated under the *Port Authorities Act 1999*. The strategic industrial land will fall under the jurisdiction of the Western Australian Land Authority (LandCorp). During its initial phase, it is expected that Anketell will be an iron ore export facility and that, at its peak capacity, not less than 350Mtpa will be exported to customers, mainly in Asia. A number of iron ore producers with mining assets in the Pilbara have expressed interest in using the planned facilities at Anketell. It is likely that the Port will be developed in stages to accord with the development of the various mining operations which are located throughout the Pilbara.

IRON ORE

Mid West Region – Extension Hill Magnetite Mine

ASIA IRON

Asia Iron has primary environmental approval to produce up to 10Mtpa of magnetite concentrate, which will be transported by slurry pipeline to the port of Geraldton for export. The company is currently seeking secondary approvals and undertaking an implementation study for the project.

Expenditure: \$2b.

Employment: Construction: 1000; Operation: 350

Pilbara – West Pilbara Iron Ore Project

API MANAGEMENT PTY LTD

The Australian Premium Iron Joint Venture is proposing to develop the West Pilbara Iron Ore Project. Stage 1 of the project is based on the production of 30Mtpa of direct shipping iron ore from its Red Hill and Mt Stuart deposits located 35-80km south-west of Pannawonica. The ore will be transported by a new heavy haul railway for export via the proposed multi-user 350Mtpa port at Anketell. Subject to the successful completion of feasibility and environmental studies, and receipt of government regulatory approvals, the company anticipates construction to commence following a decision to proceed by the joint venturers and completion of funding arrangements. Primary State and Federal environmental approvals for the mine and rail elements of the project were received in December 2011, and for the first stage of Anketell Port in the first half of 2013.

Expenditure: \$7b.

Employment: Construction: 3500; Operation: 1000

Yilgarn – Deception Iron Ore Deposit

CLIFFS ASIA PACIFIC IRON ORE PTY LTD

Cliffs proposes to expand its Koolyanobbing Operation to include an additional iron ore mining area at the Deception Deposit, located approximately 150km north of Southern Cross. The Deception Deposit contains an estimated 7.1Mt of iron ore and is expected to have a mine life of around five years. Mining of the Deception Deposit has environmental approval with first production expected in the first half of 2017.

Expenditure: \$35m.

NICKEL

Mt Windarra – Windarra Nickel

POSEIDON NICKEL NL

Poseidon Nickel Ltd has submitted a project development proposal for the redevelopment of the Mt Windarra underground nickel mine, the development of the new Cerberus underground nickel mine, the construction and commissioning of a nickel sulphide concentrator, a gold tailings re-treatment plant and associated project infrastructure at Mt Windarra. Subject to obtaining all relevant approvals and project finance, Poseidon is forecast to commence construction in 2014.

Expenditure: \$250m.

Employment: Construction: 80; Operation: 180

OIL & GAS DEVELOPMENTS

Canning Basin – Buru Canning Basin Tight Gas BURU ENERGY

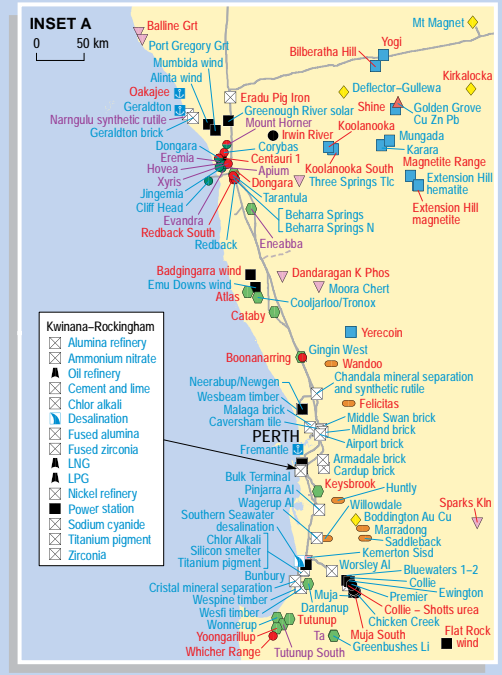
The Canning Basin is home to what is potentially the largest onshore resource of unconventional gas in Australia. Buru Energy Limited and Mitsubishi Corporation are currently investigating the potential of the basin's tight gas resource contained in the Laurel Formation, located 2-3km below the surface. The proposed 2014 program will involve testing the Laurel Formation at two locations in this basin – at Yulleroo which is 80km east of Broome and at Valhalla/Asgard which is 320km east of Broome. Testing for this potentially large tight gas resource will involve stimulation of the Laurel Formation using hydraulic fracturing and flowback of two existing Buru Energy exploration wells at Yulleroo and a further two wells at Valhalla/Asgard. These wells were drilled between 2010 and 2013. In preparation for the proposed 2014 program, Buru Energy has undertaken geological modelling, building capacity and accessing world class and internationally experienced companies to support Buru Energy's programs. The company has undertaken hydrogeological assessments and is collecting robust baseline datasets to support the rigorous environmental approvals process currently underway. Buru Energy is also currently undertaking an extensive program of engagement with Traditional Owners, pastoralists and the general Kimberley community, ensuring they have access to comprehensive information about the proposed activities, including the fracturing process and environmental safeguards, as well as independent, up-to-date advice regarding the proposed program. The results of the 2014 exploration program will assist Buru Energy's understanding of the commercial potential of the Laurel Formation as a significant and strategic tight gas resource to Western Australia. Canning Basin gas is destined for the domestic market. The development of the gas is under the *Natural Gas (Canning Basin Joint Venture) Agreement Act 2013*, which targets the delivery of at least 1,500PJ of gas into the WA domestic gas market over a 25-year period.



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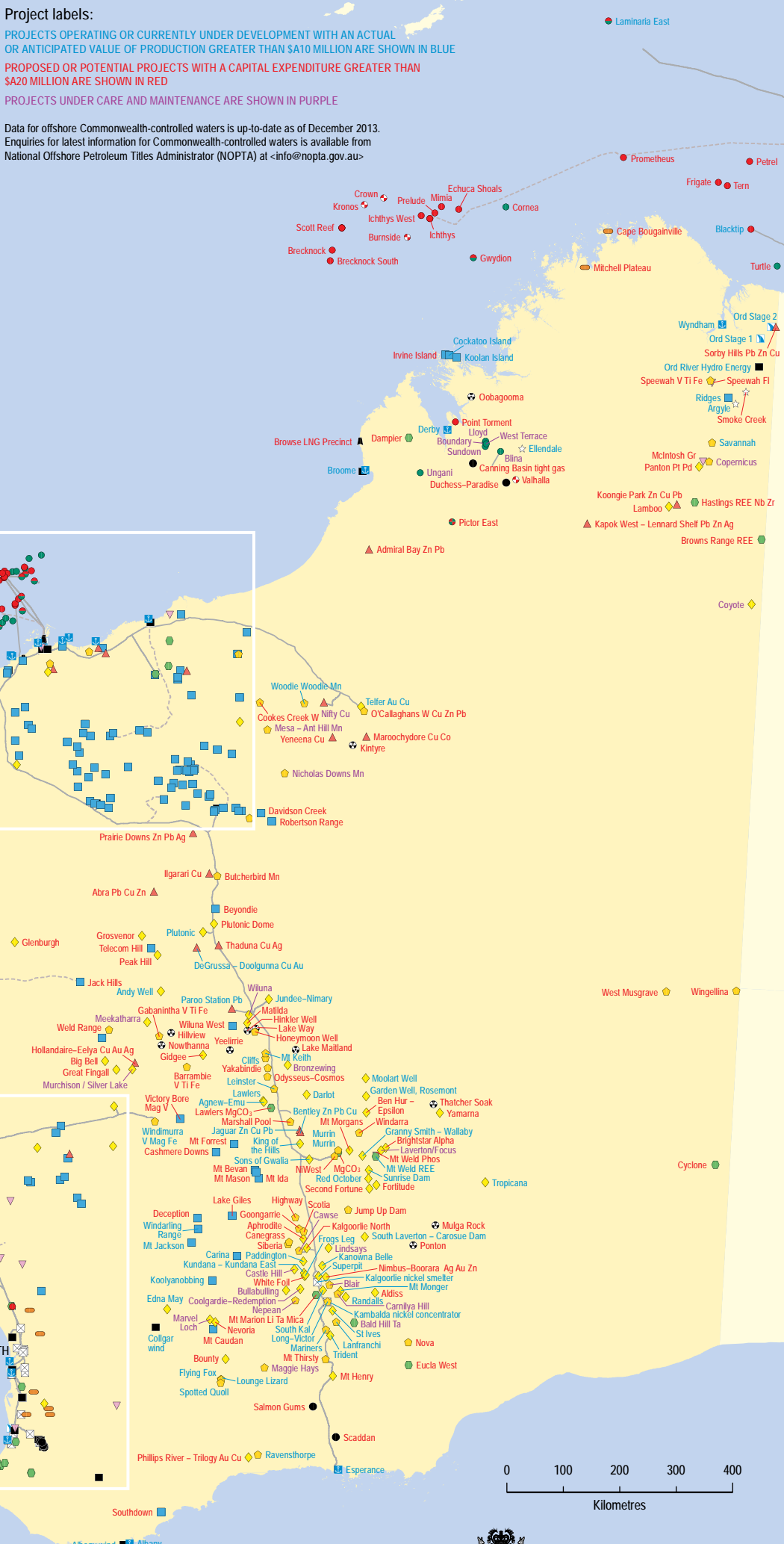
Major Resource Projects — June 2014



Project labels:

- PROJECTS OPERATING OR CURRENTLY UNDER DEVELOPMENT WITH AN ACTUAL OR ANTICIPATED VALUE OF PRODUCTION GREATER THAN \$A10 MILLION ARE SHOWN IN BLUE
- PROPOSED OR POTENTIAL PROJECTS WITH A CAPITAL EXPENDITURE GREATER THAN \$A20 MILLION ARE SHOWN IN RED
- PROJECTS UNDER CARE AND MAINTENANCE ARE SHOWN IN PURPLE

Data for offshore Commonwealth-controlled waters is up-to-date as of December 2013. Enquiries for latest information for Commonwealth-controlled waters is available from National Offshore Petroleum Titles Administrator (NOPTA) at <info@nopta.gov.au>



MINERAL SYMBOLS

- Precious mineral
- Precious metal
- Au (or as shown)
- Steel alloy metal
- Ni (or as shown)
- Speciality metal
- Ti-Zr (or as shown)
- Base metal
- Iron
- Alumina
- Bx (or as shown)
- Coal and lignite
- Uranium
- Industrial mineral
- Processing plant

PETROLEUM SYMBOLS

- Gas field
- Oil field
- Oil and gas field
- Significant gas discovery
- Significant oil discovery
- Significant oil and gas discovery
- Processing plant
- Oil / gas pipeline, operating
- Oil / gas pipeline, proposed

INFRASTRUCTURE

- Power plant
- Radio astronomy
- Irrigation / water / desalination
- Port

COMMODITIES

- Ag..... Silver
- Al..... Alumina
- Au..... Gold
- Bx..... Bauxite
- Co..... Cobalt
- Cu..... Copper
- Dmd..... Diamond
- Fe..... Iron
- Fl..... Fluorite
- Gp..... Gypsum
- Grt..... Garnet
- K..... Potassium
- Kln..... Kaolin
- Li..... Lithium
- LNG..... Liquefied natural gas
- LPG..... Liquefied petroleum gas
- MgCO₃..... Magnesite
- Mn..... Manganese
- Ni..... Nickel
- Nb..... Niobium
- Pb..... Lead
- Pd..... Palladium
- Phos..... Phosphate
- Pt..... Platinum
- REE..... Rare earth elements
- Ssd..... Silica sand
- Ta..... Tantalum
- Ti..... Titanium
- Tlc..... Talc
- V..... Vanadium
- W..... Tungsten
- Zn..... Zinc
- Zr..... Zirconium

