

THE AUSTRALIAN MINING REVIEW

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THE MAKING OF A NEW GOLD KING NEWS p16		TAILINGS MANAGEMENT BEST PRACTICE SPECIAL FEATURE p20		MINING EQUIPMENT MAINTENANCE TECHNICAL TALK p76	
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Image: Salt Lake Potash.

SALT

OF THE EARTH

Salt Lake Potash has begun construction on the country's first commercial scale Sulphate of Potash (SOP) evaporation ponds, aiming for them to be part of a clean, sustainable WA fertiliser business.

FEATURE p37



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NEWS

Commodities Snapshot	4
Explorers on the Move	12
Technology & Innovation	14
International	16
Commodity Focus: Uranium	18

FEATURES

Tailing Management Best Practice	20
Mining in the Hunter Valley	31
Salt Lake Potash	37
Granny Smith Gold Mine	39
Yarrabee & Middlemount Mines	42
Pilbara Ports	44
Regis Resources	47
Boddington Gold Mine	51
Illawarra Metallurgical Coal	54

INDUSTRY FOCUS

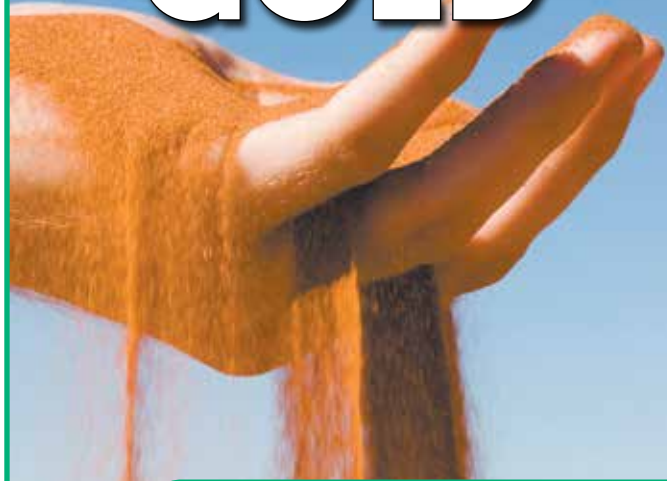
Companies Gearing Up	56
Automation for the Mine Site	60
Dredging Solutions	63
Drilling Supplies & Services	66
Industrial Cameras	68
Industrial Recycling Solutions	69
Material Handling Services	70
Pre-Employment Medicals	71
Weather Stations	74

TECHNICAL TALK

Mine Maintenance	76
Wash Down & Equipment Services	85



IN THE SPOTLIGHT:
MINERALS COMMODITIES
CHIEF EXECUTIVE
MARK CARUSO p94

GOING UNDERCOVER FOR
GOLD

Technology & Innovation p14

THE BLACK
STAR

Mining in the Hunter Valley p31

EXPORTS IN
SHIP
SHAPE

Pilbara Ports p44

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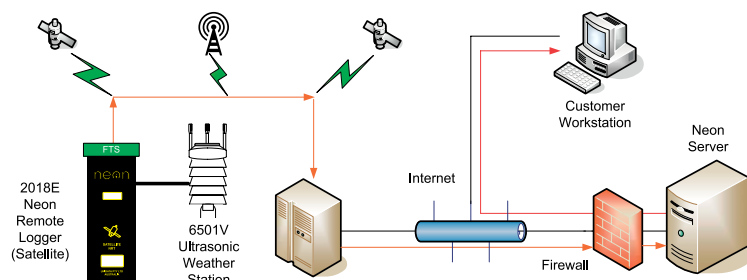
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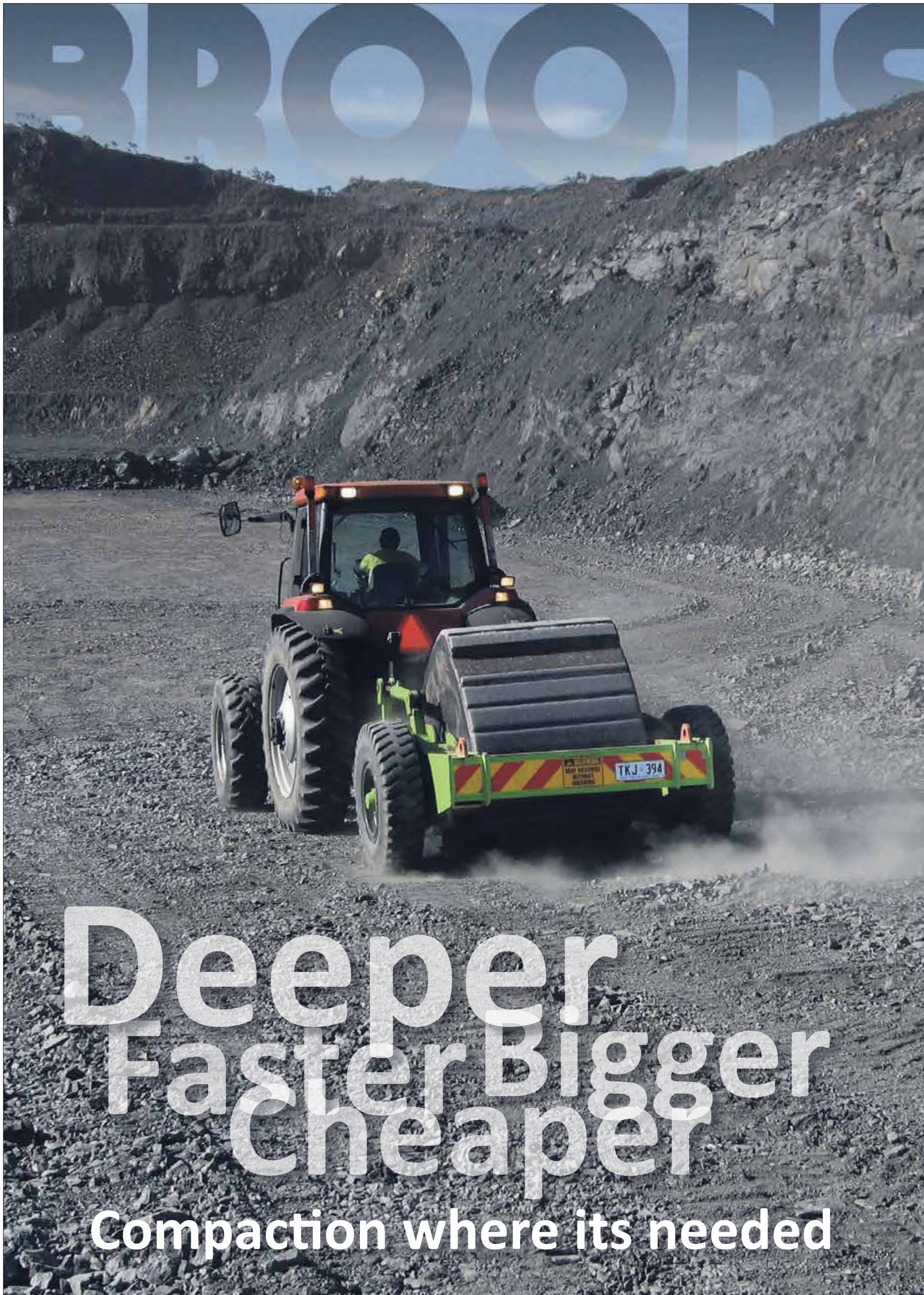
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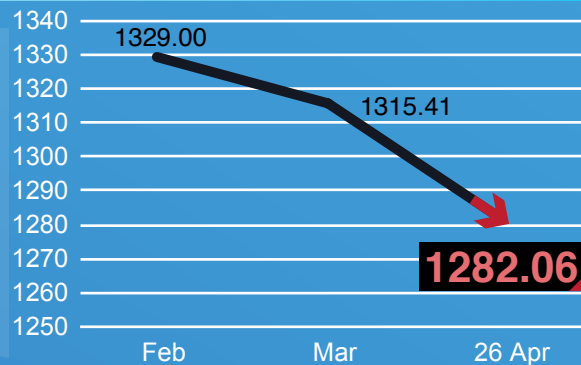
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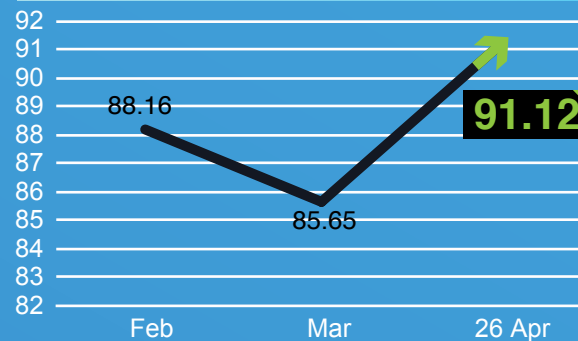
Flat US inflation left the gold price to fall marginally despite a decline in the dollar and stronger than expected consumer spending.



IRON ORE

\$US/t
62% Fe CFR China

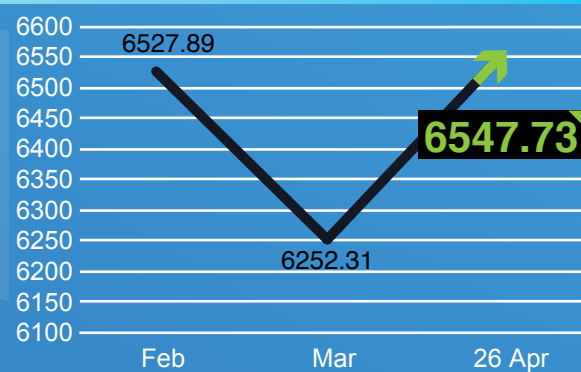
Iron ore prices rallied with a rise in global crude steel output in March and signs of strengthening demand in China.



COPPER

\$US/t
LME Price

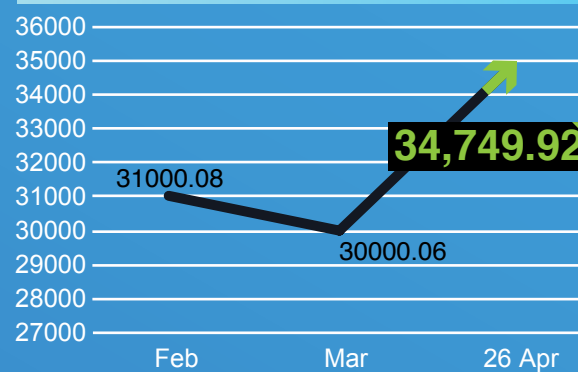
Copper rallied towards the end of the month after volumes slipped and demand decreased over the holiday period.



COBALT

\$US/t
LME Price

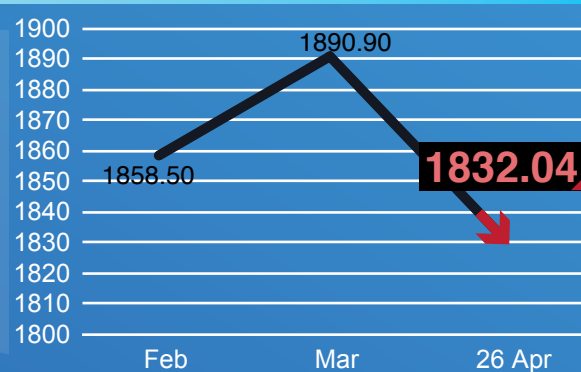
Cobalt prices recovered after a supply surge in the Democratic Republic of the Congo caused prices to decline last month.



ALUMINIUM

\$US/t
LME Price

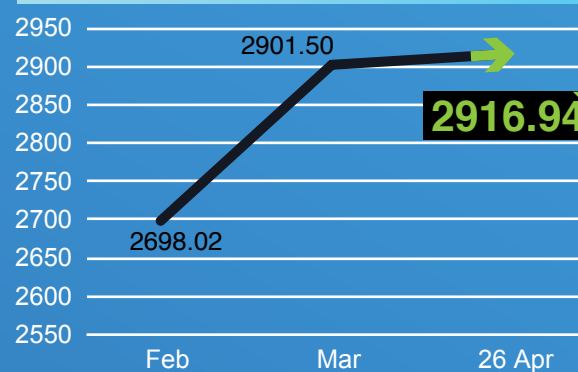
After a three-month peak in March, aluminium prices fell but could rally with an expected increase in Chinese production in coming months.



ZINC

\$US/t
LME Price

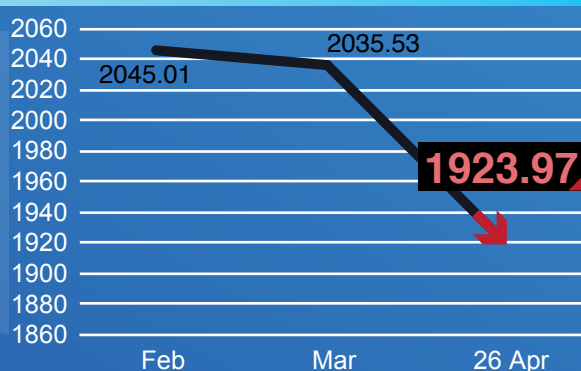
Shortages drove zinc prices to a nine-month high despite concerns that Chinese smelters will increase output and create a surplus.



LEAD

\$US/t
LME Price

Despite recovering slightly in the first quarter, lead prices look set to continue falling as existing stockpiles meet supply deficits.



NICKEL

\$US/t
LME Price

Nickel prices fell amid signs of rising supply after the Chinese government stimulus measures took hold.



COMMODITY FOCUS > URANIUM PG 18

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Image: Cameco.

The Federal Government approved the Yeelirrie mine just days after the Federal election was called.

Resources remain key election issue

EMMA DAVIES
NATIONAL

AS the nation gears up for the May 19 Federal election, the Coalition and Opposition have been quick off the mark to target the resources sector, with key funding and approvals announced for the mining industry.

Resources and Northern Australia Minister Matt Canavan promised \$100.5 million for the Exploring For The Future program, saying continued investment in Australian resources was key to remaining a leader in the global market.

“That is why the Coalition Government has invested in the program, and has developed Australia’s first National Statement on Resources,” Mr Canavan said.

“Investing in critical minerals supports the nation’s economy and will create more jobs for Australians by growing our resources sector.”

Meanwhile, Opposition Leader Bill Shorten also announced a \$75 million pledge to fund the Exploring for the Future program, indicating that he wanted the program to focus on mineral resources like lithium.

“We want to ensure Australian mines are powering the commodities of the future – such as lithium – as we build the renewable energy economy,” Mr Shorten said.

The Federal Government also approved Cameco’s contentious Yeelirrie uranium mine in WA on April 24, despite being previously rejected by the WA Environmental Protection Authority (EPA) over conservation concerns.

The EPA believes the move could threaten rare subterranean fauna species and harm populations of malleefowl, Princess parrots and Greater bilbys.

And just days before setting the May 18 election date, the Prime Minister also gave the go-ahead for Federal environmental approval for Queensland’s Adani mine.

But the moves have been condemned by Greens Senator for WA Jordan Steele-John as political stunts engineered to win votes.

“We saw a radical political decision made on the Adani mine, and now a radical political decision made on the Yeelirrie uranium mine,” Mr Steele-John said.

“This plan needs to be scrapped, and I am calling on the Labor Party on both a state and federal level to review the approvals.”

Heads up on tailings

GERARD MACARTNEY
INTERNATIONAL

THE international mining community has rallied and called for global action to ensure optimum safety measures are put in place at all tailings dams.

Tailings dams are used to store waste material from mining and have become the cause of major concerns in the wake of the Vale Brumadinho mine disaster in January, estimated to have killed more than 300 people.

The breach was the second major accident involving a tailings dam in less than four years and has made some investors wary of owning mining shares.

The Global Minerals Professionals Alliance (GMPA) announced a new Global Action on Tailings initiative to discuss and tackle problems surrounding conventional tailings storage facilities, how to improve the current practices and, ultimately, how to phase out tailings storage facilities all together.

Professor Hugh Miller of the Society for Mining, Metallurgy and Petroleum (SME) said that the way forward was through collaboration.

He said that it was possible to address the significant problems posed by tailings management, and to eventually eliminate the need for such facilities.

“As a society, we have tremendous technical capacity to confront these challenges through our members and fully recognise the need for global collaboration to make substantive change,” he said.

The initiative will take a “multi-pronged approach” to changes around tailings to focus on data collection, the dissemination of existing best practices, case studies and research that



Image: Vale.

Vale chief executive Fabio Schvartsman flies over Brumadinho after the tailings dam breach.

would all be accessible through a soon-to-be launched website specifically for global action on tailings.

Tailings teams will be established at all participating GMPA organisations, where expert analysis and research will be used to address the challenges and issues that arise.

According to Southern African Institute of Mining and Metallurgy president Alastair Macfarlane, recent events had galvanised focus on the design, placement and management of waste storage facilities, while at the same time emphasising the need for research to reduce the need for such facilities.

“The sharing of global knowledge in these efforts is essential – not only to pool global knowledge, but to prevent sub-optimisation on a local basis,” he said.

The Church of England, which is leading an investor push for a new global standard for tailings storage facilities, said it had written to almost 700 companies asking for more information to be published.

This includes data on the design of a dam, its history, location, height and third party reviews.

Church of England Pensions Board ethics director Adam Matthews said the community needed to be able to understand how every mining company managed each facility.

He said the individual company disclosures would be scrutinised by investors as they develop an assessment framework to profile each company on their tailings management.

SEE FEATURE ON TAILINGS MANAGEMENT: PAGES 20-30.

Grant energises battery manufacturing

RAY CHAN
NATIONAL

THE Australian Government has boosted specialist battery manufacturing by providing an industry-led cooperative research centre with a \$25 million grant to help the sector.

The Future Battery Industries Cooperative Research Centre (CRC), headquartered at Curtin University in WA, will help tackle industry identified gaps in the battery industries value chain, support battery deployment and optimise the circular economy for battery waste recycling.

The CRC, to be established during the year, is also supported by commitments of \$28m in cash and \$82m in kind commitment from industry, government and research partners.

The partnership of 58 industry, academic and government partners will address industry-identified gaps in the battery industries value chain.

It will focus on three research programs where industry, government and researchers have joined together: battery industry development; the processing of minerals; metals and materials for batteries and the development of a new battery storage system.

Federal Industry, Science and Technology minister Karen Andrews said the unit would also look to expand battery minerals and chemicals production.

“Batteries and battery development play a vital role in our society and present excellent export opportunities. This research will allow Australia to capture a significant portion of the benefits in global battery industries,” Ms Andrews said.



Image: Curtin University.

At the announcement of the CRC funding at Curtin University: FBI CRC CEO Stedman Ellis, Federal Member for Swan Steve Irons, Federal Industry, Science and Technology minister Karen Andrews, Curtin deputy vice-chancellor Chris Moran, FBI CRC chair Tim Shanahan, Liberal Candidate for Curtin Celia Hammond, and Federal Member for Moore Ian Goodenough.

“The CRC Program is a proven model of industry and research cooperation that produces impressive commercial results.

“Our aim is to strengthen the competitiveness, productivity and sustainability of Australian industries.”

The CRC plans to help Australia play a leadership role in making the most of the increased uptake of renewables. It has all the components necessary for modern battery technology, including lithium, nickel, cobalt, manganese, aluminium, vanadium, and rare earth metals and graphite.

The FBI CRC builds on the strengths of industry and researchers across Australia. The centre will research areas including value chain development, sourcing of materials and the wider deployment of batteries in homes, infrastructures and society.

Welcoming the development, WA Mines

and Petroleum minister Bill Johnston said a CRC based in Perth would provide substantial economic benefits and help create new jobs in the growing battery metals and mining equipment, technology and services sectors.

“The FBICRC bid process has demonstrated the close co-operation between the WA Government and industry, and recognises the opportunities the future battery industry presents for Australia,” he said.

The CRC will fund 40 PhD students and undertake an education and training program with activities that will assist in building a workforce to support Australia’s future battery industries.

A vocational education and training sector engagement program will also be run and small and medium enterprise workshops will be held to enhance business capabilities and competitiveness.

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No silver lining in iron

RAY CHAN
NATIONAL

THE Federal Government has dampened hope of new tax cuts arising from a surge in global iron ore prices.

Already well above the government's forecasts in last year's economic statement, the price has soared in the wake of the Brumadinho dam collapse in January, which is expected to lift demand for Australian resources.

Iron ore production from the Brazilian mining complex is now uncertain but it could be cut by tens of millions of tonnes per year, a gap which Australia, the world's largest exporter of iron ore, looks set to fill.

Pundits had tipped that the development could pour up to \$6 billion into federal coffers, boosting Prime Minister Scott Morrison's election hopes by giving him leverage to grant workers another round of tax cuts, as well as producing a bigger surplus earlier than expected.

A higher iron ore price means improved profits for the three major ASX-listed iron ore producers – Rio Tinto, BHP and Fortescue Metals Group – and therefore higher corporate tax payments.

Each US\$10 difference in the iron ore price above Treasury expectations could lift

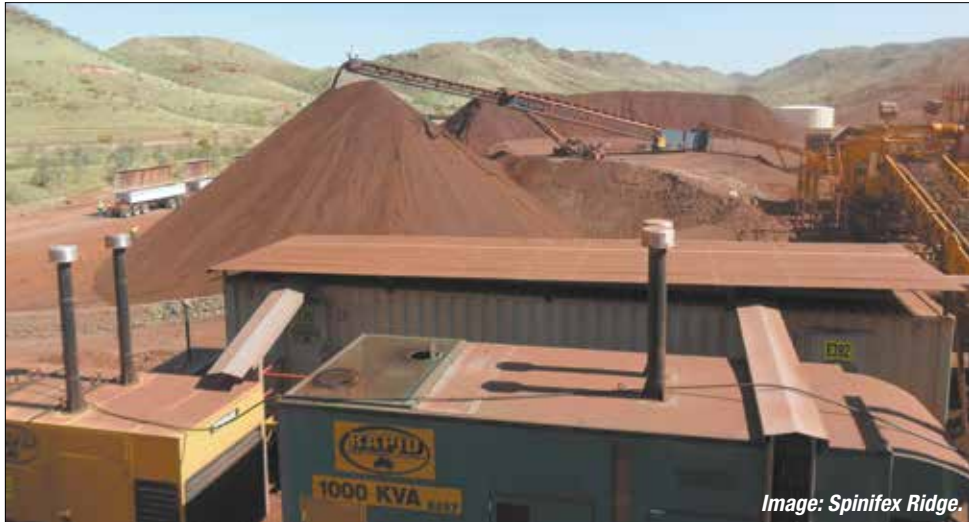


Image: Spinifex Ridge.

The Federal Budget advises caution over the price of iron ore.

Commonwealth revenue by up to \$4 billion over a full year.

The 2018 budget forecast the price of iron ore at US\$55/t, but it topped US\$90/t recently and has sat above \$US65/t since September.

However, Treasury officials believe the recent price jump in iron ore and coal prices will not last, and say future governments should not rely on them.

Last month's Federal Budget noted that there was greater uncertainty than usual around commodity prices as a result of heightened price volatility and policies in

China and Brazil.

"As such, a prudent approach to the bulk commodity price assumptions continues to be appropriate," the Budget papers said.

They pointed out that while high bulk commodity prices have occurred as a result of global supply issues, they are not expected to generate a significant supply response from Australian producers.

The iron ore price will remain elevated over the next four quarters, but the spot price is tipped to decline as supply-side issues are addressed. Iron ore is expected to decline over

the year to reach US\$55/t FOB by the end of the March quarter in 2020.

Canberra acknowledged the bearish tone of its analysis, observing that "some market and industry participants have highlighted a risk that prices could remain high for an even longer period of time".

"But if the price was to fall immediately to US\$55/t, four quarters earlier than assumed, nominal GDP could be around \$5.8 billion lower than forecast in 2018-19 and \$10.6b lower in 2019-20," the Budget warned.

"This would result in a decrease in tax receipts of around \$0.5b in 2018-19, \$2.6b in 2019-20 and \$1b in 2020-21.

"By contrast, if the iron ore price was to remain elevated for four quarters longer than currently assumed, before falling immediately to the \$55 mark, nominal GDP could be around \$0.8b higher than forecast in 2018-19 and \$15.5b higher in 2019-20."

Meanwhile, BHP, Fortescue Metals and Rio Tinto have all cut their full-year iron ore guidance following the impact of Cyclone Veronica, which caused Port Hedland in WA to be closed for five days in March.

Port Hedland is Australia's biggest port and the biggest iron ore port in the world, shipping tens of millions of tonnes of iron ore a month from mines across the Pilbara to export markets.

See commodities snapshot, page 4.



Sir Arvi Parbo.

Industry mourns death of legend

NATIONAL

THE mining industry is mourning the loss of Sir Arvi Parbo, who died on May 1 in Melbourne.

The former chairman of Alcoa, BHP and Western Mining Corporation, and Business Council of Australia president, was 93.

He has been credited with leading the development of the nation's greatest resources developments.

He was involved with major projects such as BHP's Olympic Dam and the Kambalda nickel mine, and led the aluminium industry through his position at WMC.

Sir Arvi, who had been experiencing poor health in recent weeks, was born in Estonia, and arrived in Melbourne in 1949 as a refugee after World War II.

He studied mining engineering in Adelaide and joined WMC in 1956 as a surveyor at a gold mine near Bullfinch, WA.

Sir Arvi was also chairman of a raft of diverse companies such as the Australian divisions of global companies like Alcoa, Munich Re and Zurich Insurance, and was the inaugural president of the Business Council of Australia in 1983.

RAY CHAN
WA

THE sod has officially been turned at the Albemarle lithium hydroxide processing plant in Kemerton.

The Albemarle facility is a \$1 billion investment in WA that will create 500 construction jobs and another 500 jobs in the South-West, once operational.

The ceremony was attended by Premier Mark McGowan, United States Ambassador to Australia, Arthur B. Culvahouse Jr, state and federal Members of Parliament and Albemarle representatives.

The plant will become Australia's largest lithium hydroxide processor, with approval to produce up to 100,000 tonnes per annum of premium battery grade lithium hydroxide.

The McGowan Government is working with Albemarle to ensure job opportunities are maximised for local workers in Collie, Bunbury, the wider South-West and the Murray-Wellington region.

This includes delivering an Economic Development Plan for the region, which will identify strategies and specific training to assist the South-West workforce to take up job opportunities created by WA's Future Battery Industry Strategy.

To capitalise on the state's unique resources and growth in the lithium-ion battery sector, the Government last year launched the Future Battery Industry Strategy, and the creation of the Lithium and Energy Materials Taskforce.

WA is currently the leading global producer of lithium, the second largest global producer of rare earths, the third largest global producer of cobalt and the fourth largest global producer of nickel.

Mr McGowan said he was pleased to



Image: WA Government.

Officially turning the sod at Kemerton were David Klanecky of Albemarle (left), US Ambassador Arthur B. Culvahouse Jr, Premier Mark McGowan, and federal Trade and Investment minister Simon Birmingham.

commemorate the start of construction on Australia's biggest lithium hydroxide project.

"In February 2018, I met with representatives from Albemarle in Washington DC to discuss the possibility of launching a lithium project of this magnitude in WA," he said.

"I congratulate Albemarle on making this vision become a reality.

"My Government's number one priority is creating local jobs for local workers, so we have been working with Albemarle to make sure there are opportunities for local South-West workers from Collie, Bunbury and Murray-Wellington.

"With up to 1000 local jobs being created, this project will be a huge economic boost for the South-West region and will show the capability Western Australia has in the lithium-ion battery sector."



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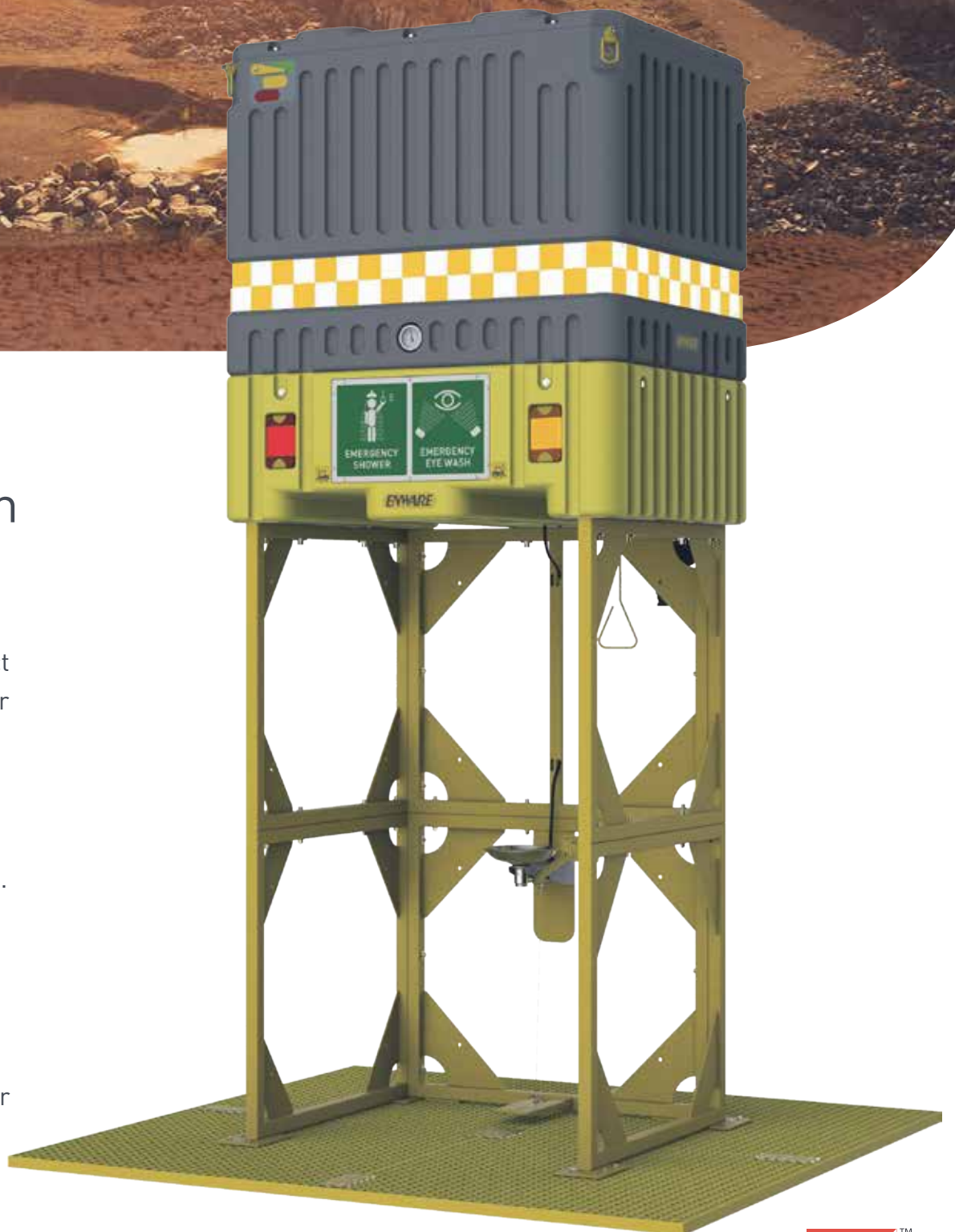
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Mithril Managing Director David Hutton speaks at the conference.

Strong zinc prices boost at Billy Hills

RAY CHAN
SA

A COLLAPSE in global stockpiles of zinc at a time zinc prices have started firming has created a more favourable market sentiment towards the commodity and project developers, according to an Adelaide company looking to discover new zinc deposits in WA's far north.

Addressing the Paydirt investment forum, Mithril Resources managing director David Hutton said the strong zinc price environment is underpinning the company's push to accelerate exploration across its 100pc-owned Billy Hills deposit, a 400km² holding at Fitzroy River and adjacent to the former Pillara Zinc Mine.

Zinc is a key anti-corrosion ingredient in galvanising iron and steel and is also used in metal alloys.

Mr Hutton said Billy Hills' appeal lay in the fact that there had been no modern zinc exploration across the project for more than 20 years, even though the host Lennard Shelf had a proven track record of producing high grade metal concentrates and was home to known large zinc deposits.

"Previous Lennard Shelf output has produced more than 1.7 million tonnes of zinc concentrate between 1994 and March 2003 so this proven mineral district history, the lack of modern field work, and publicly available historic exploration data bases, makes Billy Hills an attractive new era Australian zinc play," he said.

"In fact, the Lennard Shelf grades are comfortably ahead of Australia's other major zinc locations including Century, Dugal River, Mount Isa and Broken Hill."

Mithril has already identified high grade massive zinc sulphides in Billy Hills' fault zones, with 2019 marking the company's first field season across the tenement area.

It plans to target large deposits along strike from the known mineralisation after spending the past 12 months undertaking extensive data compilation and target generation work.

The first field work, to be undertaken over May, will target the priority Firetail and Python prospects where some rock chip samples have returned between 11-12pc zinc and lead readings. First diamond drilling is tentatively scheduled for June.

Pay dirt for South Australia

RAY CHAN
SOUTH AUSTRALIA

SOUTH Australia's mineral resources sector is in substantially better shape with a much stronger outlook than in the past 15 years or so, according to one of the sector's most influential administrators.

Addressing the Paydirt 2019 South Australian Resources and Energy Investment Conference in Adelaide, SA Energy and Mining department chief executive Paul Heithersay said that operating mines had grown significantly since 2003 with existing operators constantly looking to expand and extend the mine-life of their projects.

"The state has a healthy pipeline of projects and prospects and recent announcements such as BHP's copper discovery at Oak Dam West and OZ Minerals' decision to outsource exploratory work at its Mt Woods target, are generating considerable equity and corporate interest at the international level," he said.

"It has built a very strong platform for further exploration and mining success with a site of high resolution geoscience data, which now includes previously unavailable magnetotellurics, and drill core from brand new provinces such as Campooona in the state's west. The largest aeromagnetic survey in SA's history is nearing completion with a suite of products coming out soon.

"The state's mining royalties, employment numbers and resources exports have all grown since 2003 and the quality and quantity of geological data held by the state has grown exponentially thanks to high quality datasets generated by a number of government-led geoscience investment programs including the SAEI, TEISA and PACE programs.

"The new Carrapateena copper-gold mine, due to go into production before the end of the year, was a deposit discovered with the support of the PACE drilling collaboration."

Dr Heithersay said numerous resources



SA Energy and Mining minister Dan van Holst Pellekaan speaks at the conference.

companies forecasting increased market demand for the commodities that SA possessed would be the backbone of future "new era technologies".

"SA is blessed with abundant copper, gold, graphite, magnetite, zircon and rutile," Dr Heithersay said.

"Demand from downstream processors is underpinning renewed local exploration campaigns for these commodities."

"This new push builds on the momentum created by discoveries such as Oak Dam, imminent new production at Carrapateena and the proposed investment in Olympic Dam to significantly increase its production capacity. These projects have grabbed the attention of copper producers worldwide."

Oak Dam West is a spectacular new BHP iron oxide copper gold (IOCG) discovery, 65km southeast of Olympic Dam, whose results include a 180m intercept grading 6 per cent copper.

Dr Heithersay pointed to an innovative online crowdsourcing competition as signs of new approaches to re-invigorate South Australia's in-ground exploration spend.

Dam collapse boost for magnetite

RAY CHAN
SA

BRAZIL'S spate of iron ore mine and tailings dam calamities is proving a game-changer for global iron ore pellet feed markets, according to the developer of a proposed new US\$1.5 billion magnetite iron ore pellet project near Broken Hill.

Addressing the Paydirt 2019 Conference, Carpentaria Resources managing director Quentin Hill said the Brazilian mine dam collapse, and resultant forced shutdown of some of that country's iron ore mines, had caused a major seaborne supply squeeze across all of the commodity's types.

"Before the Brazil factor, there was already an increasing supply gap in the pellet feed market and shortages in the Middle East particularly but this has been amplified by the Brazilian iron ore sector disasters," Mr Hill said.

"The global pellet feed market was already in need of new pellet feed mines but the Brazilian impacts have disrupted the overall iron ore seaborne market.

"This will favour the development of our Hawsons magnetite pellet project, 60 kilometres southwest of Broken Hill on the SA border and at a time we are looking to



Carpentaria Resources managing director Quentin Hill speaks at the conference.

finalise remaining funding to complete the project's Bankable Feasibility Study (BFS)."

Japan's Mitsui has already committed to fund 20 per cent of Hawsons' BFS. Mr Hill says negotiations for the remaining 80pc of the BFS cost are well advanced with multiple potential Tier 1 parties, around equity and non-dilutive offtake linked arrangements to also include part of the

A \$1 million prize is being offered to geologists and data scientists from around the globe to develop ground-breaking approaches to identify new exploration targets at OZ Minerals' copper-gold Mount Woods site – home to the decade-old Prominent Hill mine.

"It was clear at the major PDAC mining investment conference in Toronto in February that a spate of discoveries and investment commitments has ensured SA remains well and truly on the radar for international investors," Dr Heithersay said.

"SA also offers substantial forward potential as a global supplier of hydrogen and battery materials such as graphite, zinc and cobalt.

"Opportunities exist to partner with battery manufacturers already lured to South Australia through the world's largest per capita rollout of home battery storage systems linked to solar PV.

"The Department for Energy and Mining plans to roll out a battery minerals strategy to sit alongside our development strategies for copper, magnetite and hydrogen."

mine construction cost.

"The market pull for Hawsons to be developed is very strong. We are highly confident of successful completion of the remaining BFS funding of around US\$20 million," Mr Hill said.

Wood Mackenzie has rated Hawsons as the leading project of its type in the world, a rating Mr Hill says can only be enhanced by the severe and likely prolonged supply disruptions out of Brazil.

Hawsons boasts a 70pc Fe grade over a 330Mt resource, of which 111Mt is in the Probable Reserve category. The project site is close to major rail export infrastructure west to Port Pirie or Whyalla, with some 10Mtpa of output to be sent by slurry pipeline 55kms direct to Broken Hill.

Mining and processing will be conducted on site. Final project costs will depend on whether Carpentaria selects Port Pirie or Whyalla as the final export outlet.

Hawsons has attracted Major Project Status from the Federal Government. Production is expected to commence within three years of financing.

Studies have estimated a robust early payback of under 2.5 to four years for a high margin project that is cash flow positive at under US\$30 a tonne.

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IN BRIEF

Penny West ore makes the grade

WA

SPECTRUM Metals continued to turn up hi-grade assays from its drilling samples at Penny North and Magenta prospects at the Penny West project near Youanmi.

At Penny North, results have shown the structure extends north by a further 40m, and remains open in the southern end.

At Magenta, drilling confirmed that the structure remains open in all directions, and now has an extended strike length of over 100m.

A large, 1.4km 'gap zone' that has shown high-grade mineralisation still exists between the two prospects, where no RC drilling has taken place.

Newcrest on a golden quest

WA

NEWCREST will sole-fund all exploration for 2019 with its junior JV partner, Encounter Resources.

Newcrest has five JVs with Encounter that cover the Tanami and West Arunta gold regions in WA. "The hunt is on for the next game-changing gold discovery in Australia," Encounter managing director, Will Robinson, said.

The exploration programs will target Tier 1 equivalent mineral deposits, and Newcrest will drill more than 14,000 metres of RC and diamond drilling in the first phase

Bullish move from Matador

INTERNATIONAL

SEVERAL WA gold mining figures are among investors in Canada-focused explorer Matador Mining, in an oversubscribed \$5 million placement.

Matador will use the funds to buy out the 20 per cent stake in Cape Ray gold project in Newfoundland it does not already own, while continuing exploration aimed at growing the existing 1.02 million-ounce resource.

Drills go in at Cadoux Kaolin

WA

FYI Resources has undertaken about 1200m of RC and diamond drilling to progress its bankable feasibility study (BFS) at the Cadoux Kaolin aluminium project.

The RC and diamond rigs were operated in sequence to generate samples and technical data to inform the BFS.

The drilling will increase knowledge of the mineralisation and environmental studies, and also provide feedstock for the planned pilot plant.

Middle Island bids for Alto

Image: Middle Island Resources.



Middle Island's Sandstone gold mill in WA.

EMMA DAVIES
WA

EMERGING WA gold developer Middle Island Resources has made a bid for nearby Alto Metals with the aim of combining resources to recommission the Sandstone gold plant, about 400km northwest of Kalgoorlie.

On March 19, Alto advised shareholders to reject the initial offer of five Middle Island shares for every one Alto share on a 90 per cent acceptance condition with its major shareholders (representing 32.12 per cent) declining the offer.

Middle Island retaliated on April 10, amending the offer and reducing the minimum acceptance condition to 50.1 per cent.

Middle Island chairman Peter Thomas said the offer would create a new gold miner with near-term cash flow potential and

considerable production and exploration upside which would otherwise be out of reach for both companies.

"Middle Island believes that a transition of Middle Island and Alto from explorers to a combined gold miner would see a synergistic uplift in both enterprise value and share value," he said.

"The offer provides an opportunity for Alto shareholders to join, in equal degree, with Middle Island shareholders to benefit from the synergy of the consolidation, under a single entity, of the exploration and mining tenure held respectively by Alto and Middle Island in the Sandstone greenstone belt of WA's Yilgarn Craton."

Mr Smith said combining the companies' resources made economic sense and that Alto's Sandstone tenements could be easily mined, hauled and processed at the Sandstone Gold Plant 30km away.

"Alto's present resource base, in isolation, does not and never will justify the cost of a

new plant. Middle Island's Sandstone Gold Plant represents the only plant within economic trucking distance of Alto's gold resources through which the treatment of those resources is economically feasible," he said.

Middle Island estimated the refurbishment cost of the existing plant and associated infrastructure was \$10.3 million and remained confident in its ability to raise capital to complete works within six months of a final refurbishment decision being made.

Alto's board released a Target Statement on 1 May advising shareholders to reject the offer, with directors insisting it was a ploy by Middle Island to acquire as many Alto shares as possible before the offer was rejected.

"Your directors believe that both they and the Alto management team, including key consultants, have the necessary skills and experience to realise the full potential of Alto's assets and are best placed to deliver shareholders value over the long term," the statement said.

Venus and Rox join forces for Youanmi

GERARD MCARTNEY
WA

JUNIOR explorers Venus Metals and Rox Resources have joined forces and entered into a "transformational deal" to explore, settle and mine at the historic Youanmi gold mine and surrounding tenements, currently in maintenance, located 480km northeast of Perth.

Venus purchased the Youanmi mine for \$5.45 million from Oz Youanmi and St Clair Resources, once Rox had fulfilled its terms of the transaction.

The companies signed a binding term sheet that would allow Venus to settle its purchase of the mine creating the OYG joint venture (JV), while undertaking aggressive exploration of the wider project area to open up the 1.2moz Youanmi projects, creating two more JVs.

Venus held significant regional tenements that would support the two other JVs, the VMC JV and the Youanmi JV, and under the terms of the deal, granted Rox the right to earn 50 per cent and 45pc from the tenements respectively.

Rox purchased its 50pc interest in the deal for \$3m in cash and issued 25 million Rox shares at \$0.008 per share to Venus, while also solely funding and undertaking



Image: Venus.

The historic Youanmi pit was first mined in 1901.

an aggressive \$2m near-mine exploration program and pre-development work at Youanmi.

Venus would take over management of the project, retain a 50pc interest in the mine, and retaining the ability to bump its stake up to 70pc.

Venus' managing director, Mathew Hogan, said joining Forces with Rox Resources was a "great deal for Venus", in

regard to the way in which the company had managed to arrange the settlement of the acquisition with minimal dilution to VMC shareholders.

Shortly after announcing the agreement, Rox announced it had analysed 550,000m of drilling from underdeveloped open pit resources, open pit extensions and cutbacks, and "other near surface resources" and confirmed a 12.4mt ore deposit containing 1960oz of gold.

Dutch backing for Siviour project

EMMA DAVIES
SA

SOUTH Australia's Renascor Resources has been offered financial support for its Siviour Graphite Project from the Dutch government.

The deposit is one of the world's largest with a mineral resource estimate of 80.6 million tonnes, grading 7.9 per cent total graphitic carbon (TGC) for 6.4mt of contained graphite, which many European governments classify as a critical raw mineral.

The Government of the Netherlands official export credit agency, Atradius, issued a letter of interest (LOI) confirming in-principle project financial support under the Dutch export credit guarantee (ECA) scheme which offers favourable debt financing terms.

Renascor managing director David Christensen said the LOI from Atradius was an important milestone in Renascor's progress to secure project financing for the Siviour Graphite Project.

"It continues to reinforce Renascor's aim to become a globally significant graphite producer," he said.

"This latest development is a potential game changer, giving Renascor much greater access to the debt markets and enabling us to accelerate our financing plan."

The competitive margins offered by the ECA cover included an increased loan duration and lower interest rates than commercially available as the repayment of



Image: Renascor Resources.

Renascor managing director David Christensen at the Siviour project in South Australia.

the debt is insured.

The Siviour project qualified based on the sourcing of Dutch content through Renascor's Dutch strategic engineering partner Royal IHC, and would now be

subject to due diligence investigations before a final agreement was reached.

"Our team at Renascor is looking forward to working with Atradius through its due diligence process, which will have the benefit of our current work on the

Definitive Feasibility Study for the Siviour project," Mr Christensen said.

Renascor estimated that around 60pc of the project's capital expenditure would qualify under the scheme.

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Image: //www. Under the partnership between Lithium Australia and Envirostream, the parties will ensure critical battery metals from recycled batteries remain under Australian control.

Partnership a boost in extracting the essence

RAY CHAN
NATIONAL

LITHIUM Australia has joined forces with lithium-ion battery recycling company Envirostream to develop methods of extracting critical metals from spent batteries.

According to Lithium Australia, currently only 3 per cent of predominantly lithium-ion batteries are recycled in Australia.

Presently, Envirostream operates Australia's only facility for shredding lithium-ion batteries.

From the spent batteries, Envirostream generates a powder containing the critical battery minerals that is then exported for refining.

Lithium Australia is creating a flowsheet to process these powders to liberate the nickel, cobalt, manganese and lithium chemicals required to regenerate battery cathodes. The company is also developing methods for recovering graphite from the lithium-ion battery anode.

Lithium Australian managing director Adrian Griffin said maximising the recycling of all battery metals was rarely done effectively.

"It's a target we have achieved in university-controlled testing," he said.

The company has also recycled alkaline batteries with the aim of eliminating all spent batteries from landfill.

Under the partnership with Envirostream, Lithium Australia will acquire an 18.9pc stake in the company through four tranches totalling \$600,000 in cash and Lithium Australia scrip.

The acquisition is expected to be finalised by mid-August.

Envirostream will use the funds to expand its battery shredding facilities, which will create local jobs and more employment opportunities.

Meanwhile, Lithium Australia will continue refining its flowsheet to recover the critical metals from Envirostream's powder. The company expects to complete this flowsheet design later this year.

One of the key challenges to battery recycling in Australia, is the country's inadequate collection network.

As part of the joint venture, Envirostream will roll out its own collection strategy across Australia to deal with the country's rapidly increasing amount of spent batteries.

With golden soil and wealth for toil



Image: CSIRO.

Explorers are successfully using innovative tools to find new gold targets in Australia's covered landscape.

LOUISE POBJOY
NATIONAL

OVER the past 30 years, CSIRO has worked with industry to develop innovative sampling techniques for gold exploration through covered terrain.

With companies long considering cover – deep layers of regolith, rock and sedimentary material – a hindrance to mineral exploration, CSIRO has shown that understanding the geochemistry of the landscape and how metals move through it can lead to significant discoveries.

As CSIRO chief research scientist Ravi Anand says, "cover can work to your advantage".

"You can discover ore bodies by using this material, because it can give you a geochemical signature at, or near, the surface," he said.

CSIRO's research in this field was shaped by two major leaps in understanding regolith geoscience and its use in mineral exploration.

The first, in the 1980s, involved developing landscape-based geochemical dispersion models, and mapping, sampling and analytical protocols for cost-effective exploration of in situ and shallow transported cover. This work led to laterite and calcrete sampling, which have helped locate gold deposits worth more than \$12 billion.

The second, in the 2000s, involved identifying how metal migrates through cover to form geochemical signatures of orebodies.

More recently, CSIRO has been exploring biological mechanisms of metal migration, with industry quickly adopting vegetation and termite mound sampling techniques. Marmota, for example, recently identified new gold targets after finding a gold anomaly in leaves.

"Tap roots of vegetation like eucalyptus and acacias can go quite deep looking for water during drought. In taking up deep water, they bring metals with them," Dr Anand said.

"Plants send that metal to their leaves and branches, which we sample to find out what is happening under the Earth's surface."

Termites also bring up small particles containing gold and stockpile it in their mounds. Like vegetation sampling, termite mound sampling is easier, cheaper and more environmentally friendly than drilling.

Other biological resources, like fungi and gas, could help identify target deposits as well. CSIRO is developing detection technologies, such as microbial DNA and passive gas sensors, to harness these resources.

Tools are also being developed to explore very deep or challenging cover, such as the interface between in situ and transported cover; iron oxide-rich gravel under sand dunes and Permian sediments.

Another important benefit is that these techniques reduce exploration impacts to the environment, because they are less invasive and aim to reduce the number or drill holes needed.

"Companies still need to drill at some stage, but they don't have to start right from the beginning," Dr Anand said.

While the exploration industry has already adopted some of these methods, CSIRO's recent breakthrough in ultra fine soil sampling could become the new global standard for gold exploration.

Soil sampling has been used for around 60 years and involves sieving soil particles and analysing these for traces of metals.

Traditional soil sampling is effective for particles around a quarter of a millimetre in size (250 micron fractions), whereas the CSIRO-developed UltraFine+ can separate much finer particles – less than two

microns. That's about one-50th the size of a grain of salt.

According to CSIRO lead researcher, Ryan Noble, small soil particles, including clays and iron oxides, have more surface area to attract gold.

"So they do most of the scavenging work, binding up little particles of metals that move through the environment to form geochemical signatures of orebodies laying 10 to 20 metres below soil or sand," he said.

UltraFine+ works well for copper, zinc and other commodities. But it's mainly designed to detect gold, offering better reproducibility and consistency in analyses.

"Its biggest advantage is that it works better than traditional techniques for gold in terms of geochemistry, because it reduces the nugget effect," Dr Noble said.

Because no large particles or nuggets are collected, the method offers a more consistent gold analysis. It's also more detailed and more accurate than other methods.

"Traditionally, analyses would show about 50 elements, such as the standard gold, silver, tin, calcium," Dr Noble said.

"Now, you can get additional measurements like pH, conductivity, spectral mineralogy proxies, and particle size distribution."

This detail and accuracy is inspiring companies to revisit old samples in the hope of finding new exploration sites.

"Companies who did surveys 10 or 15 years ago and didn't find anything, can use UltraFine+ to re-analyse those samples, get much better quality data and potentially identify new targets," Dr Anand said.

UltraFine+ grew from a partnership between CSIRO, the Minerals Research Institute of Western Australia, Geological Survey of Western Australia, several exploration companies and an analytical laboratory.



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IN BRIEF

Landslides bury more than 50

MYANMAR

MORE than 50 people were killed after a landslide buried miners and 40 pieces of heavy machinery under a mound of tailings in Hpakant, Myanmar, on April 22.

Myanmar's Ministry of Information confirmed that 54 workers were missing, and identified the companies involved as Shwe Nagar Koe Kaung and Myanmar Thura.

Landslides and other deadly accidents have been a common occurrence in poorly regulated mines around Hpakant.

Global Witness estimated Myanmar's jade production to be valued at about US\$31 billion in 2014, nearly half the country's GDP for the year.

Lucara diamond weighs in at 1758c

BOTSWANA

ONE of the largest diamonds in recorded history has been recovered in Botswana by Lucara Diamond Corp.

The diamond weighs in at 1758 carats, and measures 83mm x 62 mm x 46mm.

The diamond has been characterised as near-gem quality with "domains of high-quality white gem".

Lucara has produced 12 diamonds above 300ct from the Karawe mine since 2015, and the most recent discovery is the mine's second diamond of more than 1000ct for the period.

Sirius fertiliser distribution deal

UK

SIRIUS Minerals has secured a 10-year supply and distribution deal for its polyhalite potash plant.

The agreement with BayWa Agri Supply and Trade will result in the sale of up to 2.5 million tonnes per year, with the amount expected to ramp up after the first five years.

The Woodsmith is predicted to be one of the world's largest polyhalite mines and will be built with nearly all infrastructure underground, under the North Moors national park.

The company hopes to strike its first polyhalite in 2021.

Lynas faced with waste pressure

MALAYSIA

AUSTRALIAN rare earths producer Lynas has been under increasing pressure to solve issue of radioactive waste produced in its Malaysian factory, since it rejected a \$1.5 billion takeover by Wesfarmers.

The Malaysian government has said that its renewal of Lynas' operating licence was conditional on it transporting the radioactive waste its plant produced to Australia.

The making of a new gold king



Newmont Goldcorp predict a combined annual guidance of 6-7 million ounces per year.

GERARD MCARTNEY CANADA

THE deal to create the world's biggest gold producer was closed in April, with overwhelming support from both Gold Corp and Newmont, and the blessing of the Investment Canada Act.

But the US\$10 billion dethroning of Barrick Gold did not come without a fight.

In February, Barrick attempted a hostile takeover of Newmont, offering a US\$17.8b all-share deal in February.

Newmont rejected the deal, but instead opted for joint venture (JV) in Nevada with Barrick to create the world's largest JV gold complex.

The companies cleared all necessary regulatory conditions and were granted an early termination of the waiting period under the Hart-Scott-Rodino Act to create

the, as yet unnamed, JV ahead of schedule.

The JV will be owned 38.5 per cent by Newmont Goldcorp, and 61.5 per cent by Barrick, which will also be the operator, and was expected to generate US\$500 million in savings in the first five years.

The JV includes Barrick's Goldstrike, Cortez, Turquoise Ridge and Goldrush mines, and Newmont Goldcorp's Carlin, Twin Creeks, Phoenix and Long Canyon, and will combine the associated processing plants and infrastructures of the gold giants.

On the creation of Newmont Goldcorp, the new company would mine in the Americas, Australia and Ghana with a combined production guidance of between 6 and 7mozpa.

As a part of the Newmont Goldcorp deal, Newmont would be tightening its belt and shedding between US\$1b and US\$1.5b worth of assets in the immediate

two-year period, and the company said in a statement that it expected to generate up to \$100 million in annual pre-tax synergies.

Newmont Goldcorp chief executive Gary Goldberg said the strategic rationale for combining Goldcorp with Newmont had been "powerfully compelling on many levels, and both teams are fully committed to delivering on the transaction's value proposition for all of our stakeholders".

Newmont Goldcorp would initially be led by Mr Goldberg, who will be succeeded by chief operating officer Tom Palmer at the end of 2019. "Going forward, Newmont Goldcorp will maintain its focus on the success and continuity of our business through strategic leadership development, building high performing teams, and robust succession planning," Mr Palmer said.

Roxgold exploration starts at Séguéla

GERARD MCARTNEY CANADA

CANADIAN gold miner Roxgold has completed its acquisition of Newcrest's Séguéla gold project in Côte d'Ivoire, and has begun an extensive drilling program.

The transaction included a portfolio of 11 exploration permits around the Antenna deposit for a total upfront payment of US\$20 million, and a deferred US\$10m payment on reaching production.

Roxgold said it believes the wider Antenna deposit to hold an inferred resource of 5.8 million tonnes at 2.3 grams per tonne of gold for 430,000 ounces

Roxgold chief executive John Dorward said the company was pleased to complete the highly accretive transaction, which delivered on creating long-term value for shareholders.

"The Séguéla gold project provides a second key asset with significant growth potential both in the near term through the near-surface Antenna deposit, and attractive satellite opportunities as well as a highly prospective large land package," he said.

Exploration drilling started on April 24, with the company committing to 4000m of RC and diamond drilling at and near the



The Séguéla gold project in Côte d'Ivoire.

Antenna deposit to further extend and infill the known mineralisation.

The targets fall within 15km of the Antenna deposit, and have the potential to add additional low-cost, near-surface ounces.

On April 29, the company started a 24,000m aircore and RC drilling program to test the highest ranked targets based off the preliminary drilling undertaken by Newcrest, and of several high-grade intercepts from the Boulder, Agouti,

Ancien, Gabbro P3 and Kwenko prospects.

Roxgold vice president Paul Weedon said the acquisition would materially increase Roxgold's overall resource inventory.

"We also believe there is substantial near-term exploration upside at this deposit, and regionally, with the opportunity to significantly advance Séguéla in the near-term," he said.

Séguéla would be Roxgold's second major project, after the Yaramoko gold mine in Burkina Faso.



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THE PRIMED BULL

With 29 per cent of the world's uranium reserves, Australia holds the largest deposits of uranium in the world. However domestic policy and poor public image have been major hurdles to Australia's capacity to mine and export the heavy element.

Image: BHP.

GERARD MCARTNEY

FROM under the yoke of the 2011 Fukushima disaster, nuclear energy has found a groundswell of international demand building at a time when international surpluses are dwindling.

However, Australia's complicated relationship with the heavy element has seen production rates at historical lows.

Global production of uranium has fallen at a time when demand has increased due to heavy losses sustained by Canadian and Kazakh producers.

With prices rising steadily since 2018 to an average of US\$28.90 a pound in April, most of the increase took place in the second half of 2018, and remains well above the November 2016 low of US\$18/lb.

While the increase in price has taken some of the pressure off uranium suppliers who have been selling output at a loss during the past two years, the large

inventories of uranium still held around the world continue to act as a check on the price surge.

As the world's biggest uranium producers, Kazakhstan and Canada, continue to wind down production levels, while many prospective mines in Africa, as well as other large projects, are put on ice, global nuclear growth has continued all the way through 2018 and into 2019.

Nine new reactors have been connected internationally since 2018, resulting in a 10GW addition of global nuclear energy, with four more reactors in the construction phase that would create about 5GW of additional power.

Minerals Council of Australia (MCA) chief executive Tania Constable said that as the world's largest deposit, uranium is vital to a healthy mining sector in Australia.

She also said that uranium was "a strategic energy commodity for several of our most important trading partners – the United States, China and India, who are

seeking reliable supply for zero emissions electricity technologies".

The United Arab Emirates (UAE) had demonstrated through its recent construction of nuclear power plants that countries can move into nuclear power generation in a 10-year time frame, and about 30 countries such as Morocco, Egypt and South Africa have been building partnerships and exploring the options and possibilities of developing nuclear power programs.

"Nuclear technology is evolving rapidly, including the development of small modular reactors boosted by new designs such as NuScale, which is moving towards regulatory approval in the United States," Ms Constable said.

"This offers a potential new growth market for uranium worldwide in addition to large plants currently planned and under construction.

"There are new Gen III designs being developed and deployed in China, India, South Korea and the UAE.

"Projects are under construction in the United States, United Kingdom, France and Finland, and these designs involve more passive safety features and controls."

While the US remains the largest consumer of nuclear energy, China continued to lead the way in nuclear development, adding seven new reactors in 2018 for a total of 46 reactors with another 15 under construction.

In 2018, China alone generated more nuclear power than Australia did from all other sources, and its nuclear generation is growing at twice the rate of all other power sources combined.

Concerns over air pollution from coal-fired power plants provided a strong incentive for China to roll out its aggressive nuclear strategy.

The superpower was progressing toward a nuclear 'closed cycle': a technology that allowed for spent reactor fuel to be re-used and recycled, rather than discarded as waste, and was offering the technology as an export commodity to countries considering nuclear development.

"Closing the nuclear cycle involves reprocessing spent nuclear fuel from light-water reactors (LWRs) and re-using reprocessed materials to extract more energy," Ms Constable said.

"Closed cycle reactor designs seek to burn the long-lived actinides forming part of the spent fuel, so that fission products are the only high-level waste (with shorter high radioactive lifespans).

"Closed cycle designs in general achieve far more energy for a given amount of uranium."

In the US, bipartisan legislation has been approved to modernise nuclear regulations, cap reactor fees, and to establish a licencing framework for next-generation reactors.

The country had also completed upgrades

at many significant reactors, with 92 nuclear plants having their operations extended to 60 years.

And with the completion of capital spending associated with the upgrades, nuclear power in the US has fallen to the lowest prices since 2008.

"The US nuclear fleet accounts for 60 per cent of US low carbon power sources," Ms Constable said.

"The legislation validates one of nuclear energy's great advantages – current plants can be upgraded, maintained and operated cost effectively and safely for many decades, well beyond their original certified life."

India confirmed that it would build 21 new plants by 2031, South Korea loaded the first fuel into the Shin Kori unit in February, and Bangladesh had poured the foundational concrete of its first nuclear plant.

The Australian outlook

The *Resources and Energy Quarterly March 2019* forecast a sustained recovery to the uranium market as further growth underpinned the first quarter of 2019, with an expected real-terms price increase to about US\$40 a pound by 2024.

While there are some new uranium prospects, Australia's uranium outlook was not so positive.

Declining production rates would only be offset by the benefits of higher prices in the short term.

"Australia's uranium miners earn valuable export income and generate highly paid, highly skilled jobs, particularly in regional communities," Ms Constable said.

"However, Australia is missing out on jobs, investment and regional prosperity because of the discriminatory treatment of uranium mining projects."

As exploration and exports remain at historically low levels, production will ease from 2019-2020 as the Ranger mine winds down production toward closure in 2021.

At the beginning of the year, Ranger was exporting material solely from stockpiles, and the ERA had revised its expected rehabilitation costs from \$512 million to \$808 million.

A number of deposits, however, were progressing toward production, including Boss Resources' Honyemoon project, Toro Energy's Wiluna project in WA, and Vimy's Mulga Rock project in WA.

Vimy announced that it would invest an additional \$3 million for exploration at Alligator River, while also pursuing offtake contracts for output.

Boss resources had revised its estimate, up 30 per cent to a total of 36m lb of uranium; however, although work is ongoing, it is not clear whether these deposits would be producing by 2024.

These new projects would be key to sustaining the uranium market in Australia as a precarious future threatens to dampen the promises of a well-primed bull market.

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CLARKE ENERGY POWERS UP GRUYERE PROJECT

The Gruyere gold project is a 50/50 joint venture (JV) between Gold Road Resources and global miner Gold Fields.

As an emerging tier one gold project, the Gruyere JV partners expect that once full production is realised, it will be able to produce an annual average of 300,000 ounces over the projected 12-year mine life.

After flooding in 2018 delayed the first pour, the company pushed the start date back to the March quarter of 2019, and announced its 2019 guidance to be within 100,000 and 120,000oz.

The project is in the Yanama greenstone belt in WA, 200km northeast of Laverton, and to the north of APA Group's eastern goldfields pipeline.

One of the biggest challenges for the JV in bringing the project toward production was its remoteness, and the significant infrastructure investments had to be made in order to ensure the viability of the project.

APA Group was contracted to install 198km of new gas pipeline, and Clarke Energy was contracted to design and construct the 45-megawatt gas-fired power station at the Gruyere gold project.

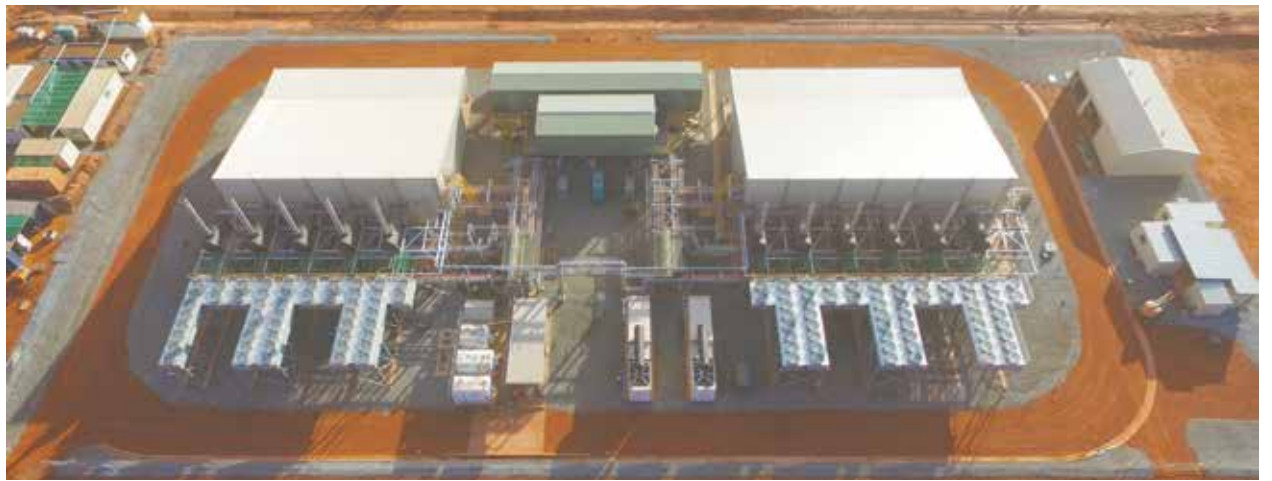
Clarke Energy is the Innio Jenbacher distributor and service partner, and has installed 11 high-efficiency Jenbacher J624 gas engines for the new power station at the Gruyere gold project.

Innio's Jenbacher J624 is the world's first two-stage, turbocharged gas engine.

It provides significant advantages, particularly in the areas of operation in hot environments – such as the Gruyere gold project– and in multiple engine power plants for independent power production and combined heat and power applications.

Clarke Energy engineered, procured and constructed the power station, while APA will transport the gas for power generation – a total of about 1500km – using its interconnected pipelines and its purpose-built 198km Yamarna gas pipeline.

APA Group networks and power group executive Sam Pearce welcomed the collaboration.



Clarke Energy was chosen by APA to build the gas-fired power station for the Gruyere Gold Project.

"Together with Clarke Energy as the EPC and Jenbacher demonstrated gas engine technology providing the power, we will be able to, once again, deliver a compelling energy solution for our customer using both our interconnected pipeline and power generation capabilities to the remote gold mine," he said.

"As an infrastructure owner, our priority is to provide safe, reliable and efficient energy to our customers."

The Jenbacher J624s were built in Innio's Jenbacher Austrian facility and transported during late 2017.

Clarke Energy managing director Greg Columbus said that Jenbacher's high-efficiency, high-performance and dependable gas engine technology was an excellent fit for APA Group's needs of safety, reliability and efficiency.

"It's well-proven with an installed gas engine fleet of more than 700MW in Australia," he said.

The pipeline was commissioned late in 2018 in alignment with the Gruyere JV's expectation of first gold scheduled for 2019.

Additionally, the new power station also incorporates two 2MW Kohler KD2500 11KV diesel generators configured for black start application that can be

called on for rapid start-up.

Kohler is a world leader in the manufacture of diesel generator sets ranging from 8KVA to 4200KVA, offering class leading fuel efficiency, advanced design, all manufactured to and tested for the most arduous conditions.

Clarke Energy is wholly owned by Kohler and distributes Kohler generators which are suitable for a wide range of applications including mining, commercial building, power utilities and the telecommunications sector.

They are designed and manufactured in the Kohler facility in France with more than 50 years of product optimisation experience, available with a "plug and play" design philosophy for ease of installation.

Dedicated Kohler service and parts support is available 24/7 and includes stock holding held within Australia to service Clarke Energy's customers.

Service training is available on-site or at its Adelaide based training facility.

Clarke Energy is a leader in engineering design, installation and long-term maintenance of gas and diesel engine power plants.

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SPECIAL FEATURES

TAILINGS MANAGEMENT BEST PRACTICE

PRACTICE MADE PERFECT

In the wake of the recent Vale dam collapse in Brazil, the Australian Mining Review presents a recap on good practice in tailings management, from conceptual through to operational stages and beyond.

Image: ANCOLD.

The Princess Creek tailings dam at Mount Lyell, Tasmania.

A KEY challenge for mining companies is to earn the trust of the communities in which they operate and to gain the support and approval of stakeholders to carry out the business of mining.

A 'social licence to operate' can only be earned and preserved if mining projects are planned, implemented and operated incorporating meaningful consultation with stakeholders, in particular with the host communities.

The decision-making process, including the technical design process, should involve relevant interest groups, from the initial stages of project conceptualisation right through the mine's life.

Stakeholder consultation, information sharing and dialogue should occur throughout the tailings facility design and operating stages, so viewpoints, concerns and expectations can be considered for all aspects of planning and execution.

Regular, meaningful engagement between the company and affected communities is particularly important for developing trust and preventing conflict.

The 'precautionary principle' should be drawn on when considering the impacts of mine operations, including tailings storage facilities.

The principle states that where there is a clearly identified threat of serious or irreversible harm to people or the environment, the lack of full scientific certainty should not be used as a reason for postponing measures to prevent harm to people or environmental degradation.

A proactive approach to risk mitigation should be taken where there is significant uncertainty in relation to the consequence or likelihood of risk scenarios.

The primary responsibility for tailings and tailings storage facilities regulation in Australia rests with state and territory Governments.

While the regulatory requirements vary between jurisdictions, common principles apply.

In all jurisdictions:

- responsibility for tailings deposition and management (including rehabilitation and closure) regulation rests with the mining department or environmental protection agency
- responsibility for pollution control and tailings storage facility water discharge regulation rests with the environmental protection agency
- the focus of the regulation is on ensuring that tailings management methods, including tailings storage facilities, are safe, stable and non-polluting.

In some states the regulation of tailings storage facility design, construction and ongoing management may be covered by specific legislation.

While different jurisdictions issue their own tailings management guidelines, where tailings management actions are likely to have a significant impact on a matter of national environmental significance, they are subject to a rigorous assessment and approval process under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Matters covered by the EPBC Act include national heritage, threatened species and wetlands of international importance.

Compliance with government regulations establishes a minimum performance platform for the mining industry in relation

to tailings management.

The principles of leading practice tailings management are underpinned by a risk-based approach to planning, design, construction, operation, closure and rehabilitation of tailings storage facilities.

In taking this approach, plans need to be tailored to manage a tailings storage facility effectively over its full life, with sufficient detail to manage the potential risks within acceptable limits.

A low height (10m) earth-fill containment wall in a dry, semi-desert climate (250mm average annual rainfall), for example, is not likely to require the same level of detailed planning and design as a 100m high valley containment wall in a high rainfall environment (> 3m/year).

Tailings storage facilities with higher risk ratings will require more rigour at the design phase, greater quality control during construction, and closer attention to risk management, emergency action planning systems, and documentation during the operation phase.

Tailings storage facilities must meet operator and public health and safety, community, and environmental protection objectives.

These objectives can only be met if tailings storage facilities are designed, operated, closed and rehabilitated to a level of risk that is acceptable to stakeholders for the full operating life of the facility and beyond.

A life-of-mine tailings storage facility plan is necessary to ensure operational and public health and safety, community, and environmental objectives are met over the entire life of the operation.

This would normally involve major

updates on about a five-yearly basis, with annual reviews.

Where a tailings storage facility is developed in stages to satisfy production requirements, a detailed schedule needs to be prepared that includes: timing of the start-up of new stages or modifications; a schedule required for designs, investigations and approvals and estimated costs annually and for each stage.

Such planning will ensure an adequate budget for the work, that the investigations and design are performed in time, and that there is adequate time for construction (including a contingency for weather and other factors) to complete and commission the new stage or modification.

Starting at the pre-feasibility or environmental impact assessment stage, it is important to continuously measure the nature, quality, level or quantity of any environmental feature that may be impacted by the presence of a tailings storage facility prior to it being built.

Background conditions that need to be defined will normally include groundwater levels and quality; water content and geochemistry of foundation soils and rocks; air quality, fauna and flora population and density; and natural and background radiation levels where radioactive materials are to be stored.

Risk assessment in the conceptual stage

Tailings storage facilities require a formal risk assessment to identify and quantify the risks that need to be managed. Tailings storage facilities are normally rated high, significant or low-risk facilities, in accordance with a set of ranking criteria.

The risk rating is used to determine the design, construction, risk management, inspections and reporting requirements.

The higher the risk rating, the more stringent the design, construction supervision, risk management, and emergency action and response planning requirements. High-risk tailings storage facilities are often auditable by government regulatory agencies.

Define operating parameters

The conceptual study must be based upon data. This data should include the life-of-mine plan; site topography; hydrological catchment areas; historical rainfall and evaporation data; the projected volume and rate of production of tailings, and their physical, chemical and rheological characteristics; the availability, quality and price of water; the geotechnical parameters of available construction materials and the foundation; and seismic data.

Possible tailings storage sites may include green field sites, existing tailings storage facilities, current and future mine voids, and waste rock storage areas.

Dewatering options and general TSF (tailings storage facility) design

There is a range of mechanical and in situ tailings dewatering options that can be applied at a particular tailings operation. These include conventional, high rate and paste thickeners, vacuum and pressure filters, centrifuges and cyclones.

It is important for the key design criteria of a tailings storage facility to be defined by the mine project team, and provided to the facility designer.

Key design criteria include knowing minimum, maximum and average tailings production rates at which the delivery system will operate; geochemical characteristics which may influence the selection of the most appropriate design for operation and closure; and range of solids concentrations and the average solids concentration over which the production rates are applicable.

Construction and operational matters

It is important that the construction report maintains an accurate record of the construction works in order to ensure the tailings storage facility was constructed by a competent contractor, with an appropriate level of supervision and quality control of construction materials, and techniques to show they were in accordance with the

design drawings and specifications.

A tailings operating manual is required for each tailings storage facility. This manual must be aligned with the design objectives of the facility.

Regular inspections and performance reviews

All tailings storage facilities and associated pumping and pipeline systems should be inspected on a daily basis at a minimum.

Any extraordinary observations or maintenance requirements must be documented and appropriate action taken, including reporting to regulators and the community.

The inspections include position of the decant pond and observations relating to freeboard requirements; visual and operating checks of lead indicators, such as damp, seepage and erosion; and the status of leak detection systems.

Containment wall design and construction

Tailings containment structures are designed and constructed in accordance with sound geotechnical engineering principles, such as those provided by the Australian National Committee on Large Dams (ANCOLD).

The principal considerations for design of a tailings containment structure include foundation conditions, zoning of the containment wall and geotechnical parameters of the construction materials; geotechnical slope stability; and selection of construction materials, including excavated tailings or run-of-mine waste rock where appropriate.

Seepage control

For tailings slurry deposition, there is a high risk that seepage will occur through the containment wall and into the foundation.

During the operation of a conventional tailings storage facility, a perched water table will typically develop within the deposited tailings — held in place by the low hydraulic conductivity of the unsaturated foundation beneath the tailings and maintained by ongoing wet tailings deposition and any incident rainfall.

If there is a risk that tailings seepage will cause groundwater contamination that could lead to public health risks and environmental damage or impact, consider the hydraulic characteristics of the foundation beneath the tailings storage

facility, including the presence and value of groundwater, and the need for a liner; and the hydraulic characteristics of the containment wall, including the need for a clay core and cut-off into the foundation beneath the containment wall.

The principles of leading practice tailings management are underpinned by a risk-based approach to planning, design, construction, operation, closure and rehabilitation of tailings storage facilities.

Water management

The effective management of water quantity and quality is a key driver for responsible tailings management. Key water related considerations in the design, operation and closure of a tailings storage facility include the availability of water of acceptable quality; competing water users and the value the community places on water; the need for water and reagent recovery; and pumping flow-rates and distances.

Mines often compete for water resources with other users such as agriculture, domestic and industrial water supply, and the environment. It is important that the mining industry be seen as good stewards of water to ensure continued access to a limited resource.

As the surface desiccates, tailings containing sulfides have the potential to oxidise, and also potentially produce acid and metalliferous runoff and seepage. Rainfall infiltration may leach the oxidation products, releasing contaminants to the groundwater.

Potential contaminants will be transported in any runoff and seepage emanating from the tailings storage facility. These risks to the environment are controlled by effective operating, closure and rehabilitation strategies

Tailings disposal

Tailings are usually pumped as a slurry in a pipeline and discharged sub-aerially into a surface tailings storage facility. The consistency of the slurry (percentage solids by mass) depends on the type of tailings, the particle size distribution and specific gravity, and the extent of thickening at the processing plant.

Tailings are often thickened at the processing plant prior to pumping to the storage facility.

This enables process water to be directly recycled back to the mineral processing plant, reducing water losses and reducing processing plant water demand.

Where tailings are discharged into surface storage facilities, depositional beach angles will steepen as the tailings are discharged at a thicker consistency, and the reducing water content will, in turn, reduce the containment requirements.

Mine closure, decommissioning and rehabilitation

The dominant mine-related risks to public health or the environment are from TSFs. This is reflected in the high level of community concern about their closure, decommissioning, rehabilitation and aftercare.

The principal objective to leave the facility safe, stable and non-contaminating, with little need for on-going maintenance. In some cases it will be possible to enhance the value of mined land, to create a modified landscape that offers recreational, commercial or natural value that can be enjoyed in the future.

To achieve such outcomes, it is essential that post mining land-use objectives are developed and agreed to with regulators, the local community and stakeholders prepared to accept ongoing responsibility for the land.

Factors to be considered when planning the closure, decommissioning and rehabilitation of a tailings storage facility include ore type and geochemistry, which will dictate the potential for the tailings to contaminate, taking into account the variable nature of the ore; crushing, grinding, and the process and process chemicals used for ore extraction; and the tailings disposal technique.

Each site will have specific commitments relating to closure of a tailings storage facility, based on the outcomes of technical studies, and agreements with landowners and regulatory agencies.

Active stakeholder engagement is an important part of the process, enabling the mining company to present closure plans, listen to feedback from key stakeholders, and refine plans to a point where community acceptance and government endorsement is achieved.

Excerpted from Tailings Management - Leading Practice Sustainable Development Program for the Mining Industry

Published with permission from the Commonwealth Department of Industry, Innovation and Science.



Dead trees in the Brukunga Pyrites Mine tailings dam, east of Adelaide in the Mount Lofty Ranges, South Australia.

A guide to good practice

NATIONAL

ANCOLD is a non-government, non-profit and voluntary association of organisations and individual professionals with a common technical interest in dams.

Formed in 1937, it is an Australian-based apolitical industry body that focuses on disseminating knowledge, developing capability and providing guidance for all aspects of dam engineering, management, operation and associated issues.

ANCOLD is an active member of the International Commission on Large Dams (ICOLD) and has representation on a number of ICOLD technical groups including Dam Safety Management, Tailings Dams, and Earthquake committees.

ANCOLD has a range of resources that can provide guidance to owners of tailings dams and professionals involved in all life-cycle phases for tailing dams.

ANCOLD's mission statement recognises that it is the skills of the people involved in these activities, and their sharing of knowledge and collaboration that will sustain its mission for continuing development of good practice.

The ANCOLD 2012 Guidelines on Tailings Dam – Planning, Design, Construction, Operation and Closure provide extensive guidance on good practices particularly for the physical



Image: John Coppi.

Dead trees in the Brukunga Pyrites Mine tailings dam, east of Adelaide in the Mount Lofty Ranges, South Australia.

asset risks of tailings dams. This guideline is widely used by practitioners.

An update to the Tailings Dam guideline is under preparation and planned to be ready for issue in coming months. The update will cover some recent developments or clarification on good practice for matters such as governance of tailings dam safety and design issues including earthquake considerations, static liquefaction, acceptable factors of safety and deformation.

Practical guidance for tailings dams is

not limited to the ANCOLD guidelines for tailings dams. Good practices for owners, operators, and other professionals are available across a number of ANCOLD guidelines that importantly should be considered as a package.

These include the Guideline for Dam Safety Management (particularly for governance), Guideline for Risk Assessment, Guideline for Consequence Categories, Guideline for Dam Instrumentation and Monitoring, and Guideline on Regulation and Practice for

Environmental Management of Dams.

New guidelines are continually being developed by ANCOLD which are similarly of relevance to tailings dams. Preparation of a guideline for Geotechnical Foundation Investigations is nearing completion, and the previous 1998 earthquake guideline is to be replaced with a revised Guideline for Design of Dams and Appurtenant Structures for Earthquake to be issued this year.

A Dam Safety Liabilities and Corporate Governance Course is available upon request and this course is targeted at executive and corporate managers and Boards for organisations that own dams. Professional development resources are available with Seminars on demand across a range of technical topics.

The ANCOLD tailings dam guideline committee is planning workshops later this year to share knowledge. The Western Australia Tailings Interest Group regularly run events and meetings to share learning of good practice and lessons from recent failures.

A similar Tailings Interest Group is being formed in Queensland. The annual ANCOLD conference brings together a range of professional from the industry and ANCOLD are encouraged to see increasing participation of professionals involved in tailings dams.

Further information is available at: www.ancold.org.au

Keep it simple and safe

NATIONAL

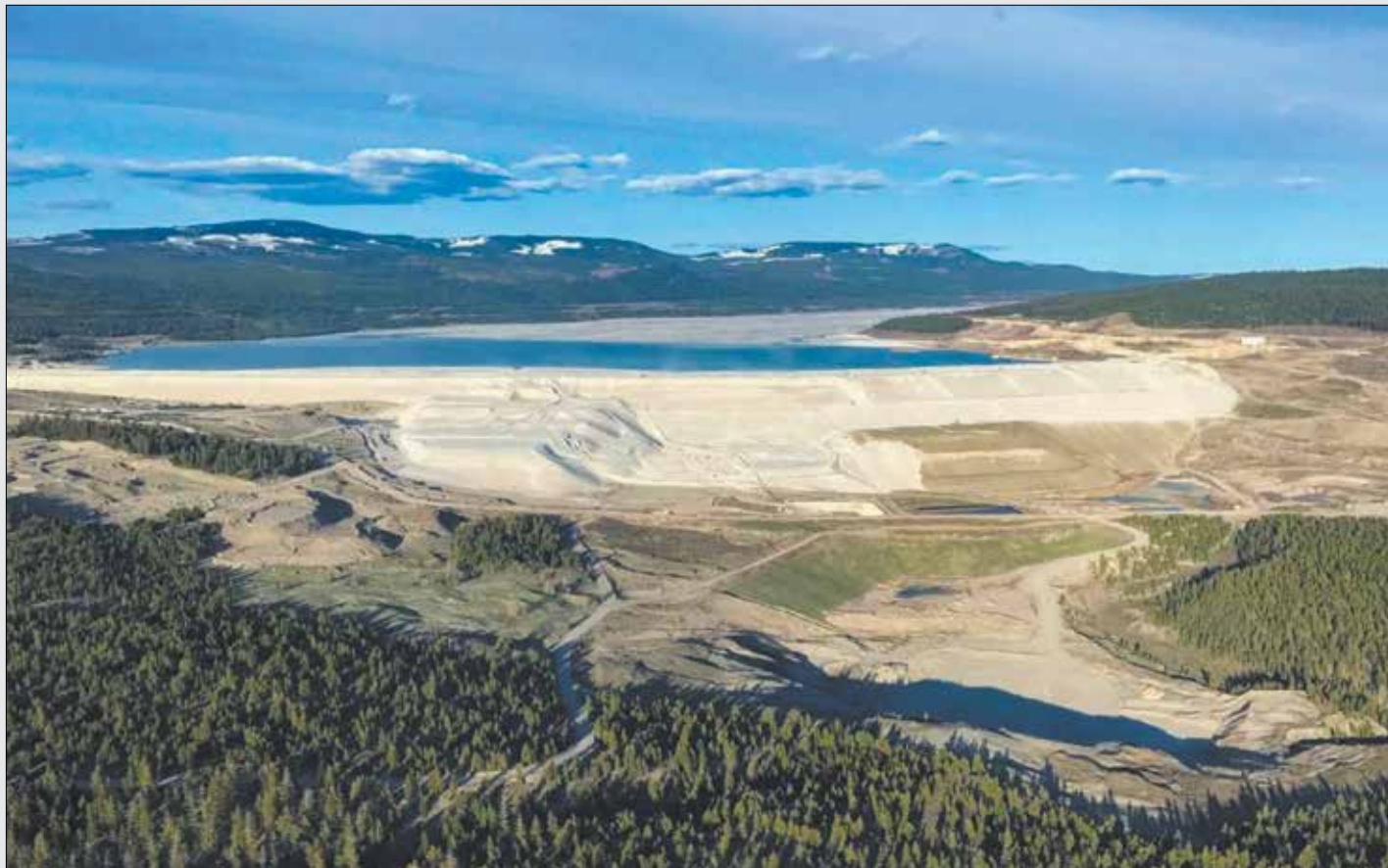
KLOHN Crippen Berger (KCB) has been tackling large, complicated tailings dam problems since company founder Earle Klohn introduced engineering design concepts to tailings dams in Western Canada in the 1960s.

The company prides itself on correct and thorough work when it comes to evaluation, planning, and the execution of tailings projects, and in the planning for and management of associated risks.

Senior geotechnical engineer Brett Stephens said planning is the fundamental component for a successful tailings dam.

"A regular dam is built to its full height, and its design, in a single program of work – you fill it and then you operate it, and that dam doesn't change its complexity or its operation for the life of the structure," he said.

"The complexities with tailings dams is that every year the dam needs to be re-evaluated, planned and then executed; you build them to store a material that changes through the life cycle of the mining project, and as the ore changes, the materials used to build the dam



Klohn Crippen Berger has been working to provide simple, well thought-out solutions to tailings management since the 1960s.

changes – the height of the dam changes.

"You really need to plan the dam, because the planning allows you to understand exactly what you're going to build, how you're going to build it and how to predict where your problems are. Planning lets you stress test the design and operation of a dam.

"I always ask 'what's the weakest part of this plan?' If the water balance changes, 'does the design continue to allow safe dam operation'? If the mine changes the ore type and I end up with a beach that's a lot flatter, can I still get my water and

storm storage?"

Mr Stephens believes that the best plan to have is a simple one – one that is backed up by sound, well-reasoned and well-budgeted engineering that allays financial qualms involved in investing heavily in tailings dams.

"Most new mines are really tough to get going; there's a lot of risk and money involved in the companies investing, and they are trying to balance cost, risk and operational complexity. Sometimes cost savings can leave them with pretty big risks," he said.

"You need to balance the risks against the contingencies if these things happen during a mine life, and a mine is a complex thing.

"In mining projects, and especially the big ones, the plans need to be simple.

"They need to be understood by the operations and the operators and they have to be executed efficiently.

"If we do our jobs well, we end up producing a really simple plan backed up by all the necessary engineering to support it."



A thickened tailings trial at 10 per cent of full production.

Thickened tailings safer

INTERNATIONAL

TAILINGS disposal does not rank highly on the scale of overall mine production costs, but it does weigh heavily in terms of overall risk to an operation in connection with permitting and approvals, as well as ongoing operations.

There is nothing like a well-publicised tailings dam incident to damage a company's credibility and reputation.

Tailings are fluids, typically a mix of water and fine grained solids particles, which have to be deposited and stored safely.

However, an inherent conflict arises when deposited tailings are commonly loose and saturated, which creates a potentially unsafe condition.

As part of the report on the Mount Polley dam failure which took place in British Columbia, Canada, in 2014, the review commission discussed two options for improvement.

Firstly, it considered implementation of "best practice" applied to existing designs.

This included improved accountability by management, improved foundation and tailings investigation and characterisation, better control of progressive construction processes, improved monitoring and surveillance procedures, and rigorous third party review of all aspects of design, monitoring and operations.

The panel took the view that while these incremental improvements should be applied to existing operations, they would nevertheless be insufficient to guarantee reduction of failures to zero.

Secondly, the commission recommended consideration of a new approach to tailings management, which it termed "best available technology" (BAT). The fundamental principles of BAT are to eliminate surface water from the impoundment, and promote unsaturated conditions in the tailings with drainage provisions, in order to

achieve high strength throughout the deposit by compaction.

Many practitioners have taken this as indicating that filtered tailings and "dry stacking" are necessarily the next step, and it is a fact that some mining companies explicitly mandate this technology in considering management options.

However, it is generally the case that filtration and dry stacking technology is prohibitively expensive, and for this reason has not been widely adopted.

It is also not well understood that filtered tailings do not necessarily reduce the tailings moisture to a level that enables compliance with the BAT principles, and that not all tailings types are suited to filtration.

In the rush to get on board and consider filtration, what is often overlooked is that the fundamental principles of BAT can be achieved by other means, at a comparable performance standard but at a far lower cost.

Specifically, these other means relate to thickened and paste tailings.

The methodology of thickened discharge (central thickened discharge, or down valley thickened discharge) is well established, and provides outcomes that conform to the BAT principles.

For more than 20 years, ATC Williams has been involved in design and implementation of thickened and paste tailings disposal schemes in a wide range of geographic locations and climates, including Australia, South America, Iran, Europe and Central Asia.

Such methods have been applied from relatively small operations (less than 1 Mtpa) through large operations (20 Mtpa to 30 Mtpa).

Scaling to very large capacities (in excess of 50 Mtpa with total storage capacity of 3000 to 4000 Mt of tailings) has also been proven by ATC Williams to be feasible.

The thickened tailings method has presented a new paradigm in tailings disposal, including a total revision of

the risk profile of a tailings storage facility (TSF), with significant savings in capital and operating cost compared to filtration and significant savings in water consumption and overall rehabilitation costs compared to conventional low slurry density systems.

Features of this methodology include beaching at an appreciable and reasonably uniform slope to improve storage efficiency; substantially improved embankment efficiencies; direct water recovery by thickening for improved water recovery efficiencies; pond areas that can be minimized and maintained off the tailings; high density and shear strength (due to evaporative drying); and earlier and more trafficable tailings beaches for rehabilitation purposes.

Most importantly, the higher densities and corresponding higher tailings shear strengths provide a marked improvement in safety, particularly compared to a conventional system.

Thickened tailings schemes are most applicable to flat terrain, where the natural surface gradient is flatter than the beach slope.

They are also more suited to climates with high levels of evaporation.

Like all TSF projects, design challenges exist; the most notable in this case being the requirement for a higher level of co-operation and integration between processing and tailings disposal designers.

This is because the critical factor to beach slope is a function of the complex interaction between the degree of thickening, slurry pumping approach, and beach slope.

ATC Williams has developed the necessary range of technical skills and experience to effectively optimise these factors.

These skills are complemented by unique and highly specialised in-house testing facilities, applying laboratory testing procedures tailored to characterise tailings both physically and rheologically in support of thickened tailings designs.

The critical design challenge for such techniques has always been the ability to appropriately forecast the actual profile of the beach formed by the deposited tailings.

ATC Williams recognised this over a decade ago, and has sponsored fundamental research in this area, supporting two PhD doctorates and a range of technical studies throughout this period.

Prediction methods for beach profile design are now well established, as well as statistically based methodologies of linking beach profile outcomes to the real-world performance of thickeners.

ATC Williams has found that one of the militating factors against wider adoption of thickened and paste tailings technology is that available land areas do not necessarily provide suitable terrain for siting of a viable thickened discharge facilities.

This suggests that mining companies may need to start preliminary siting studies sooner in the development sequence to ensure that there is time available to acquire the necessary real estate without compromising the overall development schedule.

ATC Williams is a professional engineering services company that has provided specialist expertise to the mining industry in the area of tailings management for nearly 35 years.

Its highly experienced staff across three Australian offices is emphatic in its support for the principles of BAT, whilst also being expertly equipped to provide the most suitable, cost effective and pragmatic solution to any tailings management issue.

The company is firmly of the view that thickened tailings technologies meet BAT principles, and whilst filtration is being adopted theoretically as a favoured option, in many cases the thickened tailings approach can be delivered to achieve comparable performance standards, often at significantly reduced costs.



For several decades, Klohn Crippen Berger has participated in some of the largest and most challenging engineering, geoscience and environmental projects across the world.

KCB was among those to revolutionise modern tailings facility design over 50 years ago. Today we continue our pioneering role through coupling our mine waste designs with environmental, socioeconomic and water management solutions. We have worked on hundreds of mining projects worldwide and bring practical solutions to your mining challenges.

We are proud of our legacy, and continue to build a better world through excellence, innovation and teamwork.



Technology and know-how

NATIONAL

SCIDEV specialises in the development of technology and the production and supply of polymers and associated chemistry for wastewater, mineral processing and tailings treatment.

The company is helping to create the most effective and cost-efficient solids-liquid separation processes available across several industries.

Its capabilities were recently strengthened through a partnership with the world's second-largest manufacturer of water-soluble polymers, Nuocer Group.

SciDev innovations can now be fast-tracked through to manufacturing.

One recent SciDev innovation, OptiFlox, has commercial utility across both thickening and dewatering processes.

Through understanding the tailings geochemistry, especially the clay-sized fractions, the company can provide highly-coordinated technology and innovative chemistry solutions.

The OptiFlox system measures online, in real time, the key parameters that drive thickener and dewatering behaviour.

End users can then use these parameters to drive improvements in their processes through precise automated chemistry application.

Often a key technical challenge with tailings treatment is the variability of the



Image: Mariusz Prusaczyk on Unsplash.

SciDev specialises in tailings treatment applications.

material.

In greenfield applications, mining plans change over time and the water chemistry that governs particle behaviour can also change.

These changes can have a material impact on thickening and dewatering performance.

The world-class SciDev team is committed to solving complex tailings

problems and will continue to invest in R&D, partner with OEMs and end users, and work to develop long-term partnerships with industry to deliver a sustainable future.

Next-generation technology for solids-liquid separation in mining, water and wastewater



SciDev is a leader in the development and application of both chemistry and process control for solids-liquid separation.

Our innovative technical capabilities, unique manufacturing operations and unparalleled support enable us to deliver real value and low operating costs.

Our Technologies are:

MaxiFlox™ - Innovative chemistry for the mining industry

OptiFlox™ - Specialised process control technology for mineral processing applications

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INNOVATIVE SCIENCE • REAL VALUE

A crisis of trust



Following the failure of the Fundão tailings dam at Samarco, Brazil, in 2015, BHP was tasked with an enormous re-construction effort that was not completed until 2017.

RICHARD DAVIDSON
PE, CPENG, AECOM

GEOTECHNICAL engineers in the mining industry have found themselves in a crisis of trust.

The industry has lost the trust of the public and its regulators.

It has lost the trust of shareholders and managers, and it has lost the trust of geotechnical colleagues.

In the last few years the industry has suffered previously unimagined catastrophes with open pits, waste dumps, crushed leach operations and tailings dams.

Have these structures ceased to obey the laws of physics and geotechnical engineering, or are there other more systemic issues at play?

Erosion of the three R's

The recent string of unfortunate mining industry failures reflects an erosion of resilience, robustness and reliability, the three R's, resulting in incremental increases in risk which were not recognised or not acted upon.

Failures typically result from a sequence of events that may not only be geotechnical, but also management and operational decisions.

Resilience is the capacity to recover quickly from difficulties, also often thought of as 'toughness'; it is the ability to absorb or avoid damage without suffering complete failure.

Robustness in design usually refers to the number of lines of defence – it contributes to resilience.

The US Army Corps of Engineers (USACE) has said that robustness is "the ability of a system to continue to operate correctly across a wide range of operational conditions (the wider the range of conditions, the more robust the system), with minimal damage, alteration or loss of functionality, and to fail gracefully outside that range".

Reliability in design refers to whether you can count on those lines of defence during an emergency.

Management systems

The three R's are relevant to the industry's management systems, operations and construction, and downstream consequences.

Three-R management has not been well understood in the mining industry, but its application requires a structure and clear definition of the responsibility, authority, capability, resources and liability of each position and role.

Management resilience begins at the top of the organisation.

Mining industry leadership group International Council on Mining and Metals (ICMM) has stepped up to guide the evolution of the industry management systems.

Operational and construction resilience

Operations and construction resilience, robustness and reliability can be eroded by gradual and seemingly insignificant compromises made during construction, and by becoming complacent with marginal situations with an imperfect knowledge of just how close the structure is to failure.

Because mining structures are under a constant state of construction, unknown changes can occur that have devastating consequences.

For this reason, the industry applies the observational method for these structures.

The observational method, if properly implemented, provides extensive instrumentation coverage and thresholds for potentially dangerous conditions with enough time allowed to respond and correct the situation.

Consequence resilience

Consequence resilience refers to the

ability of the area downstream to absorb failure consequences.

This is clearly demonstrated in the differences between the Mt Polley and other failure events.

In the case of Mt Polley, the geotechnical breach of the rockfill dam had a limited geometric extent, and the tailings released were primarily driven by the excessive amount of water stored in the impoundment.

The consequences were limited to tailings flow into a nearby deep lake.

Other recent failures released retained tailings downstream with enough energy to flow many kilometres.

Hence, these structures had both low propagative and consequence resilience.

Three R design

One protection against these devastating consequences is having a design that meets the three R's.

For example, upstream method tailings dams may have relatively little design robustness.

To overcome this, companies must add operational reliability with critical operational practices that maintain the decant pond as far as possible from the crest, and they must create a wide structural shell of drained sand to maintain stability, in effect adding resilience and robustness.

Centerline and downstream method dams can be more resilient with robust lines of defence and high reliability if they are constructed correctly.

Thickened thin lift deposition and filter dry stack construction can add additional resilience by limiting the amount of water retained in the structure.

However, the three R's can be eroded by compromising on slopes, beach width and freeboard, not conducting sufficient geotechnical investigations to identify flaws in the foundation, storing too much water, and not providing important

quality control and quality assurance that what is being built satisfies the design intent.

Preventing the erosion of the three R's

To prevent erosion of the three R's, first and foremost, the mining company must retain a competent engineer of record with enough resources to develop and maintain a safe design.

The designer must consider various alternative technologies and mining approaches to achieve the project objectives by avoiding potentially dangerous conditions.

Second, a design review board or panel can be utilised to provide independent opinion on each stage of the design and construction process.

A group of experienced subject matter experts should provide unbiased assessment of all aspects of the project.

They must be free to ask the uncomfortable and difficult questions that may challenge the design and "the way it's always been done," and provide mine management, including the corporate board of directors, a clear understanding of the risks they bear.

Third, an independent safety reviewer may be helpful to conduct "cold-eye" periodic inspections.

Finally, adequate geotechnical resources must be committed by the mine to the safe operation of the facility.

The future

Not surprisingly, recent tailings tragedies have lost the trust of the public and galvanized opponents to mining.

It is time for the industry to earn back this trust by demonstrating that it can indeed provide resilient, robust and reliable structures that can protect the public as well as shareholders' investment.

While there have been successes, even one failure can erode years of progress in a moment.

HydroTerra identifies seepage flow paths

NATIONAL

IDENTIFYING tailings dam leaks and preferential subsurface groundwater flow paths is important information to aid in managing potential structural failures of tailings storages and associated environmental impacts to groundwater and surface water.

HydroTerra has identified – and now exclusively distributes in Australia – a unique geophysical methodology (Willowstick) specifically designed for identifying groundwater seepage flow paths.

This technology has been used in many mine sites worldwide.

The Willowstick method is a quick and non-intrusive technology used to identify, map and model preferential groundwater flow paths.

The technology works by establishing a signature electric circuit within the groundwater of interest.

Next, the distribution and flow of subsurface electric current is revealed by measuring the signature magnetic field at the surface.

Measured data is processed and



Like an angiogram that enables medical personnel to see blood flow inside the body, the Willowstick method is able to quickly identify groundwater flow paths.

compared to the expected magnetic field to form a theoretical homogenous earth model to highlight the anomalies.

Finally, 2D and 3D models are generated and interpreted in conjunction with available hydrogeological data to provide enhanced

definition of preferential groundwater flow paths.

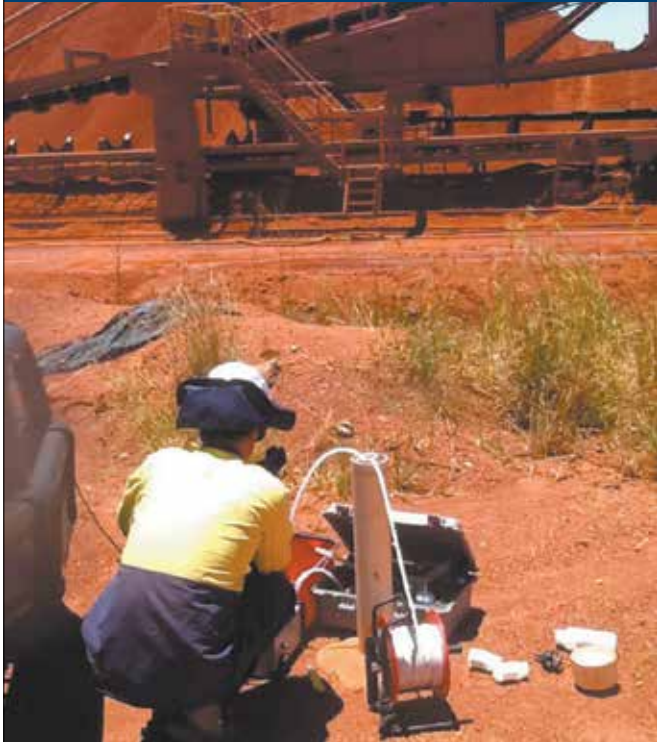
The mining applications include identifying seepage through dams, liners, heap leach piles, and tailings storage facilities, characterising groundwater

flow paths, locating production wells and the infiltration or exfiltration of mine groundwater.

More information about HydroTerra and the Willowstick methodology can be found at: www.hydroterra.com.au.



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AQUAREAD



Sentek technologies



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OCEANα

Monitoring tailing dams for integrity

NATIONAL

THE structure of water reservoir dams and tailings dams could not be more different.

Water dams, or embankment dams, would normally be engineered and purpose built to store water, whereas tailings dams would be designed for the storage of unwanted waste, and done so at the lowest cost.

Embankment dams are usually completely built before being used to retain water, but tailings dams, by the very nature of their purpose, would be built slowly, sometimes over years.

This means conditions could change, the process (material concentration) could change, and the method of building the dam could change.

This has often led to problems with the structural integrity of tailings dams.

The collapse of Vale's Brumadinho iron ore tailings dam in Brazil was devastating and, according to researchers at World Mine Tailings Failures (WMTF), this was the 11th serious tailings dam failure in the past decade.

Tailings dam management has become critical, as has the monitoring of the integrity of tailings dams.



Fibre optic sensing helps monitor and identify the location of landslides.

When processing ore bodies, mines monitor many of the processes; so it only makes sense to monitor the integrity of the tailings dams.

The monitoring of tailings dams and slope stability issues – such as landslides – using distributed fibre optic sensing (DFOS) has gained major interest.

A prime example is a strain-based system using Brillouin optical time domain reflectometry (BOTDR), developed by Hawk Measurement (HAWK).

This distributed strain sensing (DSS) system is based on measuring the strain profile of the soil.

Fibre optic cable is buried in the

tailings dam, and soil movement monitored continuously.

It is critical to use the best cable-to-soil coupling to identify the progressive ground movement.

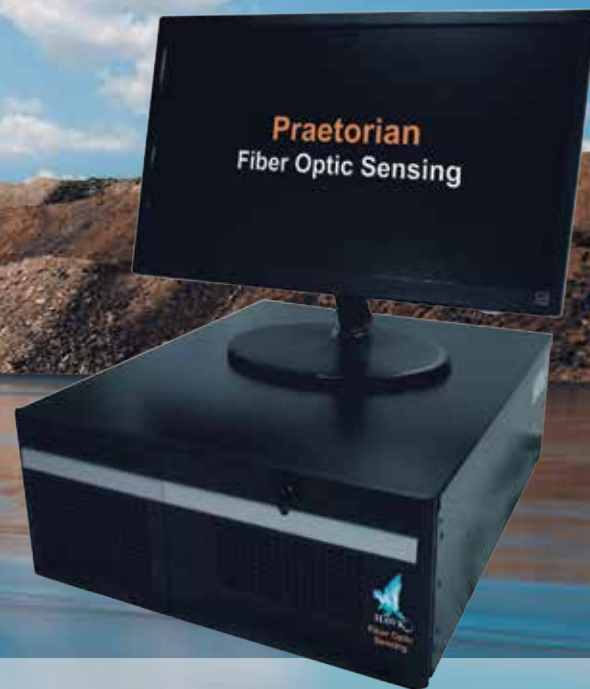
HAWK has various methods of installing and anchoring the cable to effectively monitor and identify the location of landslides.

Praetorian Fiber Optic Sensing

Tailings Dam Leak Detection and Wall Displacement Monitoring

Want to Know More?

If you have a problem or want to reduce the amount of risk with your existing or planned tailings dam, HAWK is here to help. We have specialists on hand available and ready to assist you with everything from feasibility, design, installation, commissioning, and after sales support. HAWK has historically been involved heavily in the coal and hard rock mining sectors. We understand, appreciate and have adapted to the challenges accompanied with mining sites.



Hawk Measurement Systems

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Tel: +61 (0)3 9873 4750 | Email: info@hawk.com.au | www.hawk.com.au

Hawk Measurement

90 Glenn Street, Suite 100B, Lawrence, MA 01843, USA

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A dam and spillway being built. Knight Piésold's mining expertise has been used on hundreds of surface and underground mining projects worldwide.

Technical, cost-effective solutions

NATIONAL

KNIGHT Piésold is an international company of consulting engineers, scientists and technicians, providing specialised engineering and environmental services to the mining, power, environment, water resources, transportation and construction sectors.

Knight Piésold's mining expertise has

been used on hundreds of surface and underground mining projects worldwide and under a variety of climatic and seismic conditions.

The Australian operations focus on providing sound tailings management solutions around the globe and clients have trusted Knight Piésold to successfully move their projects forward to completion for many years.

With more than 90 years' experience,


Knight Piésold continues to evolve its expertise to ensure that its clients are provided with the most appropriate technical and cost-effective solutions for their projects.

Over the past 25 years, clients have changed their engagement practices with their tailings management consultants, moving from cost-based selection processes to technical.

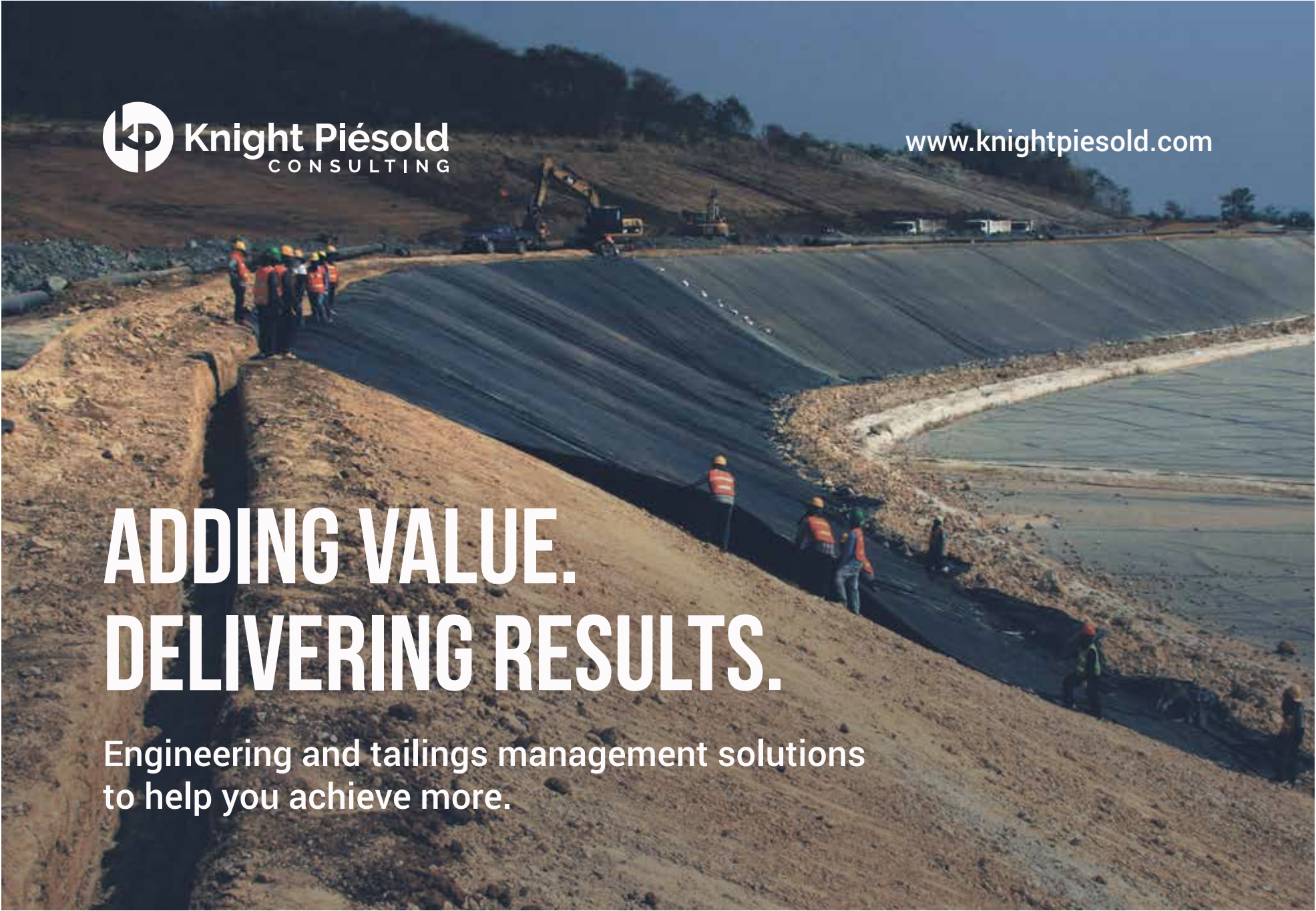
Knight Piésold believes this is the right

approach and has always encouraged it. The importance of tailings management to the success and reputation of mining companies is critical, as demonstrated by the recent tailings dam incident in Brazil.

Knight Piésold focuses on developing long term relationships with their clients to ensure they are involved from conceptual design through to construction, operations and eventual closure of their tailings facilities.



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ADDING VALUE. DELIVERING RESULTS.

Engineering and tailings management solutions to help you achieve more.

Experts in tailings storage facilities

NATIONAL

ENGINEERING Geology Ltd (EGL) is a well-established professional engineering consultancy practice based in Auckland, New Zealand, that specialises in geotechnical and earthquake engineering, and water and tailings storage facilities.

EGL has provided services to a wide range of clients in the commercial, industrial and mining sectors, as well as to other consultants and professionals for 30 years.

EGL has been involved with mining projects in New Zealand, Australia, New Caledonia, Indonesia, Papua New Guinea, Fiji, Philippines, Africa and Eastern Europe.

The company's clients range from small to large international mining corporations.

EGL employed highly skilled and experienced staff, particularly in the area of earthquake design for embankments.

The principals each have more than 30 years' experience including tailings storage facilities in Queensland, NSW, Victoria, South Australia and WA, and the company offers a number of services in relation to tailings storage facilities.

The company provides services for scoping and feasibility studies, geotechnical investigations, tailings characterisation and deposition modelling, as well as dam breach studies and the assessment of consequence categories.

EGL also provides site-specific



EGL has been giving expert advice in tailings management for 30 years.

seismic hazard studies, liquefaction assessments and numerical modelling (including response to earthquake shaking assessment).

It works tirelessly on all projects to produce detailed designs; prepare plans, specs and contract documents; monitor

construction advice given and certification; and to ensure dam safety management to include the development of operation, maintenance and surveillance plans.

EGL has proven itself an expert in the evaluation and interpretation of monitoring and surveillance data,

preparation of emergency action plans, and the performance of dams and dam safety review.

The company has also provided forensic examination and been contracted to provide expert opinion and independent third party reviews.

CONSULTING GEOTECHNICAL, EARTHQUAKES AND DAMS ENGINEERS

OUR CAPABILITIES INCLUDE:

- Feasibility studies, geotechnical investigations and design of water storage and tailings dams
- Monitoring, surveillance and safety reviews
- Dam breach studies and the assessment of consequence categories
- Site-specific seismic hazard studies, liquefaction assessment and dynamic numerical modelling
- Construction monitoring and certification
- Expert opinion and independent third-party review



CONTACT US:

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Coal exports have more than doubled since 2001, and up until 2003, there was no regulatory body to coordinate the more than 1400 vessels carrying coal out from the port of Newcastle.

GERARD MCARTNEY

THE Hunter Valley region is undoubtedly one of NSW's engine rooms, and a powerhouse of Australian mining.

Its history goes all the way back to the early 1800s, when the government began mining the first coal in the colony's history.

Today, the Hunter Valley is home to more than 272,000 people and comprises 41 coal mines owned by 11 producers.

Spread over more than 450km, coal haulage distance was typically up to 380km.

There were more than 31 points for coal loading, four rail haulage providers delivering to three terminals, and as a collective, filled and exported more than 1400 coal vessels every year through the port of Newcastle.

With the growing demand for coal in South East Asia's up-and-coming economies vastly outgrowing the down turn in European demand, coal mining looks set to remain intrinsically linked to the valley, and to the community of miners that support it.

The Hunter Valley Coal Chain Coordinator (HVCCC)

The Hunter Valley coal chain was a complex interconnected operation that targeted very large deposits of coal from a concentrated network.

Until 2003, there was no coordination process for the movement of coal through the Hunter Valley, which often led to inefficiencies, logistical errors and a lack of synergy between the coal producers.

The complexities of having so many individually managed mines competing for the four independently managed rail providers and transport operators was further compounded by the "two-week visibility" window for arriving vessels at Newcastle Harbor, and the allocation of their supply to individual mines.

The HVCCC was set up to streamline operations through a centralised planning model for the production, transport and export of coal from all the sub-regions of the Hunter Valley.

The body was originally tasked with the day-to-day scheduling, and to look at long term capacity planning. However, in 2009, it went from a cooperative of service providers to a separate entity with legal status.



The Hunter Valley is NSW's oldest mining district, and has been mining coal since 1817.

Today, mines such as Mandalong and Westside in the Newcastle coalfield to Ulan and Springvale in the Western coalfield have access to the services provided by HVCCC, which helped get thermal and coking coal to Newcastle where about 85 per cent of Hunter Valley coal is exported to Asia.

BHP

Mount Arthur is the biggest mine in the Hunter Valley region.

Also known as New South Wales Energy Coal, it is 100pc owned by BHP and reported 18.5mt of saleable coal produced in 2018.

The company planned to expand its Ayredale and Roxburgh pits that would push the mine life out to 2026, and reported an increase from \$US75 per tonne in 2017 to US\$87 in 2018.

The company had launched its extensive tailings dam operation, with its stage 2 raise project underway to raise the existing embankment 10m and increase the tailings storage capacity.

In 2018, the company came under fire from the CFMEU for its announcements surrounding in-house labour hire company Operations Services, which was expected to impact about 300 local roles.

Yancoal

Chinese heavyweight Yancoal is the 51pc owner of the unincorporated Hunter Valley

Operations (HVO) JV with Glencore, and is 100pc owner of its other Hunter Valley Tier 1 asset, Mount Thorley Warkworth.

HVO was located about 24km northwest of Singleton in the upper Hunter Valley, and was considered to be one of the highest quality thermal and semi-soft coking coal mines in the world.

Offering semi-soft coking coal and low, medium and high-ash thermal coal, HVO operated a multi-pit open cut mine.

The JV used a "dragline truck and shovel" method and processed through two on-site coal preparation plants.

HVO had a mine life of 43 years, and a reserve of 796Mt producing 13.3Mt at a 100 per cent basis in 2018.

Mount Thorley Warkworth is a tier 1 coal asset that operates two open cut mines with the potential to head underground.

Following preliminary studies, drilling and technical assessments were commissioned to consider the feasibility of an underground opportunity. In 2018, the company recorded 21.1Mt production of saleable coal.

Glencore

One of the world's largest gold producers, and the largest economic contributor in the Hunter Valley, Glencore operates 15 active mines in the Hunter valley including its JV with Yancoal, Hunter Valley Operations and Bulga Coal.

Bulga Coal was the biggest landholding operation in the Hunter Valley, and produced about 12mtpa of semisoft coking coal and thermal coal making it a tier 1 asset.

Located 15km southwest of Singleton, Bulga includes the Bulga open cut and the handling and preparation plant. BHP began mining Bulga in 1982, when it was known as the Saxonvale mine.

In 1992, the mine went underground and was operational until May 2018, when it completed operations and closed the mine.

Today, it continues to operate the Backfield North pre-drainage gas wells in order to provide gas for the 9MW power station, and Glencore had begun the long and arduous task of rehabilitating the mine, aiming for completion of the outer face stage by August 2019.

The outlook

Coal has been the big employer in the Hunter Valley, providing about 9000 jobs to the community and generating billions in revenue, but international pressure, and government scrutiny over clean energy alternatives has long loomed over the future of mining in the Hunter Valley.

In a recent report, the Institute for Energy Economics and Financial Analysis (ERRFA) warned the NSW government that coal exports had peaked and the industry was now facing a terminal long-term decline.

According to the report, Australia's largest thermal coal export locations – Japan, China, South Korea and Taiwan – all aimed to reduce their consumption of thermal coal in order to increase the development and uptake of renewable energy.

However, other sources tell a different story.

The March 2019 Resources and Energy Quarterly said that In 2017, Australia exported 54 per cent of all coal worldwide, and 20 per cent of all thermal coal, making it the world's largest coal exporter.

While international demand is set to plateau between 2019-2024, the report predicted that coal demand would remain strong through 2019 and 2020.

In March, NSW Mining reported that since 2001, coal export volumes from NSW had more than doubled – from 75Mt to 164Mt – due to increased international demand.



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Top marks for mine services

NATIONAL

A PLUS Contracting and Poly Welding works throughout the Hunter Valley delivering high-quality civil services, including labour hire.

The company is regarded as a leader in the region for dam construction, dewatering, containment fencing, sediment control, road construction and repair, earthmoving and complete site rehabilitation including design, construction and on-going site management.

The company utilises new and state-of-the-art equipment, and has a highly skilled workforce experienced with the knowledge and training to complete all aspects of a project.

A Plus Contracting and Poly Welding's management and engineering team provides the technical support and resources to ensure all our quality standards are satisfied.

From the company's beginning, safety has been a major priority, with a great track record including regular review of safety management plans, regular collection and screening for drugs and alcohol, in-house safety interactions and inspections, and other important procedures.

Managing director Damian Hamilton said safety is a major concern when working on any project.

"We take a strong and proactive



Ongoing desilting carried out at a slurry catchment dam.

approach to safety management and have recently achieved more than 1500 days without a lost time injury," he said.

A Plus Contracting and Poly Welding plans to maintain a continued and sustainable growth in poly pipe installation, as well as plant and equipment hire.

Mr Hamilton said the business is a

client-focused organisation which takes pride in understanding each client has its own specific requirements.

"It's important to deliver products and service to clients within their stringent demands and time frames," he said.

"We provide follow up support and offer complete honesty and transparency."

The company guarantees delivery of

the highest quality service on time and to specification by utilising the relevant Australian or International Standards, such as ISO 21307 Butt Fusion Jointing Procedures and ISO 14001 Environmental practices.

A-Plus Contracting & Poly Welding has been nominated for the 2019 Singleton Council Business Chambers Community Super Star award.

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TH15000 resolves SAFETY ISSUES like:

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- access to wheel nuts by providing a work platform and jib arm for tools.

TH15000 resolves SPACE ISSUES as:

- it has a narrow footprint of 2833mm wide by 5366mm long allowing you to work and manoeuvre in confined spaces.
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TH15000 resolves TIME AND EFFICIENCY ISSUES:

- in independent trials the TH15000 Workshop Tyre Handler was proven to be 60-75% more efficient - improving workshop productivity by 47%. For most customers it shows a return on investment after handling 126 tyres.

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SMART AUTOMATION PRODUCT SUITE

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Our suite of mine-to-port materials handling products have been proven in the Hunter over generations of field deployment. We use laser technology and advanced data modelling to make machines smarter.

SMART WAGON PRODUCT SUITE

Our third generation technology for train load-out or dump station automation is a market leader and an upgrade for ageing equipment. Key benefits:

- Increase accuracy.
- Lower maintenance requirements.
- Centralise management.
- Significantly reduce fines for over loading.
- Increased load by 7% at German Creek to reach optimal capacity.
- Monthly service fee option – no capital outlay.

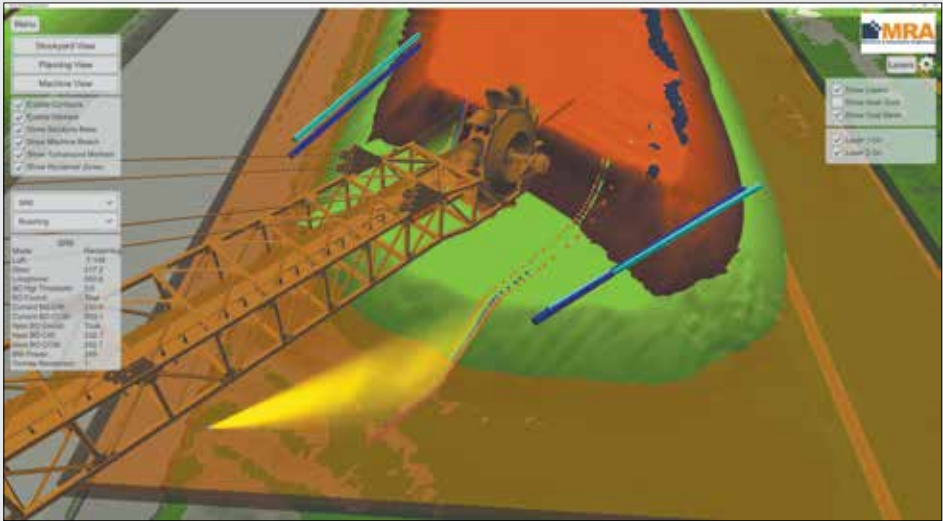
SMART STOCKYARD MANAGEMENT SYSTEM

Significant advancement in the management of a modern mined-material stockyard. Deployed in four eastern seaboard ports processing 250MTPA. Key benefits:

- Highly accurate, volumetric stockpile modelling.
- Visualisation of the entire stockyard, individual stockpiles and mobile machines showing actual and projected performance with 30-day playback.
- Quality management with the tracking of 100kg blocks through the materials handling lifecycle onto the vessel.
- Significantly increase time in material and throughput gains – 13.7% on a manually optimised automatic machine at Abbot Point.

Keen to find out more?

You're welcome to contact our Engineering Manager Peter McPherson **m** 0403 453 250 **e** peter.mcpherson@mra.com.au **w** mra.com.au



Smart Stockyard Management System Machine optimisation showing laser scanner data points and calculated turnaround slew position for the current and next slew swings at Abbot Point.

World-class automation products from MRA

NATIONAL

A NEW suite of high-tech mine-to-port machine automation products developed in The Hunter can make a substantial difference to mining operations.

There is a great deal to gain for operators today simply by upgrading to the latest in automated products. Doing so can bring substantial benefits, including lower maintenance and operating costs, increased accuracy, optimised performance and enhanced operational control.

One company that is committed to developing these types of efficiency gains is Hunter-based MRA.

MRA engineering manager Peter McPherson said the firm specialises in smart machine automation and has developed a suite of mine-to-port materials handling products that have been proven over generations of field deployment.

“Two of our newest products are our Smart Wagon Product Suite and Smart Stockyard Management System – technology that is suitable for any mined material (including iron ore, bauxite and coal) for both brownfield retrofit and greenfield sites,” he said.

According to Mr McPherson, MRA’s key point of difference lies in its deep understanding of machines and the automation process.

“We use laser technology and advanced data modelling for accuracy and have developed our products through a long collaboration with The University of Newcastle’s mechatronics division,” he said.

The Smart Wagon Product Suite is a third-generation product designed for train load-out or dump stations and can replace an onsite operator or an aged photo-electric (PE) cell solution.

The Suite’s speed reader calculates highly accurate and reliable measures of speed, and its position and speed sensor automates detection of wagon position set points and chute control for load-in and load-out processing at the mine site and port.

In addition, a profile monitor detects material hang-up and over- and under-loading of wagons, and provides detection for train wagon derailment.

Being able to optimally load a train wagon is a critical consideration and is now available with today’s high-tech solutions.

Production throughput can be maximised with optimal loading.

Another consideration is fines for over- and under-loading materials, which can now be virtually eliminated with smart technology. Fines have been an issue for many operators in Queensland and have recently been introduced into The Hunter.

MRA business development manager Andrew Wilshire said the Suite offers a significant upgrade in reliability and efficiency over traditional PE-based solutions.

“These face a number of challenges, including environmental sensitivity, a high failure rate and costly maintenance,” he said.

He said simply by switching to the Smart Wagon Product Suite, Anglo American in German Creek increased its average throughput rates by 7 per cent and Newlands’s Glencore mine limited fines for train wagon over and under loading by 95pc.

Stockpile stacking and reclaiming

With any efficiency gains related to stacking and reclaiming directly impacting on throughput and profitability, four eastern seaboard coal terminals processing 250MTPA have all optimised their machines by using MRA’s Smart Stockyard Management System.

“Our System represents a significant advancement in the management of a modern mined-material stockyard, its stockpiles and machines, including job and task management,” Mr McPherson said.

“The accuracy of our solution for machine level optimisation and quality management over the materials lifecycle is world class.”

This management solution provides highly accurate, volumetric stockpile modelling and can track-and-trace 100kg blocks through the materials handling life cycle onto the vessel, including attached properties.

“In fact, operators can visualise the entire stockyard, individual stockpiles and mobile machines showing actual and projected performance with 30-day playback,” he said.

For further information contact MRA’s Engineering Manager Peter McPherson on 0403 453 250 or peter.mcpherson@mra.com.au.

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r i t e d r i l l . c o m . a u



Sky Land Management's UAV provides solutions for safe, efficient and effective application of herbicides across many areas of a mine site.

Safer herbicide application

NATIONAL

MANAGEMENT of vegetation on a mine site comes with a range of safety issues.

Personnel need to access steep or unstable areas such as low and high walls to manage vegetation issues like weeds or may need to walk over uneven – and thus unsafe – rehabilitation areas during ground application of chemicals.

Sky Land Management's innovation, the rotary winged Unmanned Aerial

Vehicle (UAV), solves this problem, and provides solutions for safe, efficient and effective application of herbicides across many areas of a mine site.

The slow and low operational nature of the aircraft, combined with the downdraft created by the rotor blades, directs the spray or other products down within the column of air, which results in accurate application and reduces the risk of off-target application such as drift.

Sky Land Management managing director Phil Milling said that the

UAV significantly reduced the need for ground-based personnel and machinery in many areas of site, which directly improved safety.

"The capabilities of our high payload UAV are unique within the 'drone' industry," Mr Milling said.

"We have been a pioneer in the development of its capabilities in Australia.

"We continue to innovate, working closely with partners and clients alike to achieve higher standards in safety

efficiency and improved environmental outcomes."

Compared to land-based options, Sky Land Management can cover more area in fewer days, offers a more direct application of chemicals and thus requires less product, has a lower cost per hectare and provides weed control in previously inaccessible areas.

More information about Sky Land Management's safe and cost effective vegetation management can be found at: www.skylandmanagement.com.au.



Sky Land Management provides safe, efficient and effective solutions using our high payload Unmanned Aerial Vehicle (UAV)

Weed control on:

- Rehabilitation
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- Aquatic areas
- Prestrip
- Dam walls
- Offsets

Seeding and Fertilising:

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- Windrows
- Stockpiles
- Cover crops

Phil Milling 0402 244 073

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All images: Salt Lake Potash.

ENVIRONMENTAL APPROACH

Salt Lake Potash will be a safe, low cost producer utilising the sun's renewable energy to support a clean, sustainable WA fertiliser business.

Excavators building the evaporation ponds at the Lake Way Project.

RAY CHAN

SALT Lake Potash has begun construction on the country's first commercial scale on-lake Sulphate of Potash (SOP) evaporation ponds.

The ASX-listed company, along with about half a dozen other groups, is seeking to pioneer the production of SOP from Western Australian salt lakes.

It has received approval from the WA Department of Water and Environmental Regulation, clearing the way for construction of the initial Lake Way Ponds near the northern goldfields town of Wiluna to begin, as well as the dewatering of the Williamson Pit.

The lake is one of nine in the portfolio of lakes owned by the company, which aims to establish a highly profitable, globally significant fertiliser business in which sustainability is treated as an absolute priority.

The company plans to extract hypersaline brine from across the salt lakes in the area to produce potassium-rich harvest salts, which are then converted to SOP for the domestic and international markets.

SOP is valued by farmers for its high potassium and very low chloride content, which boosts flower and fruit development. The macro-nutrient also helps to ripen and strengthen plants, ensuring they can defend against pest, disease and weather damage.

The initial Lake Way ponds will have a volume of 1.8 gigalitres, sufficient to capture the total measured brine resource in the nearby Williamson pit of 1.2 gigalitres at 25kg/m³ SOP equivalent.

This equates to 32,000 tonnes equivalent of premium SOP and represents only a small portion of the Lake Way mineral resource estimate, the highest-grade brine resource in Australia.

And this is just the start. Extensive exploration activity is also underway across the whole region as the company seeks to optimise the project's significant resource potential.

Each of the lakes have been selected based on potential brine volume, known



Salt Lake Potash CEO Tony Swiericzuk signing the Native Title Land Access and Brine Minerals Exploration Agreement with Tarlka Matuwa Piarku (Aboriginal Corporation) chairman Robbie Wongawol, covering the Lake Way Project area.

hypersaline brine characteristics and the potential for production from shallow trenches or deeper paleochannel aquifer bores.

The initial lakes the company is targeting for production and exploration are close to established transport and project support infrastructure, which will be important in minimising operating costs.

Salt Lake Potash managing director Tony Swiericzuk said the building of the ponds was a key milestone not only for the company, but also for the creation of the new SOP industry within Australia.

"It is extremely exciting to be part of what is shaping as a major new industry for Australia, and one that is a little different to more traditional forms of mining that we are familiar with," he said.

"Essentially, we will be harnessing the abundant Australian sun as a renewable energy source to produce a premium fertiliser that will help feed the world's growing population."

Mr Swiericzuk said although there was no firm date yet for full scale output to begin, Salt Lake Potash was well placed to be one

of the first Australian SOP companies to reach commercial production.

"But there is scope for multiple successful players, and that is what we hope to see," he said.

"The brine evaporation process that the Australian companies are promoting is lower cost and more environmentally friendly than the Mannheim Process, which currently accounts for more than 50pc of global SOP production."

Indeed, Salt Lake Potash is already working alongside a competitor to share infrastructure and other costs in the region.

As Salt Lake Potash and Australian Potash own neighbouring projects at Lake Wells, one of the Lakes in the portfolio, and therefore share many common infrastructure elements, Mr Swiericzuk said it made sense to explore the potential for sharing development costs.

The company believes that the prospect of significant capital and operating cost savings from sharing infrastructure, and potentially evaporation and salt processing facilities, is ample motivation for pursuing the MoU and cooperation agreement.

While the building of a 50,000tpa demonstration plant is the initial focus, Salt Lake Potash is now considering larger commercial scale production scenarios following a recent whole-of-lake mineral resource estimate.

"The most recent resource update delivered for Lake Way in mid-March estimated a resource for the whole of the lake for the first time," Mr Swiericzuk said.

"At 73 million tonnes of SOP, the resource is a significant size and very high grade and supports our view that Lake Way has the potential to sustain a larger scale production scenario than originally envisaged.

"We anticipate releasing the technical results of our review into a larger scale production scenario towards the end of this quarter."

SOP quantities that cannot be absorbed locally will be targeted to premium markets abroad that provide the most optimal commercial outcomes for company shareholders.

Mr Swiericzuk said there was currently a strong domestic market for SOP of about 100ktpa.

"We are looking to work with local farmers and distributors to see how Salt Lake Potash can feed into this market," he said.

In other good news for the industry, the WA State Government recently announced a new class of mining lease for brine minerals, with a significantly reduced rental rate.

The initiative means potash companies will pay \$2.32 per hectare for the first five years from the grant of a mining lease and \$4.64 per hectare thereafter, down from \$18.70 per hectare previously.

"We are continuing to engage with state and federal governments in regards to other areas in which they may be able to assist in promoting the development of the industry," Mr Swiericzuk said.

"The SOP projects slated for WA not only represent another source of export revenue, royalties and taxes, but will offer a vast number of opportunities for those people living in the regional areas where they are located."



More information can be found at www.gres.com.au.

GRES wins Salt Lake contract

NATIONAL

GR ENGINEERING Services Limited (GRES) is an ASX-listed process design and engineering company providing fixed price EPC or EPCM project delivery services to the mineral processing industry internationally.

GRES was recently appointed by Salt Lake Potash Limited (SLPL) to undertake the bankable feasibility study (BFS) for

the Goldfields Potash Project – stage 1.

The stage 1 project will involve the study, design and development planning for a 200,000 tonnes per annum sulphate of potash (SOP) manufacturing facility at Lake Way in the Goldfields region of WA.

The innovative engineering solutions developed by GRES enable clients to move into development with the knowledge that the outcomes from study work will be replicated in their several projects.

GRES has successfully completed feasibility studies, process and engineering designs, and construction for projects of various scales, which have covered a diverse range of mineral commodities.

The company has delivered mineral processing or hydrometallurgical facilities and infrastructure for precious metals, base metals, mineral sands, industrial minerals, tin, tungsten and iron ore projects for a large range

of clients, both in Australia, and internationally.

GRES also has a presence in the hydrocarbons industry via its wholly owned subsidiary, Upstream Production Solutions (Upstream).

Upstream is a leading provider of operations, maintenance and well management services to the oil and gas industry in Australia and South East Asia.



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Image: Aggreko.

SUNNY SIDE UP

The Granny Smith and Goanna deposits were discovered in 1979. Ten years later, open pit mining commenced at Granny Smith where it has remained in production continuously for the last 30 years and, to date, has produced more than 8 million ounces.

The Granny Smith deposit was discovered 40 years ago.

GERARD MACARTNEY

SINCE 2001, the Wallaby deposit has been delivering ore to the Granny Smith mill, marking 30 years of continuous production; and in 2019, Granny Smith looks set to deliver another milestone as it installs one of the world's largest solar PV micro-grids.

In 2013, Granny Smith changed hands when Gold Fields purchased 100 per cent of the mine from GSM as a part of its Yilgarn South operations purchase.

Today, the mining at Granny Smith takes place underground at the Wallaby deposit, where Gold Fields uses the inclined room and pillar (IRP) method for mining in areas with a moderate dip, and transverse long-hole stoping (TLHS) in zones with variable dips.

The ore was transported 12km from the Wallaby underground mine to the 3mtpa processing plant at Granny Smith, which operates a two-stage crushing circuit with a standard SAG and ball mill grinding circuit, a gravity circuit, a leach/carbon in pulp train, a pressure Zadra elution circuit and tailings facilities.

The Wallaby deposit was currently operating at a depth of 1.2km underground, and in 2018 Gold Fields spent \$25 million on exploration to extend the life of the mine.

In the first quarter of 2019, as gold prices reached near-record heights, Granny Smith under-produced.

In its quarterly report, the company said that it was due to a decrease in the production of stoping fronts "as a result of the geotechnically controlled mining sequence".

This "mining sequence" resulted in a 14 per cent reduction of ore processed, which lowered the overall gold production by 2 per cent, from 71,000oz in the December 2019 quarter to 69,300oz.



Image: Goldfields.

The processing plant at Granny Smith has been operational for 30 years.

The ore that was mined increased the gold yield by 14pc from 4.77 to 5.42 grams per tonne, which the company attributed to the higher head grade that was mined.

And the reduction in ore processing facilitated a reduction in production costs.

The cost of sales, before amortisation and depreciation, was down 10pc from \$61m to \$55m, and capital expenditure was steady at \$21m, as was the AISC of \$1204/oz.

Gold Fields said it had allowed for this reduction in production in its annual guidance and when Granny Smith and the Gruyere project reach capacity, the company's Australian assets would again deliver strong results.

Getting off-grid

As a part of its mission to reduce emissions,

Gold Fields has increasingly turned to renewable energy.

The company will use Granny Smith as a prototype, retrofitting the mine with hybrid technology to build Australia's largest solar PV hybrid micro-grid.

The microgrid will be built by Scottish firm Aggreko, which was responsible for the conversion of the mine from diesel to LNG in 2016.

As a solar-LNG hybrid, the grid would integrate with the existing 24.2 megawatt (MW) LNG generation plant, with construction to begin in May 2019, and work expected to reach completion in the December quarter of 2019.

Aggreko will design, construct and install what will be one of the world's largest micro grids.

The hybrid solar PV and battery

technology would have an 8MW capacity from the planned 20,000 solar panel solar plant, and a would be backed by a 2MW/1MWh battery system.

Gold Fields executive vice president, Stuart Mathews, said it would be a welcome addition to the company's suite of on-site energy solutions across other operations, enabling it to reduce the carbon footprint.

The company believed that renewables would generate nearly enough power to run the mine's processing operations, and the solar-plus-battery system could potentially reduce fuel consumption by up to 13 per cent and produce about 18 gigawatts (GW) of energy per year.

Aggreko AusPac managing director George Whits said this was equivalent to removing 2000 cars from the road.

The current LNG power station at Granny Smith was upgraded from diesel and installed by Aggreko in 2016, and the new hybrid power system would combine with a thermal station expansion to create a 24.2MW capability.

Solar PV would reduce the needs of Gold Fields to run thermal generators and the battery plant would provide essential services such as "spinning reserve displacement, PV ramp rate control and transient voltage/frequency support," Aggreko said.

Of the 24.2MW generated, about 12MW would be allocated to the Wallaby mine and the remaining 12MW allocated to the processing plant and the associated facilities and mining camp.

"We expect the renewable power microgrid will be up and running at Granny Smith by Q4 2019 and it will be a welcome addition to our suite of on-site energy solutions across other operations which will enable us to reduce our carbon footprint," Mr Mathews said.

Newtrax lights the way

NATIONAL

IN the past decade, technological disruption has been at the forefront of conversation in the mining industry.

With topics such as automation, big data, and AI and AR among others becoming common vocabulary among mining operations and management teams, the industry is also seeing social licence, corporate social responsibility and worker safety issues increasingly important to the operational best practice of modern mines.

These conversations have happened in correlation with ore bodies extending deeper underground and rapidly advancing technology processing higher volumes of ore than ever before.

Goldfields' Granny Smith gold mine has been at the front of Australian Mining's technological revolution, converting the old diesel powered generators to LNG in 2016 and, in 2019, installing one of the world's largest hybrid energy grids.

Goldfields also employed the services of Newtrax Technologies to manage the crucial elements of miner safety for its underground operation at Granny Smith.

Traditionally, grabbing a brass ring was the standardised system to account for underground miners.

This system had flaws and inconsistencies, but was a crucial practice in helping emergency teams determine



Newtrax reimagined the cap lamp to provide state-of-the-art safety solutions at Granny Smith.

how many men were underground.

The implementation of safety protocols and procedures can require unnecessary time and effort if the technology was difficult to understand.

Taking this into consideration, Newtrax Technologies understood that it needed to develop a solution that was both easily integratable and user friendly.

Newtrax re-imagined the cap lamp for underground miners as the centrepiece of a comprehensive solution to miner location.

All existing cap lamps at the Granny Smith mine were replaced with

Brando corded and cordless cap lamps, with Newtrax safety features and a high-brightness light.

The mine was fully integrated with the Newtrax evacuation system that, once activated, would send an emergency message underground to every cap lamp.

Goldfields ran its first emergency drill to test the technology at Granny Smith in July 2018, and through an underground mock emergency exercise, the hardware functioned perfectly.

When activated from the surface, the cap lamp lights flashed to notify employees an emergency procedure had

been initiated in parallel with the stench gas and voiceover alarm.

The system allowed the emergency response team to know exactly which miners were in what refuge chamber, and could therefore refocus the team's energy on those individuals who had not yet made it to their chamber.

By developing a system that allowed emergency teams to track each individual miner underground, unnecessary confusion and uncertainty was prevented during emergency and evacuation procedures.

The technology was able to remove the limitations of two-way radios that made it difficult to ascertain whether miners were 100 per cent safe.

The Newtrax evacuation notification system was able to position each team member underground in real time and managed to get all personnel to refuge chambers within 37 minutes, which is about 20 minutes faster than they would do previously.

The Newtrax technology reduced the time and resources needed to effectively execute and complete the drill.

Due to the safety features that the Newtrax-enabled lamps offer, additional upgrades can be added to the software as required in the future, such as vehicle proximity detection, full mine employee tracking, and positioning through the expanded Newtrax MineHop network.

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More information about Gekko's innovative and collaborative approach can be found at: www.gekkos.com.

Collaboration is the key

WA

COLLABORATION is vital for any project – something Gekko Systems understands and embodies.

The company excels in successfully collaborating with clients like Gold Fields' Granny Smith Mine.

Gekko designed, installed,

commissioned and optimised a complete gravity gold and concentrate treatment package for Granny Smith in 2015/16 achieving set objectives, both technically and commercially, for the gravity project.

The partnership builds from foundations in Africa in the late 1990's and early 2000's, with early InLine Leach Reactor (ILR) technology development at the South Deep (South Africa) and Damang (Ghana) mines.

Since then, Gekko installed the first 'batch automatic' ILR at the Agnew Gold Mine (WA) in 2003, and installed an innovative gravity circuit design for the St Ives Gold Mine (WA) in 2006 (comprising Gekko's ILR and InLine Pressure Jig (IPJ)).

The company has also undertaken major upgrades to the Damang ILR and designed, installed and commissioned the complete gravity circuit at Agnew in 2011.

Gekko's work with Gold Fields has led to a long term and successful collaboration, working on the Granny Smith Project and more recently the complete gravity plant upgrade at Agnew in 2018.

Gekko and Gold Fields are now ready to build on established successes at Gruyere where the ILR is installed and ready to commission.

Below: Gekko's ILR 3000 intensive cyanidation system at Granny Smith gold mine.



Gekko is pleased to have delivered for Gold Fields' Granny Smith mine

A strong collaboration with tangible outcomes.

- Gravity and concentrate treatment circuit development
- Testwork and gravity recoverable gold modelling
- Plant audits and optimisation

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Images: Yancoal.

SUCCESS STORY

Yancoal is one of Australia's largest coal producers, operating a diverse portfolio of world-class assets including the Yarrabee and Middlemount open cut mines in Queensland's Bowen Basin.

EMMA DAVIES

FULL year financial results for 2018 showed Yancoal's Australian operations are performing well, with a record annual total saleable coal production of 50 million tonnes (32.9mt attributable) up 59 per cent from 31.5mt (or 18.5mt attributable) in 2017.

Yancoal's coal mining operations produce a mix of premium thermal, semi-soft coking, and Pulverised coal injection (PCI) coals, together with mid-to-high ash thermal coals.

To maximise pricing opportunities, Yancoal also has the diversity of product types and mining operations to blend Run-of-Mine ("ROM") and washed coal ("Saleable") to meet specific customer needs.

ROM production was 17.3mt - up 9pc compared to the previous corresponding period (PCP) - and saleable coal production was up 2pc over the PCP at 13mt.

Yancoal chairman Baocai Zhang stated that the company's combined asset base is delivering results and that 2019 production is tracking towards the guided target of around 35Mt of Saleable Coal production.

"2018 has been a year of extraordinary growth and success, with a record dividend declared, debt reduced by more than half a billion dollars, and Yancoal Australia listed on the Main Board of the Stock Exchange of Hong Kong," Mr Zhang said.

"Our exceptional full year financial results have also provided Yancoal with the cash required to begin 2019 by immediately reducing our debt liabilities by a further US\$500 million."

Yarrabee and Middlemount

2019 marks the 10-year anniversary of Yancoal's ownership of the Yarrabee mine.

The site, 40km north east of Blackwater in the Bowen Basin, had successfully produced up to 3mt of saleable ultra-low volatile, semi-anthracite PCI coal annually for export to steelmakers in Asia via the Port of Gladstone.

For the year ending 2019, Yarrabee had a total coal resource of 195Mt and had produced 0.6mt of ROM coal by the March 2019 quarter - up to 100pc over the PCP.

The successful production rates didn't end there; Yarrabee achieved 0.7mt of saleable coal in the quarter, 75pc over the PCP.

Wet weather impacted the ROM coal production in the first quarter, increasing time spent on processing ROM stocks which influenced the saleable coal output.

But Yancoal was positive this would not be indicative of Coal Handling Preparation Plants (CHPP) feed material through the majority of 2019 and stated that it still expected to deliver on its full-year targets.

Unlike Yarrabee, Yancoal's Middlemount mine was unable to echo the company's positive results across its assets for the March Quarter.

Usually producing 4mt of saleable coal (low volatile PCU coal and hard coking coal), Middlemount produced 1.1mt of ROM coal steady against the PCP and 0.8mt of saleable coal - a disappointing drop of 20pc from the PCP.

Wet weather was also a factor in lower production rates, with the rain delay compounding some geotechnical (coal seam thinning) and geological (model reconciliation) issues.

Middlemount ended 2018 with a total coal resource of 135mt.

The site, 90 km north east of Emerald in Queensland's Bowen Basin, was a joint venture with Yancoal's ownership consisting of a near 50 per cent interest and the remainder owned by Peabody Energy.

The future of coal

Yancoal's split of thermal coal and metallurgical coal sales have successfully met market demands and achieved the maximum price for the company.

Sales volumes typically exceed the saleable coal production as Yancoal purchases additional tonnages for blending purposes and to enhance the overall sales mix and pricing achieved.

The attributable sales volumes, including purchased coal, in the March Quarter, was 7.8mt in thermal coal sales volumes and 1.6mt in metallurgical coal sales volumes, 16pc up and 33pc up on the PCP respectively.

"Without question, this year's financial turnaround demonstrates the robustness of our operational, investment and cashflow management strategies," Yancoal chief executive officer Reinhold Schmidt said.

"We are exceeding expectations and continue to forge our own path as a leader within the competitive global coal market."

Yancoal was optimistic in the March 2019 quarterly report that coal prices were expected to remain stable and potentially

increase as the year progresses due to the curtailing of new supply growth which are impacted by ongoing challenges associated with obtaining Australian development approvals for greenfield developments - which have the potential to strengthen premium coal prices.

"As a result, locally-based operators with brownfield expansion opportunities are likely to benefit from the combination of sustained premium grade undersupply and greenfield limitations," the report stated.

"Seaborne supply from South Africa, Russia and Indonesia is also likely to be constrained to satisfy their own domestic energy requirements and likely to positively impact international coal prices.

"Based on pure market supply and demand fundamentals, coal price stability should occur in 2019 at current levels."

The company is confident that the demand for high quality low ash and low sulphur coals remained strong, as developed economies in Asia including Japan, Korea and Taiwan continued to implement environmental policies requiring coal users to consume cleaner, higher grades of product.

As higher grades of coal quality remain in tight supply, price premium increases for suppliers are expected during 2019.

"Coal remains a critical part of global baseload energy supply and we are well positioned to maximise returns from current market conditions by meeting increasing needs for high quality coal supply," Mr Zhang said.

In its March 2019 quarterly report, Yancoal stated that Asia remained a dynamic market, with coal currently representing over 50 per cent of the Asian energy requirement and remaining the cheapest energy source for developing nations.

Similarly, while China continues to introduce an alternative energy policy, it remains a growing economy in need of certainty of baseload energy supply.

"Throughout the March quarter pricing, higher grade coals held up better following the impediments to Australian thermal coal deliveries into China adversely impacting prices of lower quality coals," the report stated.

Yancoal has the flexibility to reallocate cargoes to alternate buyers, and on March 29, Yancoal formally agreed to enter into four coal sales agreements with South Korean steelmaker POSCO (and/or its associates) for the purchase of coal during

the financial year ending December 31, 2019.

Two of the agreements are set to expire on December 31, with two expiring on March 31, 2020, and the maximum annual transaction amount to be received by the Group from POSCO would not exceed US\$780 million.

2019 outlook

In the year ahead, Mr Zhang said Yancoal will continue to focus on exploration and expansion works across the Mount Thorley Warkworth (82.9pc ownership) and Moolarben (85pc ownership) sites in New South Wales.

"At the operational level, the integration of the acquired Coal & Allied assets of Hunter Valley Operations and Mount Thorley Warkworth is going well and operational synergies continue to be delivered ahead of expectations," Mr Zhang said.

"We have fortified our position as a leader in the international coal market and returned the Yancoal Group to a position of market strength and financial health."

Exploration drilling for the prefeasibility on the target seams for the conceptual underground mine at Mount Thorley Warkworth was completed at the end of 2018 and is estimated to produce 6mt ROM per annum.

The company has also received approvals to commence mining activities associated with the Lot 1 and Lot 2 areas of Mount Thorley Warkworth, which would enable the extension of the existing West pit on the Warkworth side in 2019.

Proposed modifications for the Moolarben open cut pits are awaiting approval, as Yancoal continues to maximise improved extraction rates in both the open cut and underground mines.

Mr Schmidt said that Yancoal's Australian assets looked to have a strong year ahead.

"In the year ahead we will invest in new fleets and operational efficiencies across our open cut mines, and progress our pipeline of Australian brownfield projects, with a specific focus on the Mount Thorley Warkworth and Moolarben operations," Mr Schmidt said.

"With three of the most successful low-cost, high-quality producing tier-one assets in Australia, we are aggressively pursuing new organic growth opportunities to sustain the profitable return of Yancoal."

Groundbreaking industry leader

NATIONAL

WITH more than 50 years of earth-moving experience, MacKellar EPSA offers reliability and expertise for any mining project.

MacKellar EPSA provides all types of mining solutions, civil earthmoving, mining services and coal mining, haul road maintenance, through to equipment maintenance, stockpile management, drill and blasting, as well as mine rehabilitation services - all tailored to suit the clients' needs.

The company's flexible approach to contracts and service means project budgets are met and deadlines are delivered on time, every time.

MacKellar EPSA business development manager Dave White said the company is privately owned and prides itself on its flexible services offering.

"With our ability to deliver on unique client needs, we can tailor dedicated solutions, with flexibility, value, quality and availability of our products and personnel," he said.

"Servicing Australia-wide, there is no location we won't go to ensure our clients' needs are met."

The company has worked at the Yarrabee and Jellinbah mines sites for 30 years - a testament to its focus on long-term relationships with clients and flexibility through different project needs.

"Our working relationship with



MacKellar EPSA offers a range of flexible services to suit any mining client.

Middlemount mine has also been strong for over 5 years as we continue to grow our involvement with this successful mine site, assisting with equipment hire through to maintenance and dozer mining services," Mr White said.

"Our long-term employees have a vast

array of experience with mining operations and equipment understanding."

The company offers equipment hire or full mining services including thin seam coal mining, pre-strip mining, dozer push, drill and blast or detailed civil earthworks.

"We are unique in the market place as

we offer and have experience in all types of contract structures such as Dry Hire, full maintenance and full mining and civil services, as well as access to a uniquely large fleet and range of mining plant."

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MacKellar EPSA offer extensive mining solutions including mining services, drill and blast, earthworks and mine rehabilitation. Our services also extend from civil earthmoving through to equipment maintenance to suit any clients need.



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All Images: Pilbara Ports Authority.

SHIP SHAPE

The Pilbara Ports Authority (PPA) is moving full steam ahead for 2019, upgrading facilities and using innovative technology to improve shipping standards to cater for mining exports from the Port of Port Hedland and the Port of Dampier.

EMMA DAVIES

THE Port of Port Hedland saw iron ore exports increase in FY18 by 3 per cent to 508.9 million tonnes, and exports are expected to rise for FY19 regardless of the pause in port operations caused by tropical cyclone Veronica which hit the coast in March of this year.

Cyclone Veronica caused a total shutdown at Port Hedland of 92.5 hours, 132 hours at the Port of Dampier and 109.5 hours at the Port of Ashburn.

Pilbara Ports Authority (PPA) chief executive Roger Johnston said despite the longest closure in years resulting in a slightly lower guidance for the big players like Rio Tinto, BHP and FMG, iron ore exports at Port Hedland was still going “gangbusters”.

“A week’s production up here is astonishing, we have something like 47 trains per day delivering iron ore just to Port Hedland - given that trains are three kilometres long, that’s about 150 kilometres of trains per day,” Mr Johnston said.

“Now if you stop for four or five days those are some big numbers which will have a bit of an impact.

“But regardless exports are still going strong and we expect to exceed last year’s tonnage for iron ore.”

Work was currently underway at Port Hedland for a \$33.5 million replacement of the Berth 3 deck, which had been predominately used for the export of more than 100mt of salt since its last upgrade 30 years ago.

“There will be a bit of stop and start with the salt exports while we’re refurbishing but it should be finished towards the end of the year and then it’s back to business as usual,” Mr Johnston said.

PPA was also undertaking several facility upgrades with a focus on new and innovative technologies to improve shipping capabilities.

Improvements in the shipping channel



The Vessel Traffic Services at Port Hedland cater for around 6000 vessels each year.

at Port Hedland were also set as the final phase of the \$120m Channel Risk and Optimisation Project (CROP) was due to be completed in May or June.

The CROP was intended to deliver safety and efficiency benefits in the harbour by providing a refuge zone and emergency passing lane to the 42km unidirectional shipping channel, as well as the removal of high spots in the outer section of the channel to optimise navigable depths.

The CROP was funded under the Port Improvement Rate (PIR); a temporary levy charged on vessels entering and exiting the Port of Port Hedland to fund capital improvements.

The other PIR projects were the Integrated Marine Operations Centre and the Channel Marker Replacement Program.

Mr Johnston said the Integrated Marine Operations Centre (IMOC) had been fully constructed just in time to be tested during cyclone Veronica.

“We picked up some water damage so it

was good to be able to look at that and see if the design to cater for a one in 100 year cyclone was up to the test,” he said.

The Vessel Traffic Services (VTS) installed was state-of-the-art to oversee the safe and efficient movement of around 6000 vessels each year through Port Hedland.

This would include technology for the harbour master function, dredging management, port security, marine pilot briefing facilities and improved incident control capability.

“The technology is cutting edge, it’s absolutely state-of-the-art,” Mr Johnston said.

“All the systems are integrated into each other, there’s nothing like it anywhere on the planet.”

The Port of Dampier

The Port of Dampier saw 145mt of iron ore exports in FY18 along with more than

3.5mt of salt, and similar increases are expected in 2019 if potential port upgrades get the go-ahead.

The potential redevelopment of the cargo wharf is in the works to cater for new projects in the region; the two proposed 1mtpa methanol plants potentially located in the Burrup Industrial Estate (BIE) that would require pipelines to the Dampier Bulk Liquids Berth (BLB) marine facility and new loading facilities, and a proposed 2.1mtpa urea plant that would require a conveyor to the port, storage, loading and wharf facilities.

“We’ve taken some strong steps around engineering and design to extend the Dampier cargo wharf southwards by 330 metres,” Mr Johnston said.

“We’ve looked at the dredging, the turning basin being able to facilitate bigger vessels and we’ve put some serious effort into looking at how to do it, and the potential costs and funding opportunities.”

The PPA had also implemented a new hydroid model at the Port of Dampier in 2016, which had resulted in more accurate calculations of navigable depth throughout the port and shipping channels.

“It’s our job to optimise infrastructure and our channels are basically infrastructure – so if you let them all silt up then you’re going to load less into your ships because you still need to maintain safe under keel clearance,” Mr Johnston said.

“If you make sure that you’re keeping your channels at designed depth by dredging regularly and taking all the silt out, then you maximise and optimise the loads that ships can carry.”

The new modelling allows the lowest astronomical tide to be calculated, which means a more accurate calculation of the depth of the channels at the lowest astronomical tide.

(CONTINUED ON PAGE 46)



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Tangela / TAM6836

(CONTINUED FROM PAGE 44)



“A week’s production up here is astonishing, we have something like 47 trains per day delivering iron ore just to Port Hedland.”

The PPA implemented a hydroid model at the Port of Dampier in 2016 to calculate navigable depth throughout the port and shipping channels.

“We can provide shippers with optimal under-keel clearance or the maximum depth that they can load their ships to and that’s been a very successful innovation,” he said.

“We’ve seen some efficiencies out of Dampier – in particular better opportunity windows for companies like Rio to bring their big bulk carriers in.”

Based on the positive outcomes at the Port of Dampier, a hydroid model would also be implemented at the Port of Ashburton in the next 12 months.

Innovative technologies

Mr Johnston said innovative technology was key to advancements across all of PPA’s ports.

“We use a lot of leading technology and while it might sound silly playing with

centimetres here and there, when you add it all up it really makes a difference,” he said.

“The use of technology and big data is terribly important for port operations.”

The PPA implemented unique modelling of ship movements in simulators to compare with real movements (the pitch and roll of ships) to make sure the under-keel clearance calculations account for optimising these movements.

“Every extra little bit of centimetres we can get equates to tonnes,” Mr Johnston said.

Part of the PIR project in Port Hedland included the extra dredging of safety bays in the shipping channel.

“When convoying ships, if one of the first ones has an engine failure and you have nowhere to push it out of the way then you’re compromising all the following ships,” Mr

Johnston said.

“You need to be able to safely push it to one side, so by increasing the depths of our safety bays we can do that.

“One of the reasons we have half hour departure windows is just that – if there is a problem with the vessel in the channel then we have time to do something about it before the next vessel comes along.”

Even something as simple as dredging and improving the safety bays could directly optimise shipping at an unidirectional port like Port Hedland.

“The theory we’re busy with, which will come online in the next two to five years, is that by improving the safety bays and reducing the risk exposure you can do things like facilitate shorter departure windows which means you can get even more ships on a tide,” Mr Johnston said.

Replicating reality

Simulation software was also used for marine pilots to undertake scenario-based training at PPA’s Maritime Simulator facility with HR Wallingford, based in Fremantle, WA.

“There’s nothing like it anywhere else in the world,” Mr Johnston said.

“We have four tug bridges and two ship bridges and a VTS bridge all in communication with each other and we can exactly replicate how we work in ports such as Port Hedland.

“Typically you’ll find simulators elsewhere will have two bridges or maybe three but we have replicated this so we can actually put on full crews and train tug masters and marine pilots all at the same time.”

Any time an incident occurs, PPA would reprogram the simulator to replicate the event.

“During the course of marine pilots and tug masters biannual updates we throw these incidents at them and see how they react and teach them what did actually happen and how to approach the issue,” Mr Johnston said.

PPA also used real-time software which picked up live data on currents and tides in daily port operations.

“Our portable pilot units have unique software that we’ve developed which allows the [marine] pilot to see on the screen how they are transiting on the channel,” Mr Johnston said.

“If anything unusual happens the pilot can interrogate it on the software to simulate a decision before making it in real time.”

Mr Johnston said these ongoing innovations were unique to PPA and essential to the improvement of all its operations in the Pilbara.

Consistent, efficient marine services

WA

SPECIALISED marine services company TAMS Group has proven its increased breadth of capability in recent contract wins and emergency response work around Australia, while maintaining focus on its Pilbara service offering to key customers in WA.

Over the past 12 months, the company has continued building on its successful Onslow shorebase model with establishment of three additional WA locations at Dampier, Port Hedland and Broome, and also completed acquisition of two marine service companies in Queensland, adding Shorebases at Gladstone, Cairns and Port Moresby in Papua New Guinea (PNG).

The recent expansions and acquisitions mark another significant step in TAMS’ growth strategy to create a unique multifaceted national marine organisation with locally-staffed shorebase locations, delivering broad capability base adjacent to major ports and resource export terminals.

TAMS Group Queensland operations has recently been awarded a marine construction contract at the Port of Gladstone and continues to provide support to the MV Solomon Trader salvage operations in the Solomon Islands and providing commercial diving services at Cairns and Port Moresby.

In Western Australia, TAMS Group continues to expand its presence and reputation as a reliable local supplier with proven performance across multiple shorebase locations, delivering a unique



TAMS crew installing navigation aids at the Port of Ashburton.

mix of integrated services across port services, commercial diving, marine construction and marine maintenance worksopes.

TAMS Group Pilbara shorebases are ideally located to service the Pilbara Ports Authority ports at Port Hedland, Dampier and Onslow and other nearby resource industry terminals.

In addition to ongoing port services

operations, recent Pilbara project activities include underwater asset inspections at Onslow, navigation beacon refurbishment at Dampier, and berth remediation at Port Hedland.

With a focused growth strategy across Australia, TAMS Group continues to provide customers a unique combination of marine services, maintenance and construction capability with a

commitment to safety, innovation and customer service.

TAMS Group has the marine fleet, the teams and the support systems to assess customers’ needs, assemble the right equipment, and satisfy customer requirements, anywhere around the coast of Australia.

More information can be found at: www.tamsgroup.com.au.



All images: Regis Resources.

ALL THAT GLITTERS

Regis Resources' shares climbed to an all-time high this year as the gold miner announced an \$80 million half-year profit, boosted by solid results from the Duketon gold project. And the best may be yet to come.

Gold production has increased at the Moolart Well gold mine.

RAY CHAN

THE gold continues to glitter for WA-based miner Regis Resources.

Regis Resources' shares climbed to a historic high of \$5.76 in February, after the Duketon gold project owner announced a half-year profit of \$80 million.

While the price hasn't sustained that level, it's hovered between the \$5 and \$5.50 mark ever since, allowing the company to return more than \$40m to shareholders in the form of an 8¢ a share interim dividend.

The gold miner generated \$126.5m in operating cash flows between July 1 and December 31 last year on sales of 186,726 ounces of gold and revenues of \$317.2m, with EDITDA of \$146.4m at a healthy margin of 46 per cent.

Figures from its latest corporate update reveal a number of impressive investment highlights, including record gold production of 361,373 ounces at A\$901/oz (AISC), while enjoying reserves of A\$207m in cash and bullion, with no debt.

In total, 114,966oz of gold sold at an average price of A\$1718/oz.

Managing director Jim Beyer said strong operational cash flows of A\$300.8m in the 2018 financial year were driving consistent dividend payouts, as Regis aims to develop its first underground mine beneath the Rosemont open pit.

Dividend payments lifted by 7 per cent to 16 cents per share in that period, putting cumulative dividend payments at A\$326m since 2013.

Ore reserves increased by 86pc to 4.06moz, while earnings per share were up 25pc to 34.6c per share.

Mr Beyer said that Duketon had delivered consistently low-cost production over a long period, which contributed to robust net profit margins of A\$174m, up 26pc.

"The cash flow is put to good use investing in future growth for the company, while



Regis expects to produce 340,000-370,000oz of gold at Duketon in fiscal year 2019.

returning excess funds to shareholders in the form of dividends," he said.

The miner's Laverton-based flagship operation entered production in 2010 following the construction of the Moolart Well gold mine.

In 2012, Garden Well was added to the mix, which has its own standalone mill, and a year later, the Rosemont hybrid gold project was commissioned, which includes a crushing and milling circuit, with ore slurry-pumped to Garden Well's processing facility.

In the 2018 financial year, operational excellence continued across the three mines. At Moolart Well, gold production was up 9pc in the June quarter as a result of an increase in throughput to a record annualised rate of 3.5mt per annum, 11pc up from the prior quarter.

Regis expects to produce 340,000-370,000oz of gold at Duketon in fiscal year 2019 at all-in sustaining costs of \$985-\$1055/oz.

It's an emphatic comeback from nine months ago when shares took a 12 per cent hit, after expenditure estimates were raised as a result of rising diesel costs and satellite pit development, forcing Mr Beyer's predecessor Mark Clark to defend the unexpected slump.

"Our costs are forecast to be marginally higher at Duketon this year because we're cracking the top of some high-grade starter deposits," Mr Clark had said.

"For the last two years we've given cost guidance and our actual costs have been below that guidance."

Rosy for Rosemont

One of the biggest growth drivers in the near-term will be an expansion at the Rosemont operation.

In August last year, Regis gave the green light for construction to begin on an underground mine, directly below the existing open pit.

"We believe that the approved Rosemont underground operation is a robust business in its own right; but just as importantly will see the infrastructure in place to grow that mine through exploration from an established underground footprint," Mr Clark had said.

"This growth opportunity will be targeted both laterally between the two mining zones and at depth and along strike.

"There is also a very strong opportunity

to replicate this development path at Garden Well in the near term and then at other Duketon satellite pits in due course."

The combined open pit and underground mine at Rosemont is scheduled to deliver 10.3 million tonnes of ore at 1.72 grams per tonne for 570,000oz over a current five-year mine life.

The underground component has a Mineral Resource Estimate (MRE) of 1.4mt at 5.1g/t gold for 230,000oz of gold at a 2.0g/t gold cut-off grade.

Once the underground mine was at full mining capacity, the combined operation would produce at a run rate of between 120,000 and 130,000oz per annum: an estimated 45,000ozpa uplift on production.

Regis expects full production levels at Rosemont by late 2019.

Open pit mining services at Rosemont will be carried out by MACA, which recently received a contract extension for work at the Duketon South operations, which also includes Garden Well, Erlistoun, Baneygo, Toohey's Well and potentially other satellite projects in the region.

According to MACA, the project – which includes drilling and blasting, and loading and hauling – utilises technology to optimise the mine planning across the operations, ensuring the most efficient use of both machinery and human resources.

The contractor expects the new agreement will generate about \$590 million in revenue over the initial five-year term.

Organic Growth at NSW

Outside of WA, plans are proceeding well to progress the McPhillamys and Discovery Ridge projects in Central NSW, which Regis believes constitute Australia's largest undeveloped open pit gold resources.

McPhillamys boasts a gold reserve of 2.03moz, and a mineral resource of 2.31moz.

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A Pre-Feasibility Study was completed in 2017, which determined a planned 7mtpa mining and processing operation that would produce an average of 192,000ozpa over a 10-year life.

A preliminary environmental assessment (PEA) has already been submitted to the NSW Department of Planning and Environment, the initial stage in the development application phase, and the catalyst for the Government to provide the secretary's environmental assessment requirements (SEARS) for the project.

SEARS would then allow for the environmental impact statement (EIS) to be appropriately focused to enable regulatory assessment of the project.

The completion of the EIS, planned to be lodged in the final quarter of 2019, will allow for final elements of a definitive feasibility study (DFS) to be signed off.

The document would include updated operating parameters, estimated capital and operating costs and a development timetable.

In addition, Regis was examining Discovery Ridge, 32km south west of McPhillamys, as a potential satellite mine.

The Discovery Ridge deposit was acquired in 2017 as part of the Blayney Gold purchase.

Regis considers the mine a solid growth option, with a resource of just over 500,000oz.

Recent highlights include strikes of 129m at 2g/t and 94m at 2.6g/t/

Infill drilling results have confirmed historical gold intersections, while broad lower grade intercepts containing higher grade cores have demonstrated future underground potential.

"The cash flow is put to good use investing in future growth for the company, while returning excess funds to shareholders in the form of dividends."



McPhillamys boasts a gold reserve of 2.03moz, and a mineral resource of 2.31moz.

Prospecting Prospects

Mr Beyer believes the best is yet to come for Regis, with the company only literally having "just scratched the service".

"A significant area of leases are yet to be explored," he said.

"There's been virtually no deep exploration undertaken beyond Rosemont and Garden Well, with only 5 per cent of drill holes existing deeper than 200m.

"Shallow exploration drilling alone has discovered about 7.7m oz since 2006."

Mr Beyer said testing of depth extensions beneath known mineralisation has now started, and the company looked forward to the results.

Part of Regis' success was also based on the company's culture toward staff and the environment.

"We continue to drive a performance-based culture, underpinned by our values," Mr Beyer said.

"We create a workplace where all our people can perform to their full potential every day, with a targeted approach to inclusion and diversity.

"Our investment in developing our people is delivering results as we strive to deliver exceptional business performance and sustainable outcomes."

Regis also created value through social leadership, and through demonstrated commitment to effective environmental management of activities.

"There's a broad focus on environmental, social and safety governance, aiming for consistent sustainability performance and engaging the support of local communities," Mr Beyer said.

Innovative drilling solutions

WA

PROFILE Drilling is a privately owned, Perth-based company offering reverse circulation mineral exploration services and grade control and water boring capabilities.

Its services include (but are not limited to) remote exploration projects via self-contained exploration camps, to on-mine resource drilling programs capable of exceeding depths of more than 600m.

With a fleet of modern and well-equipped high capacity rigs and support vehicles on 8X8 trucks, Profile Drilling is able to quickly and effectively meet the needs of its clients Australia-wide.

Operations manager Grant Ingram said the company prided itself on the ability to provide innovative solutions to any problem that clients may have experienced.

Mr Ingram said that Profile Drilling's experienced crews ensured minimal downtime while operating to maximum efficiency without compromising the quality of the client's needs and requirements.

"We have a commitment to continuous improvement in safety and drilling solutions without compromising



Profile Drilling's experienced crews ensure minimal down time and maximum efficiency on site.

production standards with our objective to provide a comprehensive drilling service second to none," he said.

"With the combination Profile offers

to only provide the most experienced drillers, support staff and crews along with providing modern, well-maintained equipment, we are able to provide

our clients with a safe, cost-effective service."

More information can be found at: www.profiledrilling.com.au.

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A fleet of vehicles at Moolart Well using communications equipment supplied by Comm Systems.

Remote mines need reliability

NATIONAL

WITH more than 15 years' experience, Comm Systems has the personnel, equipment and experience to deliver reliable communication systems to the most remote mines in the country.

Communication on a mine site is vital for the safety and efficiency of

staff – whether they are right next to each other in the pit or 100 kilometres away.

Comm Systems provides surface and underground radio communications, data transmission and satellite services, with its clients including Moolart Well, an open pit gold mine located 350 kilometres north-east of Kalgoorlie.

With staff safety paramount in such

a remote location, technical services manager Ben Broeder said this solid reliability was a major factor when choosing a communications provider.

"Sited 350 kilometres north-east of Kalgoorlie in some of the harshest environment in the world, communication is a number one priority," Mr Broeder said.

"Being so remote, even the slightest

delay in response to emergencies can lead to dire consequences and perhaps loss of life."

Comm Systems prides itself on the ability to install, maintain and update mine site communications to the highest standard of quality and reliability.

More information can be found at: www.commsystems.com.au.



Comm Systems

DOES YOUR OPERATION REQUIRE DEPENDABLE, SURVIVABLE VOICE AND DATA COMMUNICATIONS?

Comm Systems is the leading solutions provider for mining radio solutions for both surface and underground.



All Images: Newmont Goldcorp.

A RETURN TO FORM

Boddington goldmine continues to be Newmont Goldcorp's biggest Australian producing mine, and as the company works through its stripping campaign, the mine is gearing up across the board to reach full capacity.

Boddington surpassed the Kalgoorlie Super Pit in 2010 to become Australia's largest goldmine.

GERARD MCARTNEY

NEWMONT Goldcorp took the crown from Barrick to become the world's largest gold producer in Q1 2019, with a new global guidance of 6-7mozpa for 2019.

Despite lower production due to a stripping campaign, Boddington has continued to deliver the highest quantity of gold in the company's Australian portfolio.

With the excitement around Tanami taking much of the spotlight for Newmont Goldcorp's Australian assets, it is easy to overlook the giant in the hills of WA's Darling Scarp.

In its 2018 full-year report, Newmont Goldcorp reported that Boddington produced 709,000oz of gold and 38,500 tonnes of copper, and the company reported a 12.4moz gold reserve, and a 625,000 tonne copper reserve.

At March 31, Boddington had already contributed 155,000oz of Australia's expected 1.47moz contribution for 2019.

With continued stripping to reach higher-quality deposits, the company has also refined its shutdown procedures and cost structures.

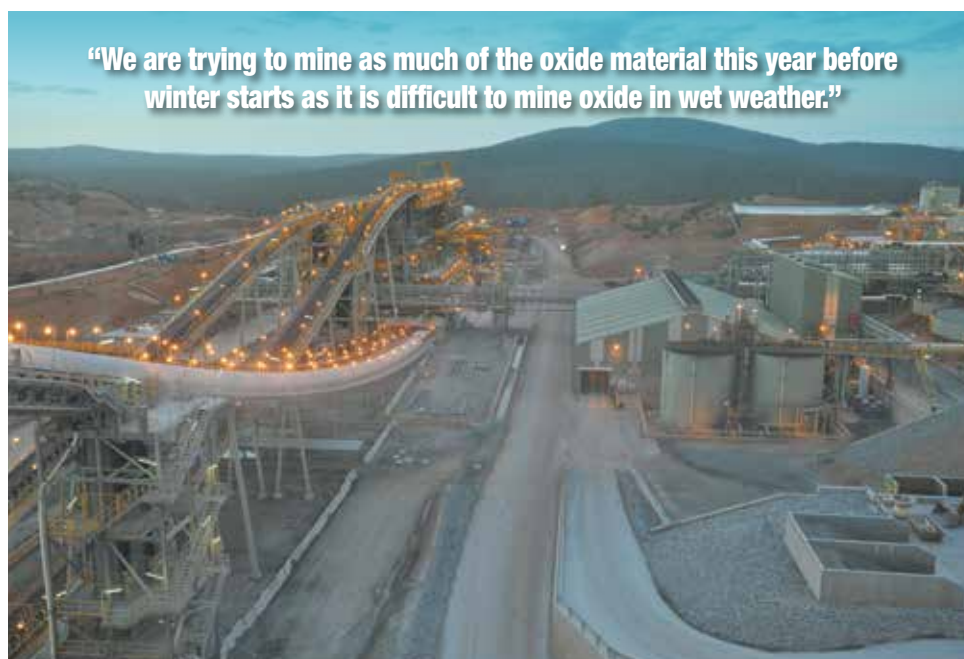
Once complete, the mine would be set to reach full capacity in 2021 and boost its guidance to 1.6moz.

General manager of operations at Boddington, Jim Cooper, said that the Boddington operation was on track to meet its production target for 2019.

"The S09A pit has a three-year mine life with all waste stripping due for completion by early Q4 2019," he said.

"Year to date, a total of 640,000 tonnes of

"We are trying to mine as much of the oxide material this year before winter starts as it is difficult to mine oxide in wet weather."



Once stripping is complete, Newmont Goldcorp expects Australia's guidance to expand to 1.6mozpa.

ore has been milled.

"We are trying to mine as much of the oxide material this year before winter starts as it is difficult to mine oxide in wet weather."

The company has also reduced the number of shutdowns from four to three, which has allowed it to significantly reduce downtime and sustain production.

"We are now working to build in more rotatable components and more modular equipment so that we make the most of the shutdowns," Mr Cooper said.

"This also allows us to do the repair work in a controlled work environment that is not part of a process plant."

The mine recently received approval for a new hydraulic shovel that would give it greater operational flexibility.

"We see continued investment and technology innovation as critical to ensuring ongoing production excellence at Boddington," Mr Cooper said.

Newmont Goldcorp's Boddington team were at the final stages of a study into implementation of autonomous haulage systems at the mine, and a final decision on whether it will proceed would be decided by the Newmont Goldcorp board in July.

"Should we get the go-ahead, we anticipate that autonomous haulage will provide substantial safety and economic benefits to Newmont Goldcorp's

Boddington operation, delivering both business and community benefits," Mr Cooper said.

2018 saw the mill achieve a record throughput of 40.2mt, and Mr Cooper said it was also "continually improving the overall capacity of the process plant through our full potential program".

Mr Cooper said that Newmont Goldcorp would continue to invest in new technology at Boddington.

The company has continued to refine the mill, and has utilised the latest technology to further improve its capabilities and maximise the efficiency of the operation.

By upgrading the screens in the leach tanks in 2018, the company has implemented part of its Full Potential initiative to improve gold recovery and throughput, and to reduce bottlenecks in the processing plants.

The refurbishment of the leach tanks begun with a full inspection of the protective coating and the steelworks with NDT technology that gauged the thickness of the coating.

This was followed by the removal and complete repair of the gearboxes, motors and the agitator shaft and downcomers.

The tank was then hydro blasted, abrasive blasted and a high-performance elastomeric urethane was installed to provide a coating of 2000 microns on the walls and 3000 microns to high-wear areas.

The company also began rolling out its first commercial application of Maptek's Vulcan Optimiser.

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The automated, revenue-based ore control software was employed to improve grade control processes in the hope of reducing variability, optimising recovery and cutting down on waste.

The technology allowed engineers to design, evaluate and maintain daily operations, and surfaces and designs could be updated as new data was gathered from the daily production reports.

According to Maptek, the system could “manage and visualise very large and complex data sets, process the information and rapidly generate models”.

“Sophisticated algorithms and fast processing allow virtually instant validation of data for building and maintaining up-to-date models of a deposit,” it said.

The technology allowed for multi-ramp, multi-slope designs and could handle input from multiple pits, create and edit 3D surface and solid triangulations, terrain models and pit designs, and generate contours.

By taking all of these variables into account, the Vulcan system could run animations and explore alternative scenarios based on resources and economic values to develop the most productive and practical mine plans.

Boddington has also replaced its outdated Wi-Fi system which would significantly futureproof the mine site’s automation capabilities.

Newmont Goldcorp regional IT manager Helen Titheradge said the IT team had “worked tremendously hard to drive toward higher-quality data and optimise the IT architecture needed to leverage technology across all of the areas of our region”.

The mine

The Boddington mine, situated 130km southeast of Perth in the Saddleback Greenstone belt of WA, has been wholly owned by Newmont Goldcorp since Newmont acquired AngloGold Ashanti Australia’s 33.3 per cent interest in the company in 2009.

The entire project area spans 18,898 hectares, and Newmont Goldcorp sub-leases 8506ha from Worsley-South 32 JV, and the project operates under multiple leases set to expire between 2020 and 2039.

Boddington, a greenstone diorite mineralisation, is mined in two open pits in staged laybacks.

The pits used three electric rope shovels and a fleet of 39 production haul trucks and ancillary equipment that gave the mine the capacity to extract about 235,000 tonnes of ore per day.

The mill, comprising a three-stage crushing facility with two primary crushers, six secondary crushers and four high-pressure grinding rolls, four ball mills, a flotation circuit and a carbon-in-leach circuit, has the capacity to process about 40mt of ore per year.

Once transported from the pit, the ore is

crushed into a coarse size at the mine and transported via a conveyor to the plant, where it was crushed and ground into a slurry.

It was then treated by flotation in successive stages that separates the gold-copper concentrate, flotation concentrates are then processed through a gravity circuit to recover the “fine liberated gold”, before it is de-watered and transported to the smelter.

The future

The creation of Newmont Goldcorp has resulted in the world’s largest gold producing portfolio.

While Mr Cooper said that there were currently no exploration projects underway at Boddington, the future of the mine as a Tier 1 asset looks bright.

“The Newmont Goldcorp merger will not change much at Boddington – for us, and the Australia region, it will be business-as-usual with our continued focus on maximising value while delivering business results safely and responsibly,” Mr Cooper said.

“Having said this, the Newmont Goldcorp merger does mean that we are now part of the world’s leading gold company with greater global reach and an unmatched portfolio of world-class assets, prospects and talent. This can only deliver dividends for us at Boddington through new opportunities for our business and our workforce.”

This sentiment was echoed by Newmont Goldcorp chief executive Gary

Goldberg, who said the company had met its goal to become the world’s leading gold business.

“We’ll maintain that position by executing our winning strategy,” he said.

“That strategy focuses on constantly improving safety and efficiency at our current operations while we continue to invest in expansions and exploration to fuel next generation production.

“An equally important part of that strategy is to meet stakeholders’ expectations.”

Newmont Goldcorp employed more than 3500 people in Australia, with three major assets in operation: Boddington and KCMG in WA and Tanami in the Northern Territory.

“Our Australian assets are an important part of Newmont Goldcorp’s global portfolio, which we are working hard to sustain, while we pursue growth through active exploration in WA, the NT and on the east coast,” Mr Cooper said.

“We continue to develop our community partnerships and social investment program.

“We believe that a partnership approach that builds on consistent and direct engagement has the potential to deliver more fruitful and sustainable outcomes for communities.

“We are also proud of our workforce diversity, including our leading female and Indigenous representation.

“Newmont Goldcorp launched its inaugural Reconciliation Action Plan in 2018, and we are using this platform to continue to stretch our performance.”

A decade of quality service

WA

SINCE 2009, Boddington Mechanical and Auto Electrical has been servicing the Boddington gold mine, and providing jobs for more than 70 people in the community.

With Newmont and Goldcorp closing the deal to become the world’s biggest gold producer, Boddington Mechanical and Auto Electrical is celebrating 10 years working side by side with Newmont at Boddington, and is looking to new horizons of its own.

The company is proudly WA-owned and has a strong focus on providing quality services to its clients.

Managing director Steven Derrick said that since 2009, the company has delivered on its mission to increase the human and mechanical efficiencies of the mining, civil and construction industries.

“Our constant focus on people, skills development and responsive service is recognised by our clients to improve profitability and reduce risk,” he said.

Boddington Mechanical and Auto Electrical has extensive experience with mobile earthmoving equipment, auxiliary plant and drill rig maintenance, planned and unplanned maintenance, auto electrical and air-conditioning servicing, as well as in-pit and breakdown servicing.

It can also assist with tyre supply and fitment and tilt tray float services, and guarantees competitively priced parts and consumables.

The company can provide long and short term labour hire solutions, as well as field service support across the whole state.



Image: Newmont Goldcorp.

Boddington Mechanical and Electrical has been servicing the Boddington goldmine for 10 years.

“Providing ongoing support to the Newmont Boddington goldmine is a highlight,” Mr Derrick said.

“We have been able to engage with Newmont management to gain a better understanding of the type of candidates they are looking for with the required skillset and experience.

“Placements have included heavy duty and light vehicle mechanics, as well as auto electricians, boilermakers and servicemen.”

The company has credited its success

over the last decade to its dedicated and well-trained staff who have optimised efficiency, and reduced the downtime that can plague mine sites of all sizes.

Mr Derrick said that the improving efficiencies at both the mechanical and human levels had formed the backbone of his company’s success, and that it was only by investing heavily in the people it employed that the company was able to achieve its goals.

“By having the appropriate skills, it reduced downtime on site,” he said.

The company is excited to be looking outwards from Boddington, and as new discoveries in the Pilbara progress toward production, Mr Derrick believes that Boddington Mechanical and Auto Electrical has gained the experience, reputation and skill base to move forward to service the entire state.

It has put in the hard work to become an established and trusted service partner for the gold mining giant, and is excited to carry on its good work for the next 10 years and beyond.



We are committed to assisting our clients with their requirements in a safe and productive manner.

Boddington Mechanical and Auto Electrical are proud to be a Western Australia company with a strong focus on providing quality service to our many clients throughout the mining industry.



We are currently employing more than 50 people and growing monthly to meet the needs of our clients.
Our services include:

- Long and short term labour hire
- Field service support State wide
- Mobile earthmoving equipment, auxiliary plant and drill rig maintenance
- Light Vehicle Fleet Maintenance
- Rebuilds to OEM standards
 - Major component change outs
- Mid-life upgrades and component change out on hours
- Machine systems improvement programs
- Auto electrical and air conditioning
- In pit servicing and breakdowns
- Tyre supply and fitment
- Competitively priced parts and consumables
- Tilt tray and float services

All images: South32.

A FLYING START

Metallurgical coal exports are set to grow for the next decade and global miner South32 is ready to meet projected demand with increased production at its Illawarra Mine in New South Wales.

Illawarra Metallurgical Coal is set to produce 6.5kt in the June 2019 quarter.

EMMA DAVIES

BOTH the 2019 half year results and March quarter results for South32 bode well for the year ahead, with chief executive Graham Kerr confident of an achievable production guidance for 2019.

“For the full year we’ve increased production guidance at Illawarra Metallurgical Coal by seven per cent with production guidance unchanged for all other operations,” he said.

“We’ve also lowered unit cost guidance for most operations as we maintain operating discipline and benefit from a stronger US dollar.”

Saleable production at Illawarra for the March quarter increased by 68 per cent and 2033kt to 5Mt in the nine months ended March 2019, and was set to produce 6.5kt as it started on the extraction of new panels at both Appin and Dendrobium in the June 2019 quarter.

The increased production guidance was attributed to operational improvements at the site - specifically improved longwall performance, after the completed longwall moves at Appin and Dendrobium performed strongly.

The two longwalls would be operated in parallel from late 2020 and a substantial uplift in development rates at Appin would be required to sustain the dual operation.

South32 chief operating officer Paul

“We look to continue our strong start to the year, reshape our portfolio and build the foundations for future performance.”

South32 chief executive officer Graham Kerr.

Harvey said that development rates at Illawarra were a prime focus for the management team on site in the lead-up to the longwall moves, and that stockpiles had been established in late 2018 to account for the slight decrease in production.

“During the course of the past six months, the management team have improved their development rates by 45 per cent, which is significant improvement with quite a good pipeline of development opportunities, programs, projects and options available to the team that they’re continuing to work on,” he said.

“We’ll set targets in our plans that we

believe we can achieve.

We do have to improve – but the trajectory we’re on is really encouraging and we’re making great progress and we’ll keep focussed on delivering that.”

Mr Kerr indicated that finding staff to work on the site’s continuous mining machines had been a challenge and that previous issues with labour agreements at Illawarra had been resolved with the Dendrobium Mine Trades and Operators Enterprise Agreement during the December 2018 quarter.

A new Appin Trades and Operators and West Cliff Coal Preparation Plant

Enterprise Agreement was also negotiated during the quarter, which concluded the renegotiation of all major labour agreements at the operation.

Upcoming projects

Mr Kerr said the company was well positioned across all operations for the year.

“At Illawarra, we advanced the Dendrobium next-to-main project into feasibility and we’ve moved closer to approval to explore the southern areas at GEMCO in Northern Australia,” he said.

“We are well positioned entering the second half of the year with net cash at \$678 million and group volumes are expected to rise by 5 per cent in the 2019 financial year as our operations deliver more consistent production.

“This is a good position to be in as we look to continue our strong start to the year, reshape our portfolio and build the foundations for future performance.”

South32 had also progressed with its acquisition of the Eagle Downs Metallurgical Coal Project in Queensland.

“We also completed the acquisition of the 50 per cent interest in the Eagle Downs Project during the period, giving us operational control of a fully permitted, partially developed metallurgical coal mine with a 1.1 billion tonne resource in Queensland’s Bowen Basin,” Mr Kerr said.



The Minerals Council of Australia reports metallurgical coal demand will increase at a rate of 7.5Mt per annum until 2030.

The company assumed operatorship with the other 50pc interest in the project held by Aquila Resources, a subsidiary of China's largest steel producer, BaoWu.

The project had the potential to export 4.5Mtpa of coal from one longwall during the first 10 years of full production

"We have commenced feasibility work on the underground long wall project and expect to make a final investment decision with our partner during the second half of the 2020 financial year," Mr Kerr said.

Subject to the outcome of the feasibility study, South32 intended to construct a multi-seam underground longwall metallurgical coal mine and processing plant with a dedicated rail spur and train loadout facility.

The project was set to benefit from previous investment that had established two kilometre drifts which were around 40 per cent completed at the time of acquisition as well as site infrastructure including water supply, high voltage systems, office buildings, water and sediment dams – all of which could potentially support accelerated development of the site.

The final investment decision for Eagle Downs was scheduled for late 2020.



Labour agreements on site were negotiated and resolved during the March 2019 quarter.

Meeting demand

South32 has managed the balance of energy and metallurgical coal well; improving production for Illawarra Metallurgical Coal, acquiring the Eagle Downs Metallurgical Coal Project and planning to broaden ownership options for its South Africa Energy Coal asset.

"We remain on track to transform the ownership of South Africa Energy Coal with binding bids expected in the June 2019 quarter," Mr Kerr said.

"Once acceptable bids are received and

evaluated, we expect to reclassify South Africa Energy Coal as an asset held for sale on the balance sheet and a discontinued operation in the income statement."

Illawarra Metallurgical Coal was well positioned in Australia to take advantage of the strong market demand for both metallurgical and energy coal.

Around 20pc or 1300kt of its total 6500kt production guidance was energy coal with the remaining 80pc, or 5200kt, as metallurgical coal.

By end of financial year 2020 this was expected to increase to 5800kt, along with a slight decrease to 1200kt energy coal.

To put this in perspective, metallurgical coal demand in Australia was anticipated to grow from 275mt in 2017 to 372mt by 2030, and in March 2019 the NSW Minerals Council reported that both kinds of coal exports from the state have doubled since 2001 from 75mt to 164mt –an increase of 118 per cent.

"Coal is our state's most valuable export so it's great for the NSW economy that

demand for our high quality resources remains strong," NSW Minerals Council chief executive Stephen Galilee said.

He said the strong global demand for high quality coal was being driven by growing energy demand as well as trends in industrialisation and urbanisation in the region.

"Our coking coal is also in demand for its role in the production of the steel needed to help drive economic development and growth," he said.



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Marcus Byrnes Mastermyne Shift Supervisor

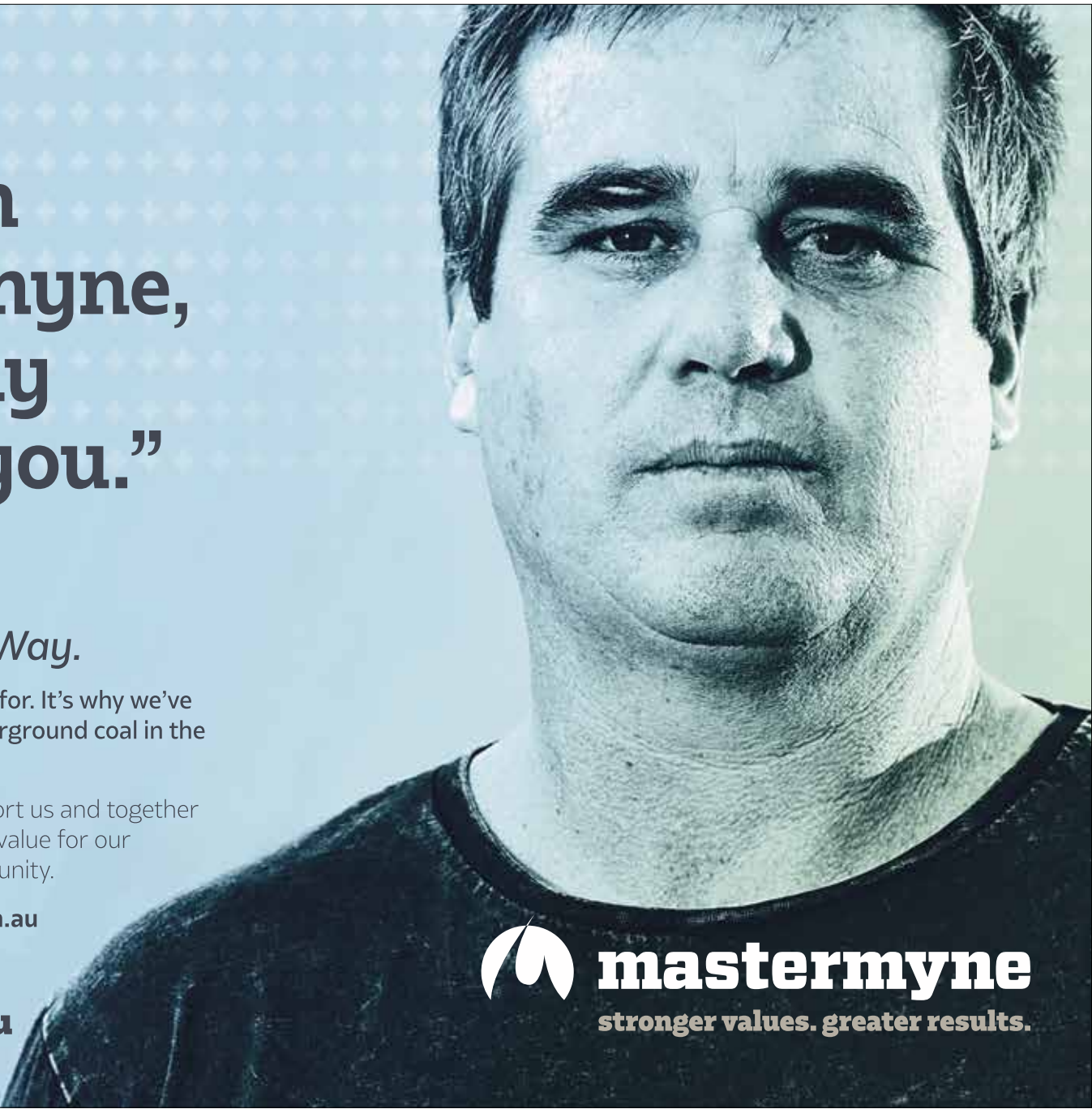
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Rockbreakers renowned for reliability

NATIONAL

IN response to customer needs, Rammer was the first company to introduce rockbreakers for tunnelling applications, and the first brand to offer large and heavy duty hydraulic rockbreakers that didn't miss a beat in tough conditions.

Rammer was also the first on the market to introduce the RD3 monitoring device together with the My Fleet platform, making it easy for customers to monitor their rockbreaker fleet remotely.

All Rammer products were developed in conjunction with customers across the world to help them reduce breaking times, maximise productivity and enjoy the industry-leading performance and reliability they have grown to expect from Rammer products.

Getting the work done reliably and on time is essential and Rammer has earned a reputation for providing efficient and reliable equipment, giving customers the peace of mind that it will deliver what it promised.

With integrated smart technology and customer-focused features, Rammer has created great experiences with customers.

Time and again, customers have returned to their local Rammer dealer to acquire more of its equipment.



Being one of the world's most trusted brands is not about technology and innovation only, it is about listening to what the customers say and what their application-specific needs are.



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Pump the slurry without the worry

NSW

AUSTRALIAN Pump Industries recently supplied a heavy duty Tsurumi four-pole submersible pump to UEA to assist horizontal drilling operations in Schofields.

UEA is one of Australia’s best known trenchless technology contractors, and the project is part of their work for Sydney Water.

UEA nominated the Tsurumi GPN411 pump for the job, due to its high-quality simple yet robust design.

The pump was used to recycle drilling mud from the drill head back to the treatment tanks.

Project manager Jonathan de Vos was impressed with the pump’s ability to pump slurry without the risk of failure.

“We are in the process of replacing our fleet of vacuumed primed pumps over to



The GPN411 slurry pump in action, recycling drillers’ mud during horizontal drilling.

the electric submersibles,” he said.

He said while vacuum primed pumps can be noisy and expensive with maintenance and fuel costs, pump reliability was critical as downtime is expensive.

“In this application there were periods where the pump was running dry,” he said.

“It handled this without a hitch”.

The inbuilt water jacket ensured the pump’s motor was cooled even when the

water level was low.

The Tsurumi 4” 11kW GPN high flow pump comes with a semi-open impeller of high chrome iron.

It is powered by a heavy duty, four-pole, slow speed motor with high efficiency levels to minimise power consumption.

The GPN411 features a large agitator for moving slurry.

High chrome-wearing parts and an extra thick pump casing means the pump delivers long lasting performance and outstanding durability.

Like all Tsurumi heavy duty pumps, it features Tsurumi’s anti-wicking cable entry point.

The anti-wicking cable gland ensures an absolutely watertight fit and prevents liquid incursion due to capillary wicking, should the power cable be damaged or the end submerged.

As added protection, the thermal motor protector is installed in the motor.

Aussie Pumps’ product manager Neil Bennett said the anti-wicking cable and the unique Tsurumi sealing device meant that water is prevented from entering the motor from the two danger points in any submersible pump.

“It’s that extra attention to detail that results in the pumps having a longevity that has earned them a well-deserved reputation for reliability and long service life,” he said.

Further information is available from Australian Pump Industries on (02) 8865 3500 and online at aussiepumps.com.au.

Less breakdown with hydraulic pumps

WA

WHILE it has been common for rig operators to haul generators around in order to run electric pumps, the practice was never very efficient.

Engine drive pumps could also be subject to “dusting” and a lack of maintenance.

Both issues could lead to breakdowns that would make them less suitable than a hydraulic drive version of the same product.

One company, Australian Pump Industries, has developed a range of hydraulic drive pumps that offers flows of up to 2500 litres per minute and heads as high as 50 metres (75 Psi).

Australian Exploration Engineering, based in Redcliffe, WA, is one of the happy customers, fitting the Aussie semi-trash version of these pumps to their 7500L Ezi Move mud tanks and self-contained trash pump frames.

The pumps were used by their clients to transfer drilling mud for diamond coring and were powered by the rig’s own hydraulic system.

With the Ezi Move mud tank, the trash pump filled the mixing portion of the tank where it was mixed until the correct consistency was achieved to suit the particular drilling conditions.

It would then be transferred by the pump into the drill tank from which the rig could draw on to be pumped down-hole, cooling the drill bit and removing rock cuttings.

The mud would then be recirculated through the system multiple times carrying rock cuttings, so it would be important to



An AustEx Ezi Move mud tank.

have a robust pump, such as the Aussie semi trash pump.

Hydraulic drive was a big benefit because it meant that no alternative sources of power were required, and that there were “engines to dust up”.

The Aussie GMP pumps are made from high-grade cast iron with big, open impellers suitable for pumping small solids in suspension, and they can self-prime through a vertical lift of six metres.

The pumps are exceptionally simple,

and built with silicone carbide seals.

A stainless steel wear plate has also been incorporated in each pump.

Aussie Pump’s chief engineer, John Hales, said operators liked the front opening port.

“This means that the pump can be cleared of debris without having to undo pipework or hoses,” he said.

Aussie Pump has now developed a range of hydraulic drive wash down pumps for drill rigs as well.

These pumps are available in pressures of up to 5,000 psi and are fitted with reliable close coupled Cassapa motors.

The motors, made in Italy, are simple and reliable, just like the semi trash pumps they are attached to.

A double bearing housing provides a simple but reliable drive line.

Further information on the complete range of Aussie hydraulic drive pumps for drill rigs is available from Australian Pump Industries.

Cost savings from rubber torsion bases

**LEVERLINK MANAGING DIRECTOR
RICHARD SHARP**

LEVERLINK managing director Richard Sharp concludes his two-part feature on the history and use of the rubber torsion spring motor base.

Tensioning device

In the early 1990s, the majority of vibrating screen drives rarely exceeded 30kW. However, once the market demanded larger motor bases for bigger screens and feeders with drives requiring motors 37kW and larger, improved mechanical adjustment was required.

Previously, this was achieved with open type mechanical devices and, while relatively inexpensive, they were prone to seizure and premature failure.

The designs of fully enclosed and lubricated mechanical tensioning devices were then developed.

These had the benefit of being able to purge old grease and lubricants at regular intervals and remain failure-free.

The late 1990s saw a greater emphasis placed on pump and crusher drives ranging up to 630kW.

Many requests from mine sites were based on safety issues, particularly with the larger overhead drives that were all mounted on conventional jacking screws.

Mechanical

In addition, the mechanical problems should not be overlooked.

These are due to design and/or corrosion in most cases.

The results of corrosion can include an inability to make the drive and driven shafts parallel, the inability to face drive and driven pulley and the inability to achieve and maintain the correct drive belt tension as per the belt manufacturer's specifications.

Cost

In today's market, labour is the single largest cost.

Almost without exception companies strive for efficiencies and cost reductions.

So, why do some end users continue with archaic technology when there are cost effective designs available that can reduce labour costs by up to 90 per cent?

Motor bases can be rebuilt and refurbished.

This may extend their service life to 30 years or more.

Many mine sites recognise the cost benefits.

Case study

Leverlink had a mining client who



For one client, the Verti-lift motor base was able to cut operation and labour time by more than half.

accepted as normal practice that it took a full eight hours and four men plus a crane to change out a set of vee-belts on a large pump drive.

All of their pumps were conventionally mounted on jacking bolts.

Leverlink designed a Verti-lift motor base to fit the existing pump base frame, used the existing vee-belts, and recommended a new guard that could be removed by two men without the use of a crane.

Windows were included in the guard at belt mid-span for checking belt tension when checking or re-tensioning.

The initial design included details such as ensuring the drive and drive shafts were parallel and that the drive and driven pulleys were faced.

Unless the motor was removed or perhaps new pulleys fitted, they would remain so at each and every belt change-out.

The cost savings were undeniable.

Two men in two hours did what took four men, eight hours plus a crane.

The payback period was well within the client's financial model.

The client went on to install about 30 additional pump motor bases.



Rebuilding a motorbase can extend its service life by 30 years.

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Metso awarded Kemerton contract

WA

METSO has been awarded a major contract to supply pyro-processing and comminution equipment for a new lithium hydroxide processing plant at Albemarle Corporation's Kemerton site near Bunbury in south-western WA.

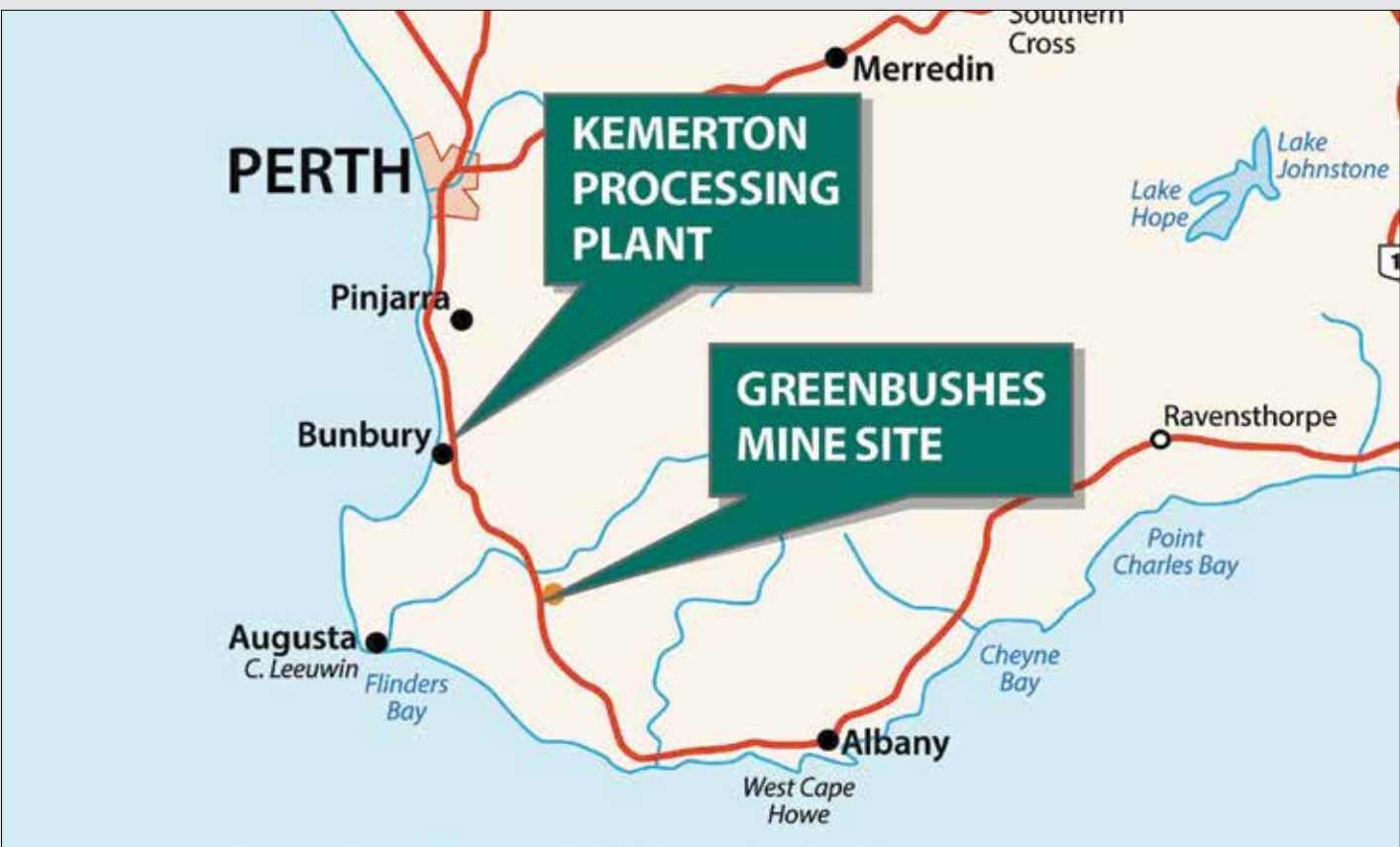
The construction of the greenfield project started in January 2019, with production scheduled to start in 2021.

The plant will initially consist of three production trains, each producing 20,000 tonnes per annum (tpa) of lithium hydroxide, with the potential to expand to five trains which would see production increase to 100,000tpa by 2025.

The plant will be supplied with lithium concentrate produced at the nearby Greenbushes mine.

Metso's scope of supply includes state-of-the-art calciner and acid roaster systems, ball mills, off-gas handling systems as well as other auxiliaries.

Metso's proven pyro-processing technology is capable of delivering high lithium recovery with low fuel consumption.



Albemarle's Kemberton lithuim project.

Orders were booked in Metso's third 2018 quarter and orders received in the first quarter of 2019, with equipment deliveries expected to begin in the second half of 2019.

Metso senior vice president Ross Wotherspoon said he was delighted with Albemarle's decision to work with Metso.

"We are very pleased to be playing such an important role in Albemarle's plans as it races to supply booming world demand for battery-quality lithium chemicals," he said.

"Critical to the success of this project, is the combined knowledge and experience of our people and Australian-based suppliers and subcontractors who are engaged to deliver major components of this important contract."

Metso mining equipment business president Victor Tapia said Lithium projects were on the increase.

"At Metso, we have diversified our solutions and services to meet this growing demand," he said.

"We are the proven technology leader

in minerals processing with a strong and capable support organisation close to our customers."

Metso is a world-leading industrial company offering equipment and services for the sustainable processing and flow of natural resources in the mining, aggregates, recycling and process industries.

With its unique knowledge and innovative solutions, Metso has helped its customers improve their operational efficiency, reduce risks and increase profitability.



Terrigena is a small environmental consultancy combining specialist knowledge with spatial analysis to undertake environmental impact assessment and associated services.

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For all automation needs

NATIONAL

ESTABLISHED in 2005, 4D Controls is Australasia's largest supplier of surplus, obsolete and used automation, control and monitoring equipment.

4D Controls specialises in three main business segments:

- repair and testing of automation, control and monitoring equipment.
- supply of new, surplus and used control and monitoring equipment.
- recovery of obsolete or redundant control and monitoring equipment from site.

As original equipment manufacturers stop supporting older automation and control equipment, they become increasingly difficult to replace, maintain or repair.

4D Controls repair and asset recovery capabilities surpass competitors by giving clients access to thousands of parts from all the major brands including Allen Bradley, Siemens, Schneider, Modicon, Omron, ABB, Yokogawa, Foxboro, Phoenix & MTL, to name just a few.

Every part is tested by in-house technicians prior to supply, with all parts covered by a full two-year warranty which is often longer than the original manufacturer's.

4D Controls parts supply is backed up by in-house testing, repair and diagnostics at its facility located in Rutherford, NSW.



4D Controls specialises in repair and testing of automation, control and monitoring equipment.

Repair capabilities cover fully traceable testing and diagnostics for: Programmable Logic Controllers (PLC's), variable speed drives, panel views, Human Machine Interface (HMI's), power supplies, servo

drives, industrial controls, inverters and transmitters (rescaling and calibration).

Being Australian-based allows 4D Controls to respond quickly to repairs, meaning machine downtime can be kept

to a minimum.

The company works with any type of automation, offering customisable solutions, tailored to any business or service.



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- ✓ Programmable Logic Controllers (PLC's)
- ✓ Variable Speed Drives - AC/DC
- ✓ PanelViews and HMI's
- ✓ Industrial Controls
- ✓ Transmitters and Sensors
- ✓ Power Supplies
- ✓ Servo Drives
- ✓ Inverters and More

Predictive, preventative maintenance

NATIONAL

UNPLANNED shutdowns and critical plant failures can cost operators millions of dollars in lost production, compromise safety of personnel and increase regulatory compliance burden.

AMOG's digital twin solutions solve these problems.

Critical plant is not only a valuable asset to a mine, but also controls production.

It is most costly if unforeseen maintenance or failure causes unplanned downtime.

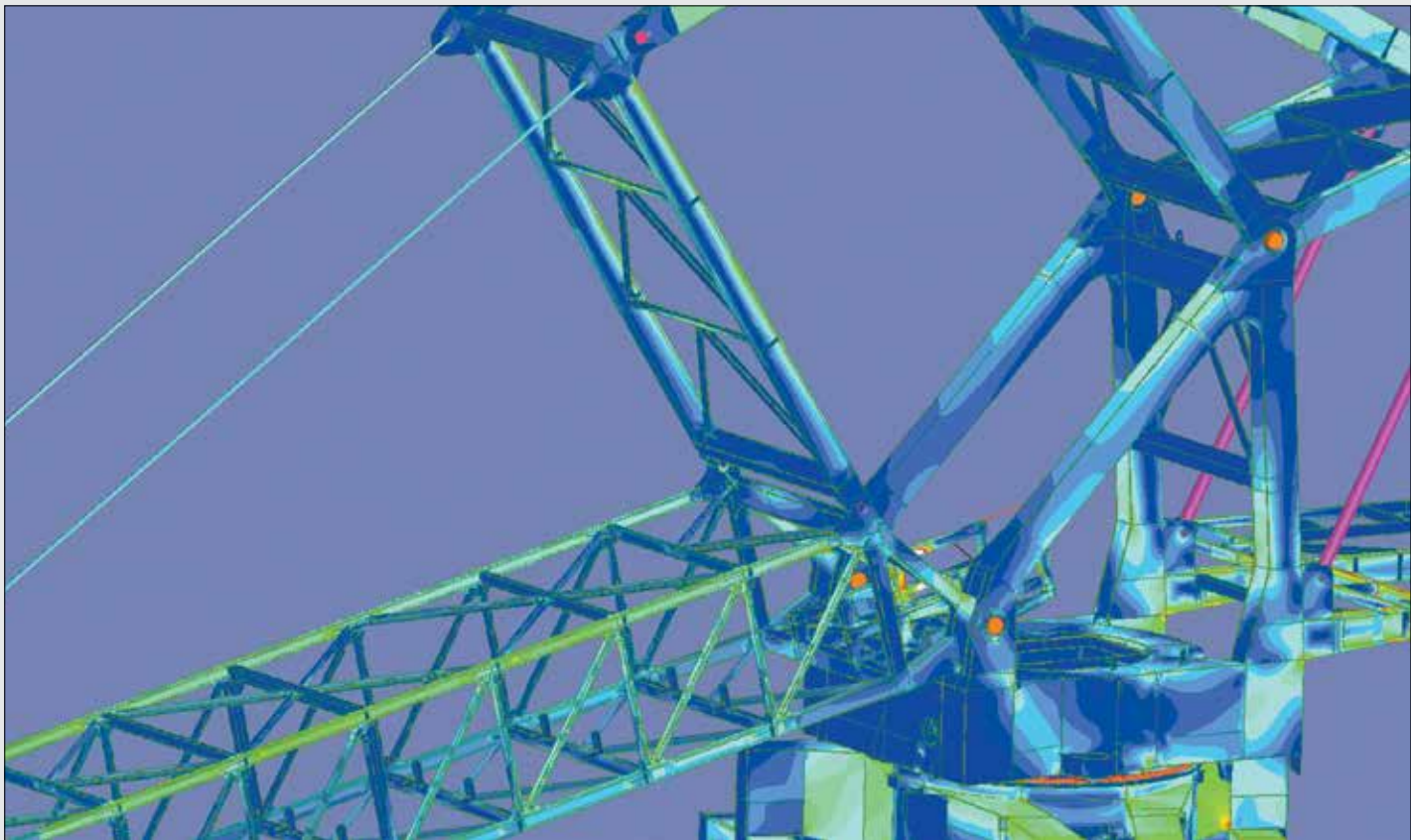
Through its work with Tier 1 clients, AMOG has developed an automated system of predictive and preventative maintenance, which can be applied from haul trucks to reclaimers and anything in-between.

This can detect and diagnose faults and failures long before a scheduled service would detect them.

It also catches items not covered by conventional servicing.

AMOG is able to feed live data and information to drivers or technicians, which are precursors to failures.

The company has developed the monitoring software and technology to



AMOG can create a real-time representation of a machine that accurately monitors, and predicts faults and failures.

analyse everything from the weak points of a bucket wheel reclaimer boom's flex points, to the changes in stress hotspots.

This changes maintenance from reactive to predictive and thereby improves operational efficiency.

By conducting thorough examinations and monitoring of heavy machinery, in conjunction with developing and configuring a digital twin, the research and development team at AMOG creates a real-time representation of the machine that accurately monitors and predicts

faults and failures.

Its image sensors are deployed to integrate with the digital twin, and mirror the physical machine to give real time readings.

This also enables machine learning which allows timely process control tailoring for best plant throughput, preventing bottlenecks and integrating with other systems.

This digital twin can actively predict and identify fatigued or stressed components and hotspots well before they

become costly downtime and can be used to extend the life of assets.

AMOG comes into its own with the ability of its team to customise software so that it can work with any existing mine-specific operating systems.

This means that AMOG's technology will seamlessly integrate into any existing platform based operating system, a development that has seen the company recognised by METS Ignited for its collaboration with Rio Tinto and the University of Newcastle in 2017.

Smart Sensors Drive Value and Improve Safety

AMOG has been at the forefront of advanced engineering analysis in mining for 20+ years.

We combine this expertise with Industry 4.0 technology to deliver smart monitoring solutions. We bridge the gap between gathered sensor data and useful operational feedback in a single holistic package that includes:

- > Asset performance optimisation
- > Real-time condition monitoring
- > Targeted inspection criteria
- > Forward predictions of remaining life
- > Safe operation of mining plant

AMOG Smart Sensors are wireless and can be installed and removed in seconds. They collect, analyse and relay real-time data and notifications to understand performance and response.

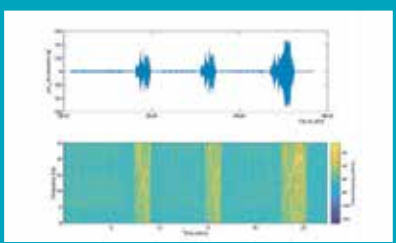
From human vibration tolerance limits to asset optimisation, these sensors can service a range of areas and be used to monitor equipment or identify failures.

AMOG Smart Sensors have the capability of on-board computing using machine learning techniques. The sensors are versatile and can be integrated with a range of existing platforms.

Contact AMOG to discuss your requirements, or to organise a system demonstration and trial deployment.



Real Time Monitoring



Real Time Analytics

Engineering solutions



Digital Twin

Crystal ball of preventative maintenance

NATIONAL

FOR any mine site, unscheduled maintenance or downtime means disruption to production, and ultimately, loss of revenue.

And even when most machinery and equipment have regular servicing schedules to prevent this, parts still sometimes fail.

During downtime, labour, parts and lost production can cost a company millions of dollars.

Therefore, the ability for a company to anticipate problems before they occur, in a preventative manner, is of critical importance.

While there are various products on the market that aim to do this, most are very specific and not compatible with a multitude of equipment.

MachineSaver's Trivibe sensor, supplied in Australia by Fast Automation, negates these problems and can be affixed to almost any mechanical product on a site or in a workshop.

Fast Automation has a strong history of executing some of the most challenging automation projects in Australia, with more than 70,000 jobs already completed.

The company is the exclusive Australian distributor of MachineSaver equipment, which has permitted numerous large businesses to reduce costs and lower disruption.

The sensor was designed to detect faults in mechanical products and alert



A Trivibe sensor monitoring vibration patterns.

users before major damage or failure occurs.

The sensor establishes a benchmark by measuring the vibrations of a running machine during normal operation, with two sets of three-axis accelerometers: one set for high frequency vibrations, and the other for low frequencies.

Using measurements in the X, Y and Z planes, the product monitors the vibration patterns for any device it is connected to.

It then sets parameters for normal thresholds and alerts users if any movement outside those parameters is detected.

The Trivibe is so sensitive, it can detect changes for even a small developing fault – like a bearing rising to a higher

than normal temperature or a change in its vibration pattern from a lack of lubrication.

The device can be used across a bank of similar equipment, allowing a company to compare its operation and establish trends for wear over time.

This means a company can monitor general wear and tear on its machinery and equipment, allowing them to establish a predictive maintenance program.

Servicing can also be scheduled at more appropriate times, leading to less downtime and wasted resources.

The Trivibe sensor can be connected to a cellular router, where data is sent to a live monitoring centre at the MachineSaver head office in the United States.

This data is then analysed in real time, with any abnormalities being reported to businesses immediately.

The data is also sent to an online server which is accessible from a browser or even a smartphone, also in real time.

For larger operations, the Trivibe can also be connected to a company's in-house process controllers.

It is also usable in hazardous environments, when the sensor is used in conjunction with current limiting Zener diodes to eliminate the possibility of sparking and explosions.

More information: Fast Automation, 1300 752 397, www.fast-automation.com.



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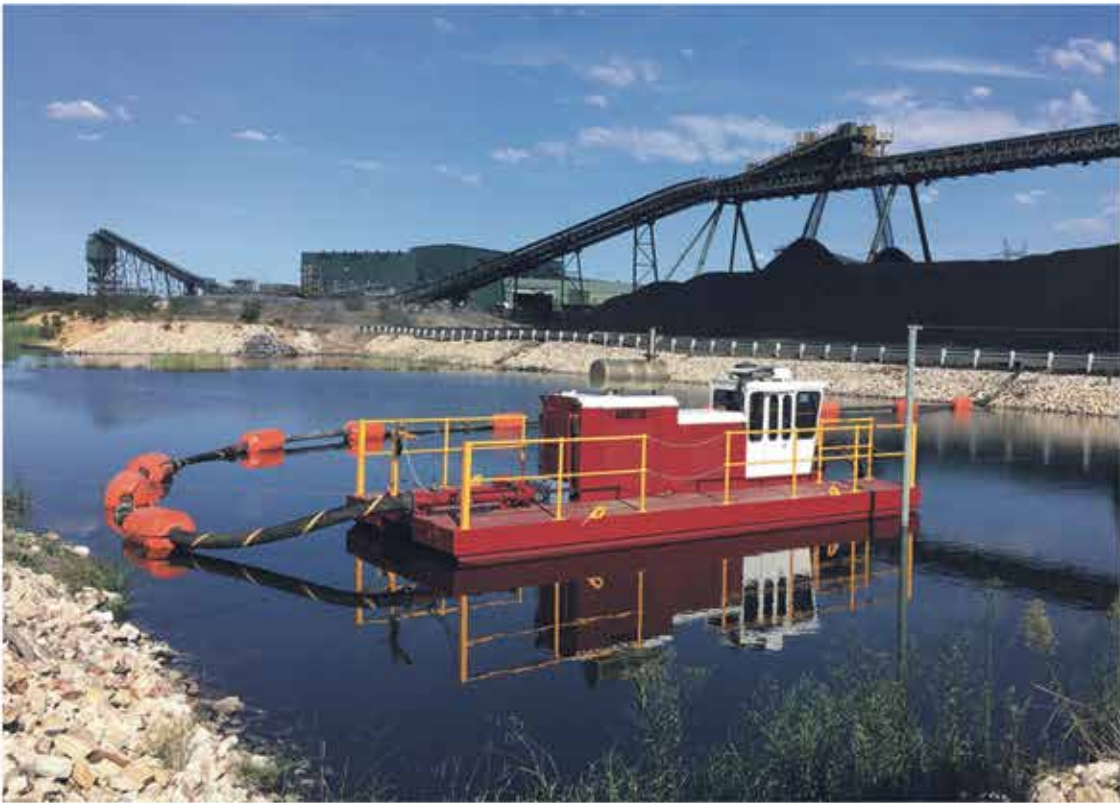
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Environmental emphasis in dredging

WA

APEX Envirocare is an innovative environmental company with a focus on water-related issues.

Established more than 20 years ago, it has grown into a successful organisation by embracing new technologies and providing them to Australian businesses.

They use the latest unmanned remote controlled dredge equipment, which can be fully automated to ensure regular solids are fed into a mining process or thickener.

Alternatively, they can dredge the sediments into their GeoPro Desludging Tubes which retain the solids and expel the water, ensuring quick drying and disposal time.

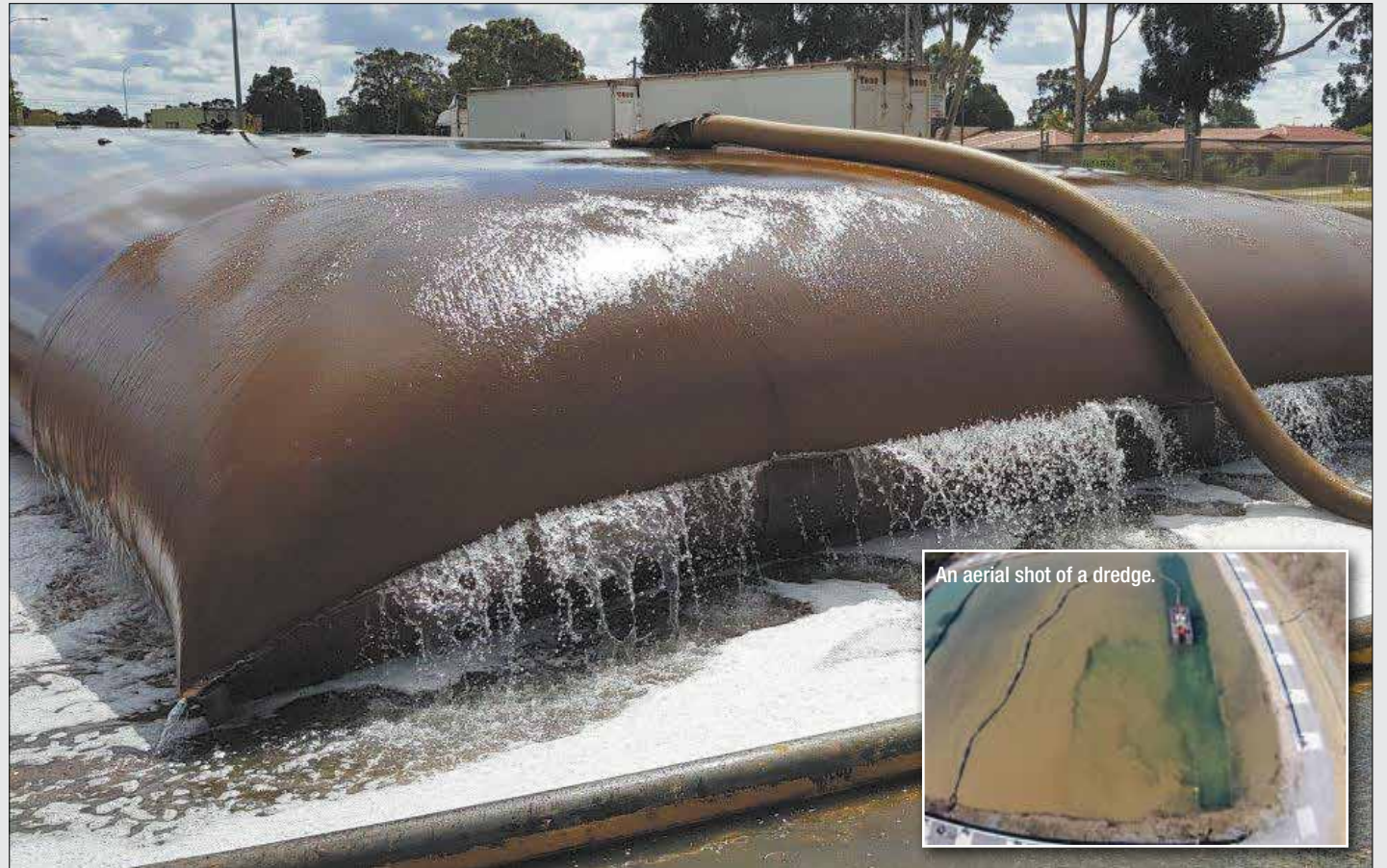
The process is much simpler than using expensive mechanical processes such as belt filters or centrifuges.

These open-weave textile tubes range anywhere in size from one cubic metre to 1000cum, and suit every project need.

Apex carries high stocks in its Wangara warehouse but it can also custom make sizes to suit particular client needs.

Apex Envirocare has recently been appointed as the exclusive distributor for Mudcat and IMS dredges in Australia and the Pacific and have already sold dredging equipment to several mining clients.

Being a dredge contractor means its expertise and experience in the field can be passed on to clients, aiding them in



A GeoPro Desludging Tube being used in Armadale, WA.

their decision-making and reassuring them that they will receive ongoing support and advice.

Another product it offers is the clever Aqua Barrier system, a temporary water-inflated cofferdam.

Apex Envirocare has been leasing them around Australia for more than 15 years.

Aqua Barrier offers a practical and environmentally preferred alternative to sandbags, earth bunds and sheet piling.

It has been used by countless large

contractors and mining companies, including a recent project in WA's Pilbara region which allowed a mining company to repair culvert structures.

More information can be found at: www.apexenvirocare.com.au.

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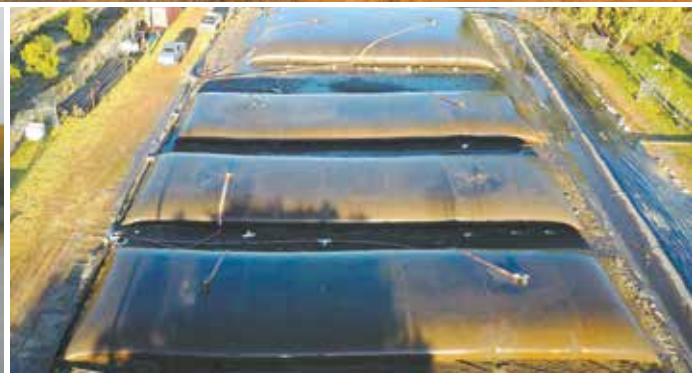
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Delivering value by innovation

WA

PERTH-BASED manufacturer and supplier of equipment, spare parts and consumables, Newland Drilling & Mining Equipment, has been delivering quality manufactured products and services for the exploration and mining industries throughout Australia and abroad for over 22 years.

The local manufacturing company produces underground diamond coring drilling rigs and replacement parts in-house as well as distributing the well-respected Diamantina Christensen's mining products throughout Australia and abroad.

These include diamond products, core barrels, overshots, drill rods and casing, water swivels and hoisting plugs.

Situated in Perth and Kalgoorlie, Newland complements this product range with its own locally manufactured products, such as recovery tools, wedging equipment, adapter subs and solid grip wrenches.

In addition to the drilling products, Newland also manufactures the Erebus range of underground diamond coring drill rigs, which are versatile, robust and



Newland's Erebus 110 mobile carrier diamond drill rig.

reliable, and come in 90kW and 110kW configurations.

Newland also manufactures a comprehensive range of drill rig replacement parts and sub-assemblies that are interchangeable with many of the

most popular brands in the market.

The company's substantial manufacturing capability gives it flexibility to offer customised and innovative products to meet clients' individual needs, and the company prides

itself on delivering quality products in addition to personalised customer service.

For more information, contact Damian Lailey at Newland Drilling & Mining Equipment on 0429 795 081 or damian.lailey@newlandassociates.net.au.

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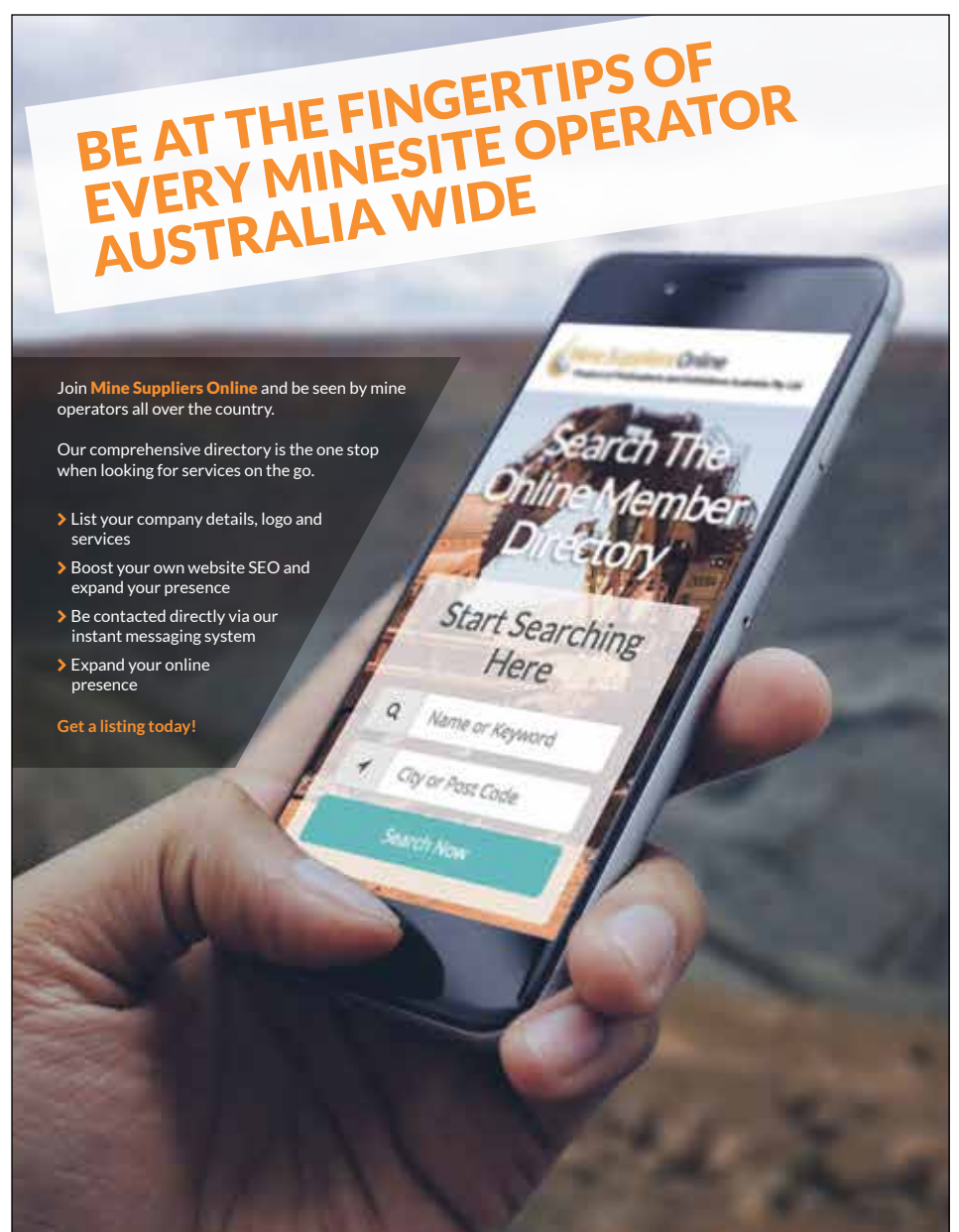
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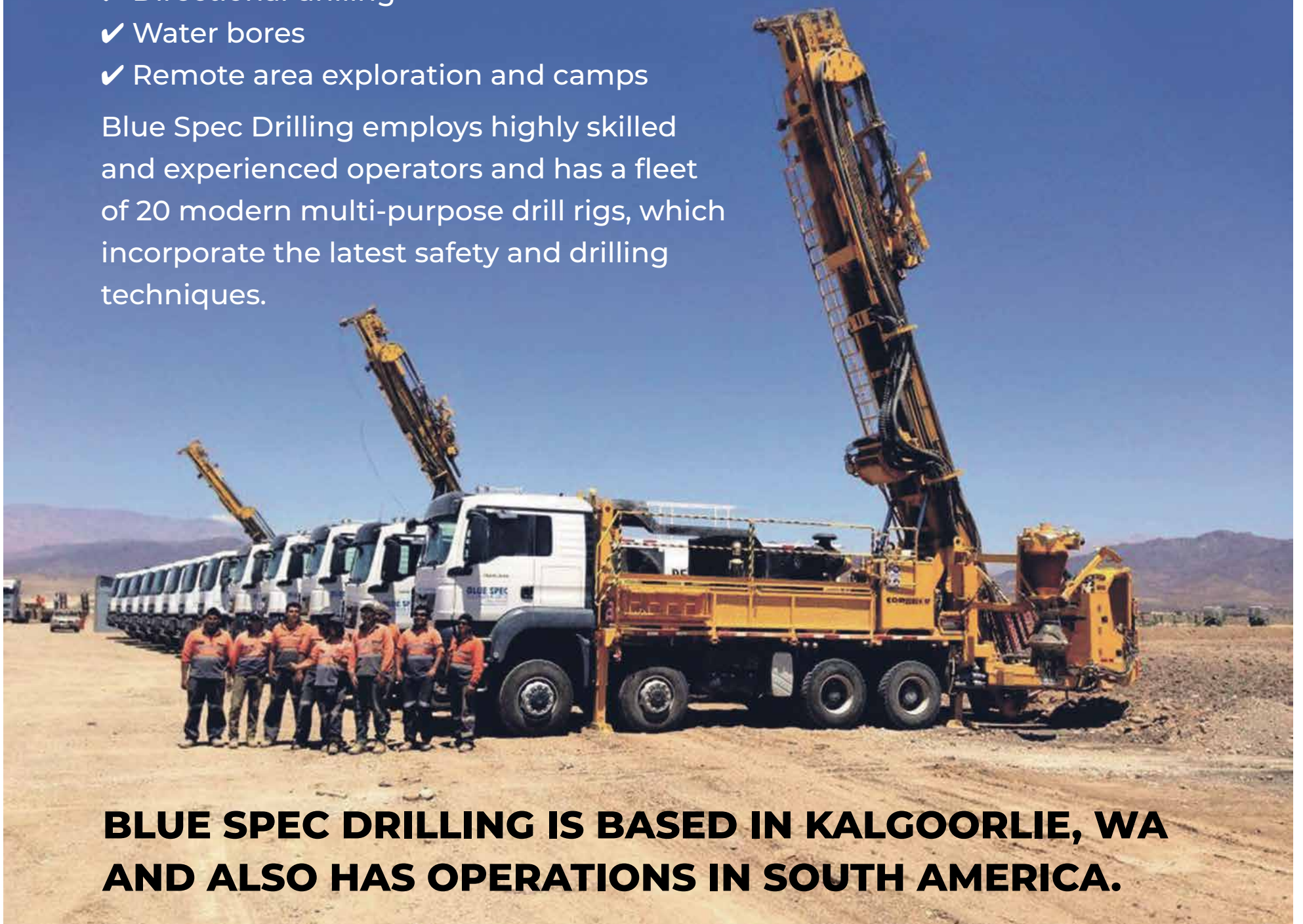
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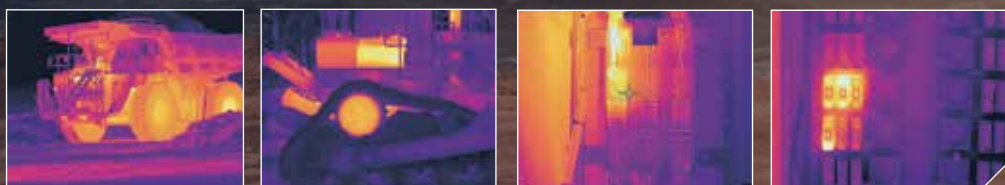
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NATIONAL

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CMA Ecocycle is commissioning Australia's first state-of-the-art battery recycling, sorting and processing plant.

Australians use more than 400 million

batteries every year, and 95 per cent of these end up in landfill.

When disposed in landfill, batteries can leak toxic substances such as lead, mercury and cadmium into the environment.

CMA Ecocycle has provided thousands of businesses across Australia with recycling solutions, accepting all types of batteries by utilising computer-controlled sorting machines that separate batteries

according to their size and chemistry.

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CMA Ecocycle also has operations and branches in all States and Territories of Australia with dedicated company owned transport.

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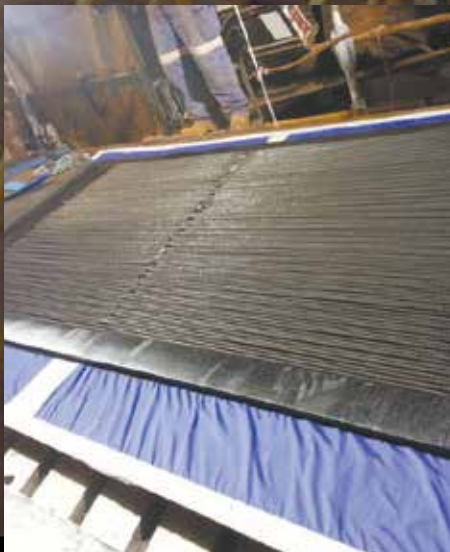
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Completed **on time**, on budget and incident free **Extending belt life on 3 primary feeders project**

Project Scope The three primary belt feeders at FMG's Solomon Hub were delivering unacceptable downtime and lost production through repeated belt failures. Mechanical changes to the loading chute combined with a new conveyor belting specification greatly improved their availability.

Key Data The feed source is the primary crusher and major conveyor parameters were: • Conveyor – Centre to Centre – 140.63 metres • Pulley Diameters – 800mm • Tonnage – 5,500tph • Belt Speed – 3.98m/sec • Product Size – ≤600mm (95% minus 400mm) • Product Bulk Density – 2,400kg/m³ • Chute Drop Height – 5.7m A combination of large primary product size and drop height generating a high impact force which exceeded the rating of the selected steel cord belt specification was identified as the cause of holes being punched in the belts and premature belt failure. Installing cross bars in the lower section of the chute and a 90° cross beam longitudinal to reduce the speed of the product resulted in improvements to the loading. The new belt installed was a composite of 1800 mm x Conquest XP 1250/2 PIW 18 mm x 7 mm ContiTech Grade Monster Hide x Stacker c/w HD Leno Breaker fabric in the carry cover. This has a belt mass of 72.0kg/m and 34.9mm gauge.

Summary FMG has had great success with 'Monster Hide' compound on CV03 at Cloudbreak Mine (toleleftpic) where it has increased belt life from three to eight months. An astonishing 165% improvement. Results of the loading chute changes combined with the new conveyor belting on the three primary feeders have been extremely encouraging.

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ContiTech

Customised risk management

NATIONAL

THE use of pre-employment medical assessments ensure the health and fitness of employees for duty, but also ensure employers take the first step in a risk management process.

Resile’s pre-employment medical assessments consider specific work practices, legislation and compensation as well as determining the baseline level of fitness of a worker.

Resile’s founder Dr Rob McCartney said that if not well-designed and conducted, a pre-employment assessment could be just an expensive, non-valid snapshot in time.

“Our occupational physicians can recommend the best strategy for employment health assessment for your organisation, keeping your risk management goals in mind,” he said.

“We will assist you in designing and implementing a best practice solution for your pre-employment medicals, the first step in managing the health risk of your workforce.”

Resile’s clients benefit from the company’s proprietary management system for ensuring fitness for duty. This is available for both pre-employment medicals and periodic health assessments.

A well-designed, risk-based assessment considers more than just the risk on that day, but also a projection of risk into the future.

This is why it is imperative that a



Pre-employment medical assessments are a key risk management step for employers and employees.

specialist occupational physician is used to determine the fitness of an individual, as it requires expertise that can only be offered by a consultant specialist in the

field who considers the full health of an individual.

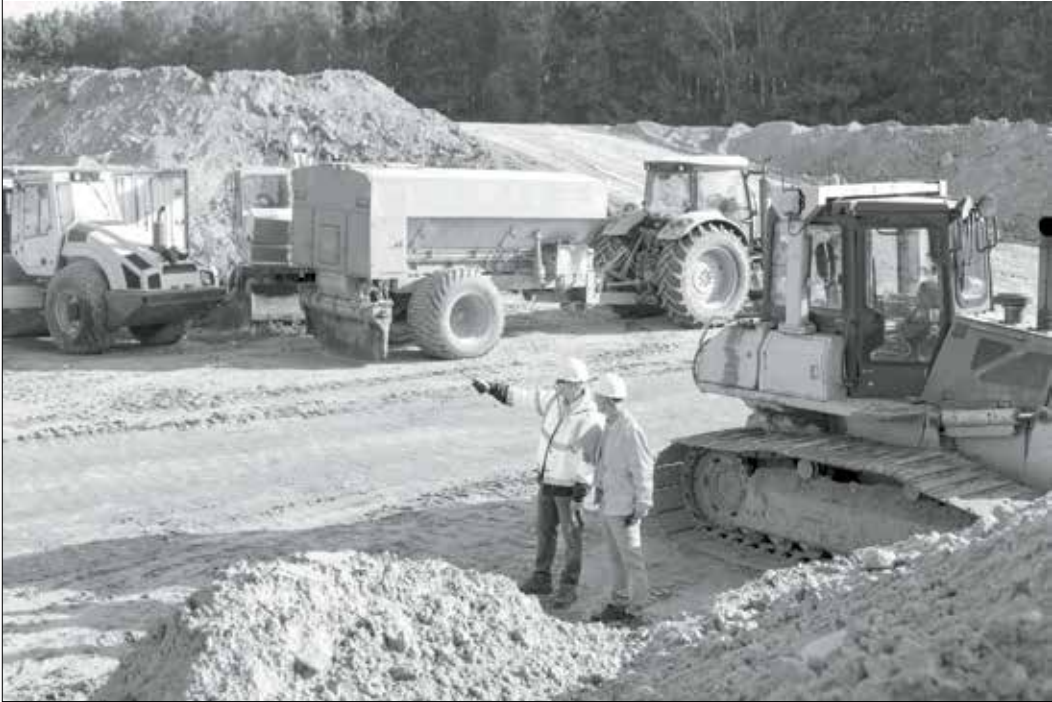
This expertise also assures that the quality of the assessment is well

controlled, ensuring compliance with legislation and reducing variability.

More information can be found at: www.resile.com.au.



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- Medical Management Consultations
- Acute Medical Management 24/7 – RAMMS line and App
- Injury Treatment
- Injury Managements
- Occupational Physician Consulting
- On-Site Services

Doctor-led medicals make difference

NATIONAL

THE pre-employment medical is a workforce risk management tool utilised to screen individuals for risk factors that may limit their ability to perform a role safely and effectively, assisting both the employer and candidate to maintain good health and optimise company productivity.

Because pre-employment medicals play a crucial role in the hiring process, it is important to rely on competent professionals who are experts in the field of occupational medicine.

According to Sonic HealthPlus specialist occupational and environmental physician Dr Keith Adam, medical assessments are like insurance.

"You pay your policy for years, but you only find out after an accident, fire, or flood whether or not the policy is worth the paper it is printed on," he said.

"A medical assessment performed by a doctor is the best way to ensure your company avoids complications due to occupational exposure.

"And it will also withstand a challenge in court."

"Securing the services of a doctor to conduct medical assessments is your insurance should problems arise."

As a leading national provider of occupational healthcare, Sonic HealthPlus has extensive experience in providing occupational and general medical services encompassing pre-employment assessments, occupational



Sonic HealthPlus' Dr Cleavland Mackay. The doctor-led model of assessments means that clients always receive expert advice from occupational medical professionals.

specific assessments, injury management, general medicine, health surveillance and emergency medical management.

The company's doctor-led model of assessments means that clients always receive expert advice from occupational medical professionals.

Sonic HealthPlus operates the largest wholly-owned occupational medical clinic

network in Australia.

The company employs and works with some of the best and most experienced health professionals, including specialist occupational and environmental physicians, general practitioners, allied health professionals and medical support staff.

Sonic HealthPlus' expertise, reach and experience means that clients can

rely on the company to help protect the health and wellbeing of their greatest assets – the workforce.

To find out more information about Sonic's vast range of medical services, visit Sonic Healthplus' website (www.sonichealthplus.com.au) or speak with a client partner by phoning 1300 339 557.



The OSH Group office in West Perth

Medicals a must

WA

OSH Group is a proudly Western Australian-owned and operated provider of specialist occupational medicine services.

Established in 2007, OSH Group has eight in-house occupational physicians and seven occupational physician registrars based across three Perth metropolitan locations.

Services also extend to six regional specialist consulting locations as well as an affiliate network across the state, nationally and internationally.

Delivering a comprehensive medical

assessment service (encompassing Pre-employment medicals, periodic assessments, statutory medicals and health surveillance), the Group employs a methodology which has had positive net impacts on injury occurrence and severity, insurance premiums and employee retention.

OSH Group also offers injury management, fitness for work appraisals, travel medicine, poison permits, drug and alcohol testing, and on-site services, along with medico-legal and independent medical examinations, providing an integrated OHS solution.



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Weather stations can provide mine managers with all the data needed to ensure operations run smoothly.

Collating data in real-time

NATIONAL

MINE managers require accurate and timely site-specific weather data for a number of reasons.

When applying for mining leases and approvals, a reliable automatic weather station can be used to undertake a local climate (microclimate) weather audit.

Baseline weather data from this audit can be used in the preparation of an environmental impact statement and various reports required by State EPA and government authorities concerned with the likely movement of dust and toxic gases, wet season run-off and the leaching of chemicals into waterways.

Data from an initial weather audit (and subsequent, on-going weather monitoring through an automatic weather station) can also inform decisions which will impact directly on mine production, worker comfort and the wellbeing of neighbouring communities.

Weather station readings also have implications for the design, selection and maintenance of plant and machinery capable of operating under the climatic conditions experienced on a mine site.

Envirodata's Weather Maestro is a robust weather station designed to cope with the extreme conditions typically found in mining sites, and provide mine managers with all the information they need to ensure operations run smoothly.

The Weather Maestro's weather sensor array for a typical mine includes sensors to measure air temperature, relative humidity, wind speed, wind direction, rainfall, barometric pressure and solar radiation.

The heart of the weather station, the Weather Maestro data logger, is available in 10, 12, 16 or 20 channel versions to ensure all critical weather parameters are monitored and features a powerful processor, large and easily configurable on-board memory, comes pre-programmed with Envirodata's custom-designed software, and is easily accessed by a range of communication and remote monitoring options.

More information can be found at: www.envirodata.com.au.

MetraWeather lights the way

NATIONAL

METRAWEATHER Australia is a leading weather and lightning service provider to Australian industry.

It is the exclusive reseller of GPATS lightning information and related alerting services in Australia.

The nationwide GPATS lightning detection network has been in operation in Australia for 20 years and is used by mine sites and other industries for visibility on lightning threats.

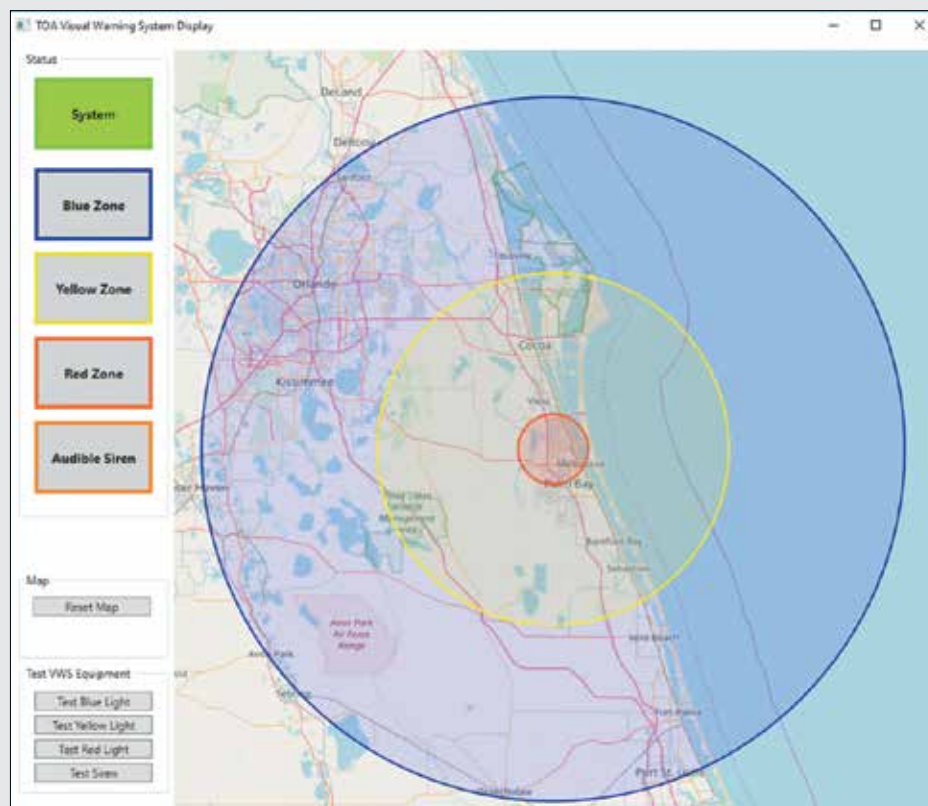
The GPATS network has more than 100 detection sensors placed across Australia, to provide accurate location information on lightning events in all states and territories using time-of-arrival calculations to in-play detection sensors.

This network approach provides a mine site with the most accurate information available on how close lightning is in terms of distance and in what direction it is located.

The accuracy of this network-alerting approach can reduce unnecessary downtime that can occur with other less accurate methods, while still maximising the safety of your operations.

GPATS is part of the global TOA lightning detection network, which has developed the innovative Visual Warning System (VWS) solution, in partnership with respected hardware supplier Campbell Scientific.

This new VWS has been deployed at Australian mines to provide on-site workers with clear audio-visual guidance



The web interface for users.

on when the proximity of lightning strikes are within pre-defined distance thresholds of a site.

The hardware takes the form of a traffic light system with a siren to alert workers to developing risks that require attention.

A web browser interface is also provided for tracking lightning threats on a map based interface, which is ideal for use in a control room environment.

Alerting distance thresholds are tailored to align with onsite Trigger Action Response Plans.

For any mine site looking to maximise safety whilst minimising costly downtime, VWS is an effective option. It also overcomes connectivity challenges for workers who are in communication blackspots, or those who do not have access to phone-based alerts.

Weather stations explained

NATIONAL

THE World Meteorological Organisation (WMO) defines stringent measurement requirements for standards compliance Tier 1 weather stations.

For example, the WMO specifies that all wind measurements must be made at a height of 10 metres, with a specified louvered enclosure, which can make the installation inconvenient.

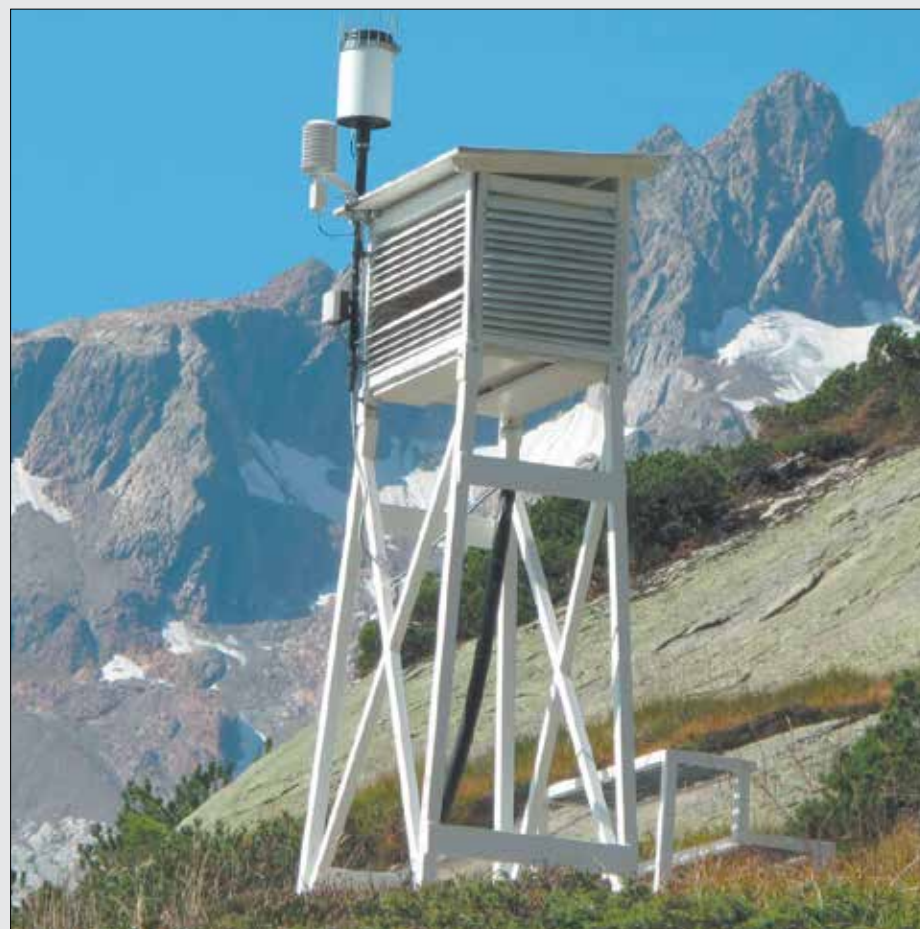
General purpose weather stations, which do not fully comply with the WMO guidelines, are called Tier 2 weather stations.

For Tier 2 weather stations some compromises were made for convenience: they are at a lower height and they have a smaller louvered enclosure called a radiation screen or gill.

Most mining and industrial companies install Tier 2 weather stations.

Unidata offers a range of weather stations, which have a broad range of applications, depending on choice of configuration and instruments.

Customers then have the choice of using a specialised instrument for each measured parameter, or a modern multi-parameter instrument, like the



An example of a Tier 1 weather station.

Vaisala WTX536 weather transmitter or Lufft WS800-UMB smart weather sensor.

The simplest weather stations from Unidata consists of a temperature and humidity sensor mounted in a double louvered radiation screen, and connected to a Neon remote logger, which is mounted in a weatherproof enclosure.

A weather station more often includes instruments that enable users to monitor

and record temperature, relative humidity, global solar radiation, wind speed and direction.

These instruments are then integrated with the Neon logger, which will measure, store and transfer weather data using either cellular, LoRa or various satellite networks.

Collected data is sent to a central Neon server to be analysed and displayed on a standard web browser.

Lightning Visual Warning System

- Accurate real-time lightning information for Australian mines
- Proximity alerts with supporting directional information
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- Customised to meet your Trigger Action Response Plan (TARP)

Maximise safety, Minimise downtime.



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MetraWeather

Push and shove

How do you strip and rebuild a CAT D10T dozer from bare chassis rails to a fully reconditioned machine? Mining Equipment Maintenance (MEM) in Queensland, which recently completed such a build, outlines the process.



The D10T dozer looks brand new after being completely stripped, refurbished, re-powered and re-painted.

NATIONAL

WHEN tackling such a big rebuild, first and foremost is a scope of work from the customer outlining the initial repairs and maintenance to be carried out.

Once the machine was delivered to MEM's 20-acre facility, the team put it through its paces to identify any other defects or problem areas not detailed by the customer.

Once the new scope of work is agreed upon, action can commence and in this case the humble dozer needed a lot of attention.



The machine was stripped back to an almost completely bare chassis.

The big ticket item on the list was a new engine. CAT's C27 V12 produces 580hp (433kW) from its 27-litre displacement at only 1800rpm but even engines of this size need rebuilding from time to time.

The decision was made to bring in a replacement engine for this job but MEM could just as easily have machined and reconditioned the motor onsite in their workshop and then reassembled it in their surgically clean engine

assembly room.

Also on the change-out list was the torque converter and the left final drive. At this point the D10T had been stripped back to the chassis, which was sand blasted crack tested, repaired and painted.



MEM's dust-proof engine room is surgically clean and has the capability to rebuild engines and all drive train components.



After sand blasting, the chassis was dye penetrant-tested for cracks, which were repaired prior to the new paint be applied.

Next was the hydraulic system. Taking advantage of the fact that the machine was almost fully stripped, the decision was made to replace all the hydraulic lines to save expensive down time from potential hose failures in the future.

The hydraulic and steering control valves were removed and resealed, as was the hydraulic tank.

All the hydraulic cylinders were removed from the machine, disassembled and resealed also.

Topping off the overhaul of the fluids department was the installation of a brand new main hydraulic pump.

Cosmetically, the bent rear fenders were removed, straightened, blasted and repainted - good as new.



Fuel and hydraulic tanks are freshly painted and ready to install.

Out back, the ripper frame was showing the scars of many thousands of hours breaking ground.



The chassis has been painted and brand new hydraulic lines fitted throughout.

The frame was completely non-destructive tested (NDT) for cracks and the few that were found in the cast steel frame were ground out and welded shut.

Linkage wear is prevalent in most machines as significant maintenance milestones arise and this dozer was no exception.

The pin and bearing bores become oversized and oval over time and must be reclaimed with weld before line boring to bring them back to OEM dimensions.

At this point they can then be treated to new OEM pins, seals and bearings, ready for active duty.



Pin and bearing bores were worn oversize and oval in some cases.



All pin and bearing bores were reclaimed with weld and line bored back to OEM specs. Here the pin bores are in the process of being line bored, note the steel bar at the rear to hold the linkages in alignment during this process.

While the structural repairs were being carried out, the cab was completely refurbished. All the old panels were replaced with near new items, while new hoodlining was installed.

Any surface rust was sandblasted before the whole office was given a new coat of jam.

With new seals and a completely new air conditioning system – from compressor to fan



The very tired and worn out D10T rolls into MEM's workshop in Central Queensland.

unit – the cockpit came up like it just rolled off the production line.

New fuel lines were fitted before the brand new C27 was slotted into the chassis and the long task of completely re-assembling the machine commenced.

A few finishing touches came in the form of new intake and induction pipes, new cooling



A look at the ripper frame before it was rebuilt. All hydraulic cylinders were stripped and resealed

hoses and some new exhaust pieces.

It took only six-weeks from the time it rolled into MEM's yard to the time it rolled out, resplendent in its new yellow paint scheme, ready for many thousands more hours of operation.

This was an impressive turnaround time, given the extent of the rebuild.



The cab was treated to new panels, new hoodlining, new air conditioning and a coat of paint.



A fully refurbished C27, 580hp engine is slotted between the chassis rails.



MORE INFORMATION: Mining Equipment Maintenance | (07) 4930 0200 | www.mem.net.au



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MINING EQUIPMENT
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Under pressure



A 6060 Hydraulic Excavator.

NATIONAL

CONSIDER the load placed on the slew bearing of a large excavator.

Not only does it bear the weight of the cab, engine, arm and hydraulics but it must allow 360 degree rotation. In addition, the bearing must withstand enormous torsional forces when the bucket is engaged.

Add sudden shock loading from bucket impacts with hard materials and rapid disengagement when the teeth lose their grip, and the torturous nature of this working environment becomes clear.

This is before the ingress of fine abrasive contaminants and water worsen an already harsh atmosphere.

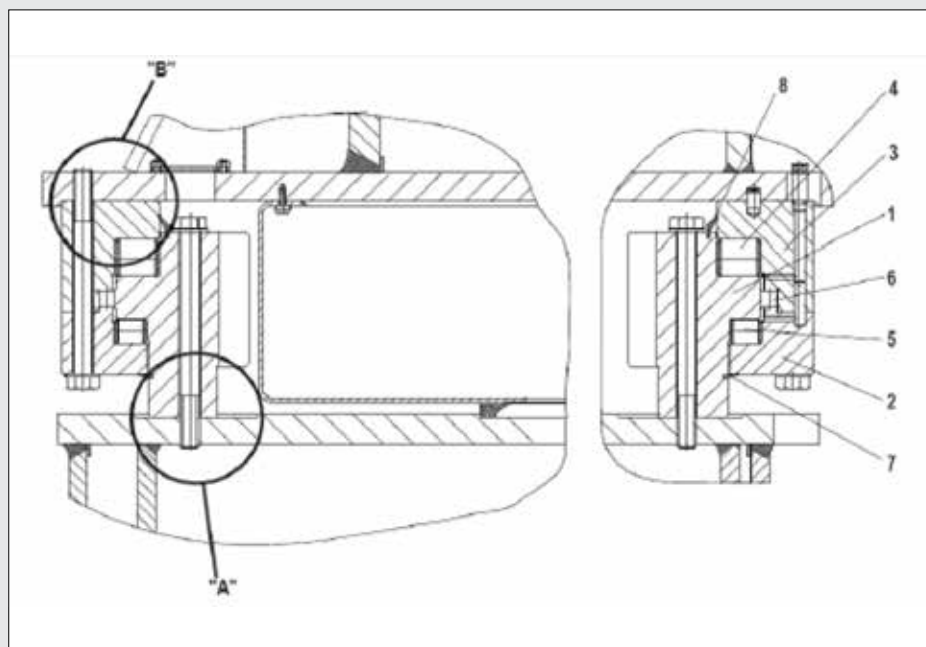
In a typical slew bearing, dozens of roller bearings run against a hardened steel race and must withstand all of these forces and the resultant heat generated from operation - for hours on end.

Given the significant cost of a new slew bearing, it makes financial sense to take the best care possible of these hard-working components.

Machine down time and labour rates for repairs add to the cost of inadequate care and maintenance.

There is a light at the end of the tunnel though and it comes in the form of a revolutionary new grease product whose remarkable performance materialised after countless hours of R&D and attention to detail in the laboratory.

Renolit CXS GSM, from Fuchs, is a highly



The slew bearing layout.

refined calcium sulfonate complex thickened grease, formulated from 100pc virgin base oils that is producing outstanding results in the field.

Renolit CXS GSM offers a new level of protection and significant long-term cost savings for some of the country's largest mining operations.

Its unique fortified and synergistic solids additive system was designed to provide maximum metal-to-metal contact resistance even under continuous heavy pressure and sudden shock loads.

An added bonus is that Renolit CXS GSM is manufactured right here in Australia at Fuch's grease manufacturing facility in Melbourne.

Given the multitude of challenges that must be overcome to protect bearing surfaces in heavy machinery like excavators, if a grease is to perform well for an extended period of time it must have a number of weapons in its arsenal.

Firstly, it must have the ability to withstand high wear, shock and shear loads under extreme pressure.

The ASTM industry standard test for these attributes is referred to as the Four-Ball test, where three stationary stainless steel balls are coated with the lubricant to be tested and a fourth, non-coated, ball is pressed into the centre of the other three under various loads while being rotated.



A Fuchs Renolit CXS GSM grease cartridge.

Measurements of surface scarring and wear under increased loads are taken under a microscope.

This is a gruelling test and the unique extreme pressure and anti-wear additive system in Renolit CXS GSM withstood over 800kg of force in the extreme pressure (EP) test with an extremely high load wear index (LWI).

Renolit CXS GSM is the grease that keeps giving, with no corrosion present on a steel panel covered with the product after 1000 hours in a 3pc salt water fog environment.

After scoring high distinctions in the lab, it was time to put Fuchs' new grease to work in the field.



Fuchs offers a comprehensive grease testing capability.

Renolit CXS GSM was applied to the slew rack and slew bearings of a massive excavator and after 55,000 hours, the bearing and rack were removed as part of the mining company's preventative maintenance schedule.

Upon inspection, the Fuchs representative noticed that the used parts showed very little wear or pitting even after 55,000 hours of use.

He asked the maintenance manager on site if he could take one of each bearing to demonstrate the excellent performance of the new calcium sulfonate grease but was told that he had a potential customer who wanted to buy them off the equipment dealer for further use.

High praise indeed.

The mining company also noted that the slew teeth still had good lubricant coverage prior to the slew rack being removed, thanks to strong adhesion and water resistance properties. Inherently high oil bleed resistance also greatly reduced drying and caking of the grease in the hot operating environment.

By delivering such outstanding results in lab and field testing, Fuchs' Renolit CXS GSM grease is already being referenced in the lube specs of major global OEM manufacturers.

Its performance in pin and bush applications has been outstanding and it is now recognised as a 'one-grease' solution for all heavy mobile equipment across the mine site.



The EX5500 hydraulic excavator.



Roller caskets.



The bearing raceway.



Bearing rollers.

MORE INFORMATION: Fuchs Lubricants (Australasia) Pty. Ltd. | 1800 1800 13 | www.fuchs.com.au

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German Technology developed for Australian conditions.



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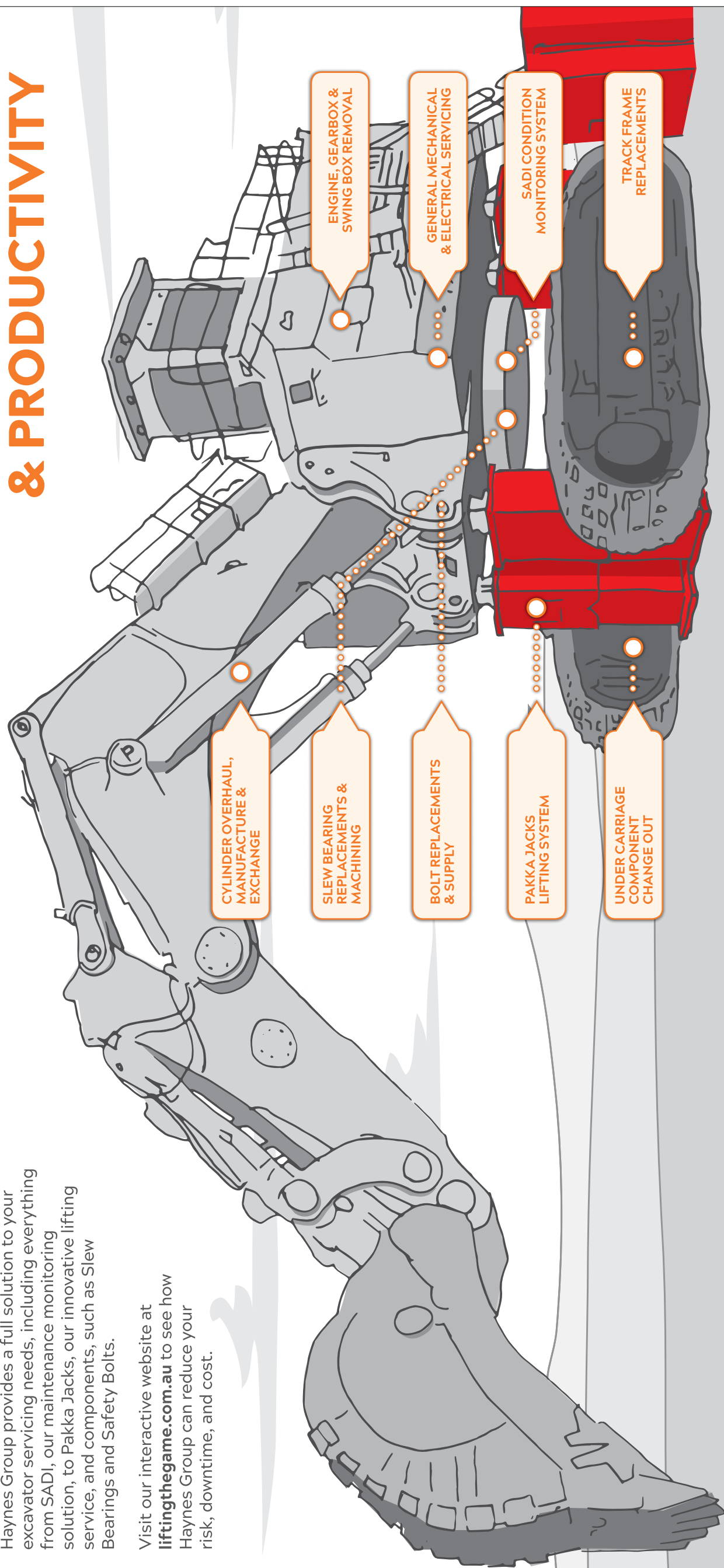
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Bearing witness

NATIONAL

MINING is a capital-intensive business with many millions of dollars invested in fixed and mobile plant dedicated to the extraction of a finite, income generating resource.

Be it gold, iron, lithium or any other mineable deposit, ultimately the size of the reserve is fixed and this can be given a value based on an agreed net present value (NPV). In simple terms, this represents the total income that can be derived from that deposit and every cost centre associated with extracting that material subtracts either capital or operating expenses from that value – diminishing the total profitability of the project.

It is little wonder then that managing one of the most significant cost centres, mine maintenance, is a science. Careful management of mobile plant can save tens of millions of dollars over the life of mine and new technology is constantly emerging to make that management more accurate, more timely and more cost effective.

Conversely, unplanned maintenance and breakdowns can rack up huge costs for both maintenance and production departments. This is most true for primary dig units, with unplanned downtime impacting production output and short lead-times often significantly increasing maintenance cost.

Primary dig unit downtime can also rack up down stream costs, with reliant haul trucks, forced to service other dig units - reducing efficiency or in the worst case sitting idle until the primary dig unit is up and running.



SADI has been specifically designed and developed as a predictive maintenance program to manage and reduce lifetime costs, risk of component failure and unplanned and costly maintenance downtime.

A new product from the Haynes Group delivers a clever and innovative approach to monitoring the wear in excavator slew bearings. These critical bearings can cost up to US\$600,000, can weigh up to 18t and measure up to 4.5m in diameter.

Consider also that if local stock is not available, these huge units require an Antonov aircraft to transport them internationally, adding another US\$1m plus to the change-out cost and a week's additional downtime. Unsurprisingly, mine maintenance managers have the responsibility to monitor the condition of these bearings at regular intervals.

The Haynes Group's revolutionary SADI system allows slew bearing wear to be measured, quickly, safely and remotely, via a linked tablet. Measuring both radial and axial deflection simultaneously, and in two locations, the entire process takes less than 30-minutes, so disruption to production is minimal.

Traditional methods for measuring bearing wear are often carried out under live testing, with maintenance personnel in the line of fire, using dial indicators to take measurements and radios

to communicate with the operator. Operated via tablet, the SADI eliminates live testing as the technician conducts the test from inside the cab, sitting right next to the operator. Viewing the deflection measurements in real time, the SADI technician provides real-time feedback to the operator improving test precision.

Using accurate deflection measurements, maintenance teams can easily monitor slew bearing wear and plan slew bearing replacements. In use at various locations throughout the world, SADI's analytical capabilities provide maintenance departments with increased insight. For example, a single machine's wear, compared to a larger sample set can be used to better predict failure or identify a bearing fault.



SADI is a live system that allows slew bearing wear in a machine to be compared against its own work history or against other machines from around the world.

By plotting this bearing wear and displaying it graphically, maintenance staff are able to make critical maintenance decisions with confidence, based on solid data.

The strength of the SADI database is continuously growing and with this growth comes increased confidence and data insights.

Bearing wear statistics and trends can be compared. For example, the effect grease has on slew bearing life, commodity impacts (iron ore vs coal) or even impact overburden vs commodity can be examined.

From this, accurate slew bearing life cycle models can be created, allowing maintenance teams to maximise slew bearing life and minimise the risk of failure. Because SADI is an interactive tool, it can be used by both maintenance and commercial teams to predict fixed cost and risk points.

How it works



It is little wonder that SADI is being adopted by mining industry leaders in Australia. Its use allows excavators to be monitored more closely and run less risk of unexpected downtime. More accurate control of maintenance costs translates directly to increased profitability and happier shareholders.



Pakka Jacks provide the ultimate safe working environment for heavy lifting jobs – rated at up to 2000t each.

Jacks system a game changer

CONVENTIONAL repairs on heavy equipment normally involve cranes, enormous suspended loads, significant downtime and potentially dangerous situations for personnel. By eliminating suspended loads, the Pakka Jacks lifting system is a game changer for mining and construction operators, reducing downtime and ensuring the safest lifting solution available in the market.

What differentiates Pakka Jacks' from traditional jacking or lifting methods is the patented screw-based packing mechanism, which enables the load to be fully supported throughout the entire lifting process. Other systems use pins or a ratchet-based packing system, which means that packing is only available at fixed positions and critically, during the jacking process, the load is not always packed. Pakka Jacks' packing system allows infinite height control and thus can follow the load throughout the lift, insuring personnel are never exposed to suspended loads.

Once lifted, the jacks then perform their second critical role as equipment stands. With systems fully rated up to 2000t and certified to Australian standards (including side loading), the operators and maintenance personnel are always safe and don't have the traditional limitations or risks associated with working under suspended loads.

In a mining operation, managers are often put in the position of balancing safety concerns with cost and time frame constraints. With Pakka Jacks this is not the case. Real-world case studies have demonstrated significant downtime reductions and huge cost savings. Pakka Jacks truly is changing the way heavy equipment is repaired and maintained.



The Pakka Jacks system delivers fast and safe outcomes for major component change-outs in a unique way that is guaranteed to save money.

Using Pakka Jacks gives maintenance staff the ability to achieve the same results as traditional methods with less workers, in much less time and without the use of multiple cranes. These revolutionary jacks have already proven themselves as Haynes has completed over 200 Pakka Jack projects, including slew bearing, track frame and even complete undercarriage replacement on mining class excavators and shovels.

These major component change-outs have

delivered reduced machine downtime, cost reductions and all without a single lost time injury. Currently, there is no solution in the world that can match the speed or safety that Pakka Jacks can achieve.



Pakka Jacks use an automatic packing mechanism that fully supports loads up to 2000-metric tonnes at every stage of the lift.

The Pakka Jack system use a synchronous lift computer automating all critical aspects of the lift for loads up to 2000t. Completing a lift plan for every project, Haynes' personnel can easily pick up any loading issues comparing actual jack loads from the lift computer to loads calculated in the lift plan.

Making the most of machine down-time, the lift plan provides the confidence to conduct additional work scopes while the machine is jacked. For example, operations such as engine removal, hydraulic pump removal, swing motor replacement and general servicing can all safely take place in conjunction with slew bearing removal, as the Pakka Jacks provide adequate clearance under the machine for these processes to take place. By allowing multiple maintenance procedures to be performed during a single stand down period, costs are reduced and it is possible to create scheduled maintenance plans to make the most of this time-saving potential.

The Pakka Jacks system meets or exceeds the requirements of all relevant Australian standards and workplace regulations and is the only lifting system that meets current Australian Workcover regulations.

Haynes Group's maintenance personnel can also offer a wide range of maintenance and repair solutions using specialist component change-out equipment and jigs, as well as machining of bearing surfaces, removal, repair or replacement of slew bearings, tracks, and any unplanned or required maintenance, whilst the unit is stood down and elevated.

MORE INFORMATION:
Haynes Group
(07) 3426 3804
www.haynesgroup.com.au

Call to arms

NATIONAL

THE best tools in the world are usually designed by people who see a need to improve the efficiency or safety of their own job.

Nivek Industries' ingenious new Lift Assist 40 tool manipulator arm is the perfect example of a workplace solution based on real world experience.

It was designed and built in Australia by Nivek's founder Kevin Cant, who was a maintenance fitter for several years.

The tool manipulator is designed to take the weight out of a wide range of tooling, including rattle guns, impact drivers, pneumatic torque guns (including Rad and J-guns,) air sanders and more.

Its 40kg SWL capacity allows these heavy tools, which can be in use for hours at a time, to be suspended by the LA-40 arm, relieving this strain from the operator.

Holding and using a heavy rattle gun is much more physically demanding than just using the

gun, hence the LA-40 was designed to reduce fatigue and improve productivity every shift.

A closer look at the arm's design reveals the degree of in-house R&D and onsite consultation with some of the country's leading mining companies, that led to its final configuration.

Requiring no pneumatics or hydraulics in its operation, the LA-40 relies solely on clever spring design to give enough strength to hold 40kg firmly at 1070mm of horizontal extension while also allowing easy, smooth and controlled repositioning by its operator.

That repositioning can be made in six planes to

provide a full 360° circle of movement: forwards; backwards; vertically; horizontally; pitch; yaw and roll. Roll is achieved with the addition of the Gimble Mount attachment.

A good tool is one that can be quickly employed and is easy to use – that's simply human nature.

To ensure that the LA-40 arm will never be retired to the 'too hard' basket, Nivek developed a quick-change tool coupling.

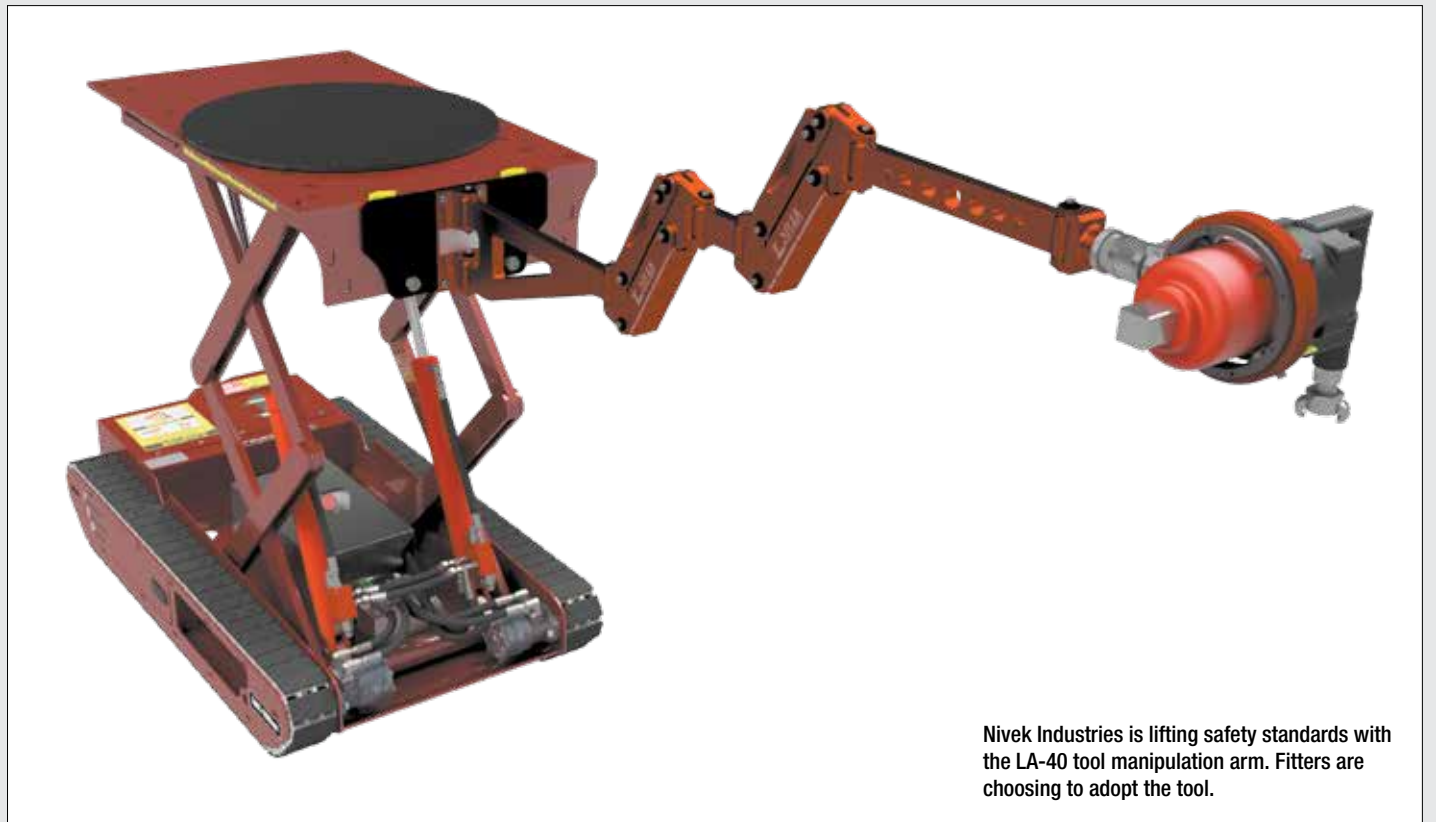
When another tool is required, the operator simply backs off a locking thread and slides a spring-loaded collar down (just like removing an

air tool from an air hose) and then clicks and locks the next tool into place. Hence, a tool change can be done in seconds.

Much of the design input from mine staff was related to workplace safety.

The goal was to keep fitters' hands safe at all times and keep fingers out of pinch points.

Once again, this is where the subtle genius of the design is apparent. All points of articulation actually force fingers out of pinch points, while internal stoppers prevent the independent spring-loaded sections of the arm from closing fully – eliminating another potential area of risk for the operator.



Nivek Industries is lifting safety standards with the LA-40 tool manipulation arm. Fitters are choosing to adopt the tool.

TED's your best mate for plant maintenance....

With an increasing range of versatile attachments, TED can help remove and fit most mechanical components from a wide range of plant machinery. With a SWL of up to 800kg, TED can help take the weight of:

Belly Plates • Steer Cylinders • Cutting Edges • Y-Links • Sumps • Pumps • Sound Suppresion • Sole Plates • Load Rollers • Stands • Tie Rods • Spindle Caps • Bucket Teeth




Let TED and the LA-40 lift your safety standards



- Remote Controlled
- Self Propelled
- Hydraulic Power
- All - Terrain
- Safe
- Efficient
- Versatile
- Durable
- Reduced manual handling
- Australian Made

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www.nivekindustries.com.au



Jess uses TED and the LA-40 arm regularly. “Nivek should be proud of the quality of their products. The range of movement and smoothness of the arm is really impressive and allows me to work smarter, not harder,” she said.

FAST FACTS:

NIVEK INDUSTRIES LA-40 ARM

- SWL for tooling up to 40Kgs
- Horizontal span - 1070mm
- Vertical suspension range - 700mm
- Six points of articulation - full 360° circle of movement
- The sixth degree of movement can be achieved with the addition of the Gimble Mount attachment.
- Quick release tooling coupler available – set up many tools - attached and released in seconds.
- Easily replaceable components
- No power or air required for operation
- Cutting-edge attachment tool available - cutting edge maintenance

Fitters love the time and labour saving aspects of TED and the LA-40 arm.



The 1070mm reach of the LA-40 arm enables fitters to loosen 11 nuts on the cutting edge of this D11 dozer without needing to move the TED machine.

As a result, there is no need to shield any of the joints for safety or durability reasons.

Most importantly is the critical safety benefit of keeping fitters' hands out of the crush zone - especially whilst loosening and tightening nuts and bolts.

Because the LA-40 arm was built by a mine maintenance professional, it was made tough for mining and earthmoving environments.

Its articulation points will not stiffen or bind in dirty, greasy environments, so it will keep working - shift after shift - as another valuable member of the crew.

With an effectively simple design, the LA-40 is easy to maintain, durable, and affordable. It enables every pit and workshop, regardless of size, the capacity to keep their fitters safe and with reduced levels of fatigue for greater productivity.

Although the arm can be mounted to any vertical surface via the four-bolt plate, its greatest ally in the field is TED – Tracked Elevating Device.

When mounted to this mobile work platform, the LA-40 arm can be used almost anywhere as TED provides greater access to confined or elevated jobs.

Nivek Industries created TED - a masterpiece of engineering - to make belly plate removal faster and safer for fitters.

Many injuries and even fatalities have occurred from dirt-laden belly guards slipping and crushing workers.

This incredibly versatile product was also designed and built by Nivek in the Hunter Valley, NSW. It has a SWL of 800kg, can lift from just 315mm off the ground and raise to 1200mm.

TED is the answer to a fitter's prayers. It is remote controlled, so it can be operated from a



The LA-40 arm makes tools up to 40kg in weight light enough for one-handed operation and significantly reduces operator fatigue. It also keeps hands out of pinch and crush zones.

safe distance.

It is powered by a rechargeable battery and does not require external air or power when it is in operation.

The tracks allow it to travel over all surfaces and make removal of belly pans in the pit safe and fast.

TED even has its own removable grader blade to quickly level a pad on which to safely operate.

It may have been built for a specific role but TED's repertoire is expanding all the time.

When it comes to moving heavy stands under large machinery, the fork tines or rhino attachment make easy work of it, with the adjustable forks capable of lifting 200kg (or 400kg when a rear counter-balance weight is added). These front-mounted accessories are quickly detached with two pins for fast turnaround.

Up top – on the table top – TED has a bearing-mounted turntable, that makes it quick and simple to bolt up a range of top-mounted accessories. Special cradles are available to handle cylinders of all types – especially heavy hydraulic rams.

When it comes to ground engagement tools, TED has that area covered too, with a cutting-edge tool specifically designed to hold, angle and align heavy grader and dozer blade edges. It's a job that can now be done by a single operator in most cases.

Just when you thought there was an end to TED's talents, Nivek has also released a sump tray fitting that can be fixed at a variety of angles to match the bottom profile of almost any sump pan.

Once angled and locked, TED's tray provides perfect support of the sump after the last bolt is removed, without the need for potentially dangerous chocks.

Re-installation is also made far easier as the already positioned sump can be lifted vertically into place against the engine block.

Optional extension blocks are available which enable TED's work height to increase to 1800mm. This is ideal for applications such as steering rack removal, where TED can be lowered to only 315mm, driven under the vehicle, the blocks added and then lifted up to 1800mm to support steering components higher than 1200mm off the ground.

When it comes to practical, field tested design, durability, tough construction, fatigue mitigation, productivity enhancement, OpEx cost reduction and full safety compliance – TED and the new LA-40 arm tick all the boxes. These are truly innovative tools that have proven themselves every hour of every shift and they are Australian made.



The Lift Assist's tough spring technology is ideal for some of the harshest mining and earthmoving environments.

SOURCES:

Nivek Industries | 0418 517 359 | www.nivekindustries.com.au
WA Equipment Placement | (08) 9479 4988
QLD Tefol | (07) 4960 4805

Get a grip

NATIONAL

ACROSS Australian industries, slips and falls account for more than 30 per cent of all lost time injuries.

While most of these are soft tissue injuries, they can result in broken bones and even fatalities. The cost to mining companies is substantial - with lost productivity, the need for replacement labour, potential fines and interruptions, not to mention the personal cost to employees.

The challenge is finding the most effective anti-slip solution that works in different areas around the worksite: from ladders to stairways and metal grate walkways, and basically, any location where a change in height presents a risk.

The seemingly innocuous checkerplate surface, for example, can become treacherous when it's covered with an invisible film of water or oil.

Furthermore, many commercially available anti-slip products simply don't cope with the harsh conditions experienced in Australian mining.

From the ice and snow of Tasmania to the blistering heat of the Pilbara, anti-slip products must be able to handle the thermal contraction and expansion from their substrates as temperatures swing from below zero to well above 45°C.

Vigil Antislip's unique proprietary manufacturing process utilises the highest quality



Custom-made metal deck panels installed on a mining excavator.

raw materials, to deliver optimal performance in Australia's diverse conditions. All of their products are made in Australia and are despatched daily to distributors and customers nationally and around the world.

Vigil Antislip's industrial range includes stair nosings, metal deck and ladder rung covers in standard sizes for both fixed and mobile plant and onsite applications, plus cleats for gratings and conveyor walkways.

The firm also supplies custom sizes, tailor-made to meet specific requirements. Unlike many cheaper imports, Vigil Antislip is built to last and their Class 1 products are backed by an iron-clad 10 year warranty - with no



Eye-catching tiger-striped stair nosings instantly highlight potential hazards.

restrictions.

This guarantee is due to the high quality of the workmanship involved and the floating fabric membrane that allows for thermal expansion inequities between the substrate and aggregate-embedded resin surface.

Foundations include 1.2mm AM100 Colorbond steel, 1.2mm 316 stainless steel and aluminium, and there is a range of colours and aggregates available. In addition to the Class 1 range, Vigil Antislip caters to price-sensitive markets where short-term cost implications outweigh long-term security.

Class 2 products offer excellent value,

look identical and have the same Colorbond foundation (three-year warranty).

Class 3 galvanised steel nosings and metal deck come with a one-year warranty and are typically used for grating panels, platforms and walkways. Proudly celebrating 30 years in Australian manufacturing, Vigil Antislip has earned its international reputation as a market leader, supplying safety products to mining and other industries throughout Asia, the Middle East and Europe.

Vigil Anti Slip's operations in Houston, Texas support resource industries throughout North, Central and South America.



Safety for offshore oil rig workers.



Flex Deck creates stability on drill strings and uneven surfaces, rolling up when not in use.

MORE INFORMATION:

Vigil Antislip | (08) 9434-4773 | www.vigilantislip.com

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Jet stream

NATIONAL

WHEN plant and equipment is not in operation, the costs of that idle time add up dramatically.

There are a number of reasons why machinery and equipment are not actively involved with production during the life of the mine and one of those reasons is the wash down process.

Maintaining expensive gear is imperative but with the estimated hourly cost of a single dump truck coming in at around \$3000 per hour, the true cost of taking time out to clean it may not be instantly apparent.

Factor into this the labour costs to wash these behemoths and add multiple trucks to the equation and the real cost of this cleaning time can run into tens of millions of dollars over ten years of production.

When confronted with such significant expenditure, the technical, financial and practical aspects of designing a washdown system take on new significance.

When you consider this example, saving just 10 minutes in wash time on a single truck represents a cost saving of more than \$500.

So, commissioning a smaller wash area with fewer, cheaper and less efficient water cannons can be false economy. A well-designed system that cleans more efficiently and faster will pay for itself many times over.

A typical wash bay for trucks the size of a Cat 785 or Komatsu 830E, used for quarry style operations, may only require a single level of water cannons and may only require one cannon per side. Bigger operations may have four cannons – one per corner – to make it easier to clean the all-important area between the wheels.

Other variants include multiple level setups with up to 12 cannons. This system allows effective cleaning of the chassis down low, while the upper cannons are closer to the tub of the tray and allow this critical area to be thoroughly cleaned in the shortest possible length of time.

I-beam rails on each side of the bay can be employed to allow one or two cannons to slide back and forth on a trolley mechanism, giving full access but keeping capital costs to a minimum. Often there is a low and a high beam on each side to give better coverage on larger vehicles.



A high quality water cannon mounted on an I-beam rail. When correctly matched to a system's pressure and water flow, it will give many years of reliable and efficient service.

With custom designed systems, there is the luxury of starting with the optimum water jet nozzle and designing the rest of the system backwards from there. However, in reality, it is often necessary to retrofit a more efficient nozzle to an existing pump and piping configuration to improve wash down performance.

Nick Foran from Fire Response has been designing and improving the efficiency of wash pads in the mining sector for many years.

"The trick is to match the orifice size of the water nozzle perfectly to the volume and pressure characteristics of an existing system," Nick said. "We need to establish what the pump is doing and that means taking some baseline readings first."

A dedicated test kit is used to take performance readings of the system's hydraulics.

From those readings it is possible to make some calculations and select the optimal discharge nozzle.



(CONTINUED OVER)

High volume and the correct operating pressure is the key to removing dirt as quickly as possible without breaking anything.

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(CONTINUED FROM PAGE 85)



Without an optimal nozzle and stream shaper, the water stream begins to break up very close to the outlet and reduces its effectiveness to move heavy or caked-on debris.



Fire Response has fitted its test kit to this cannon to establish a baseline reading of water flow and pressure. From there an optimum nozzle and stream shaper design can be selected to make the cannon as efficient as possible.



After fitting the best nozzle for the application, the water jet is capable of shifting the largest rocks and dirt at distances well over 15m from the cannon. This is a multi-cannon, remote controlled wash bay.



Some applications require a conical spray for a water deluge with minimum impact.

The key factor is to manage the velocity of the water so as not to break things – low velocity water will not break glass or force its way into the electric wheel hubs of a Haul Pac.

Keeping the water stream solid for as long as possible once it leaves the nozzle orifice is the secret to maximising cleaning efficiency and minimising collateral damage.

A design feature called a stream shaper must be incorporated inside the nozzle before the exit orifice. This important section uses offset fins to reduce water turbulence, acting like a laminar flow element in the intake system of an engine.

Straightening the flow gives the water jet its reach and therefore makes it more effective at moving dirt at longer ranges.

Nick had one instance where a particular wash bay cannon was incapable of moving a 150mm diameter rock at 3m but once a suitable nozzle was installed with the correct stream shaper inside, the same rock could be blasted with ease at nearly 19m. Science at work.

While shifting dirt as gently as possible is always the objective, it is not always possible, especially in tough areas like the tray tub where loads like iron ore or clay can be compacted like rock.

In these instances, the cannon must be designed to act like a chisel and be capable of shifting even the most consolidated residue.

Higher pressure is required to complete this work but the trays and bodies must be completely clean as material hang ups can create serious risks to personnel.

In conjunction with industry, Nick has also developed a cost comparison calculator (visit: http://australianminingreview.com.au/docs/19/04/Akron_Brass-Washdown_Facility_cost_saving_calculator-30-minute-wash.xls), which enables mine maintenance managers to enter details of their fleet: number of trucks; cost per hour; wash interval times; wash duration times and wash labour costs.

This makes the task of costing an appropriate wash bay easier because the true total cost of all wash time for the entire fleet can be established over the life of mine.

Essentially, if a company uses a single cannon to clean a large truck and that takes three hours, the real cost of that wash could be as much as \$12,000 in idle time alone. If a suitably designed system is constructed with a higher initial capital expenditure but that new wash bay has multiple cannons that can bring wash time down to 20 minutes, then the operational expenditure for each wash is reduced by \$10,600, all else remaining equal.

Multiply this saving by a fleet of 20 trucks over a mine life of 20 years and the savings run into tens of millions – far exceeding the initial higher cost of constructing the more efficient wash bay.

With the right science, the right design and the right financial model, it is possible to add millions of dollars to the bottom line of a mining operation by reducing wash times and increasing productivity.

It is easier to save a dollar than it is to earn one. A good wash bay is a proven income stream.

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The Hydrowash system is portable but semi-permanent and captures all washdown waste.

Down and dirty

QLD

WHEN the world of science is allowed to work with a clean sheet of paper in any industry, the usual result is new technology, cost savings and an environmentally sustainable system.

This is exactly the case with two separate but interlinked technologies in use in the mining industry today by Downs Wash Downs (DWD), based in the Darling Downs region of Queensland.

Modular magic

The first of these exciting products was developed for the US military, oil companies and mining companies and is essentially a portable washdown bay that not only captures all the solids and grease washed from even the hugest machine, but also cleans and recycles the water for re-use.

By huge, we mean huge - from M1 Abrams tanks to haul trucks, excavators and dozers.

The Hydrowash, as it is known, has been crush-tested to withstand more than 70-tonnes per axle.

Just because the pad can wash the biggest of the big, that doesn't mean it has to, because it can be designed and custom built to suit any machine - down to a golf cart - as required.

DWD has its own portable Hydrosite that fits onto two trucks and can be transported anywhere in the country.

It was recently used in the middle of the desert in South Australia to wash military equipment for the Army during manoeuvres.

The pad's sections are modular and the whole system can be set up in about half a day. The recycling system is fully automated and only requires water and a genset to operate.

Once mud, dirt and grease are cleaned from the dirty equipment, the watery slurry falls into a gutter in the lower section of the Hydrowash before falling into a sump.

From there the dirty water settles over two weirs, and then is pumped and filtered back to the main recycle tank for re-use.

The mud and captured debris collected in the sump and can then be removed.

With its modular design, the Hydrowash can be transported on a truck or in a container and

assembled at even the most remote location. Just add power and water and it is good to go.

In addition to having its own portable Hydrowash, DWD is the Australasian agent for Hydro Engineering, which is based in the United States.

DWD designs, sells and installs these portable wash pads for use in the mining and construction industries.

These can be assembled in a fixed location and used just like a regular concrete wash bay, or they can just as easily be demounted and loaded onto a skid or into a shipping container and moved to another part of the site or wherever required.

Biodigesters

DWD is also the agents for a remarkable product that could just be the Don Bradman of environmentally responsible waste water management.

Hydrokleen is a bioreactor that can be used in conjunction with the Hydrowash's water processing system.

Hydrokleen uses biodigestive bacteria, enzymes, nutrients and dissolved oxygen to reduce organic contaminants such as grease, oil, fuel, coolants, soap and plant wastes.

The bio-bacteria literally consumes these pollutants and is as effective as a heavy-based chlorine but without the environmental hazard.

The principle is similar to the operation of a septic tank, where the freeze-dried or liquid forms of bacteria are added to water, with suitable food, to start cleaning the water of all contaminants.

From there, the biodigesters will start to turn waste water into good re-usable water. According to DWD, the process is so effective that it will completely consume an oil skim on surface water, out-compete all nasty bacteria and algae and even eliminate bad odours.

Developed in the US as an alternative to chlorine for military applications, this totally environmentally friendly treatment of waste water not only does the right thing by the planet, but also removes the risk and associated penalties of spilling untreated wash bay water onto the ground. Once processed through the Hydrokleen system, the wash water is suitable for reuse or sewer discharge.



The Hydrowash is modular and can be transported to any location.



The Hydrowash has been crush-tested to over 70t per axle to handle even the biggest equipment with ease.

These remarkable bacteria can live in suspended animation for up to 12 months in their container as there is food inside for them to consume while in hibernation.

They can also be safely transported around Australia or the world to any site and it only takes a cup a day to keep a system in perfect health.

This is the perfect solution to the environmentally-conscious eradication of toxic washdown water. Biodigesters are the way of the future.

DWD's core business is washing and inspecting machinery for biosecurity reasons.

The company conducts washdown inspections throughout Australasia.

Clients include oil and gas companies, mining companies, the agricultural sector and the Defence Department.

This vital work prevents the spread of noxious weeds, which are affecting water ways, pastoral land, stock routes and cost the government billions of dollars every year in Australia.



DWD's Hydrokleen system uses live bacteria to digest washdown contaminants such as grease, oil, fuel, coolants and soaps. The processed water can be reused or safely discharged into the sewer.

Custom clean

WA

OEM Group has more than 60 different mobile washdown units available, and with their in-house design, engineering and fabrication teams are kept busy tailor-making custom skid and trailer-mounted pressure cleaners for customers throughout Western Australia.

Mine sites have such an array of machinery and equipment that require cleaning and maintenance on a regular basis that sometimes a custom-made pressure cleaning combination is required.

OEM Group can design and manufacture purpose-built trailers, with various configurations and specifications to suit each site's requirements.

Features may include hot or cold high pressure cleaners typically between 3000 to 5000psi, water tanks from 500l to 3000l, hoses from 30m to 100m, and lockable storage containers, all mounted on tandem axle trailers with off-road tyres.

As OEM Group also manufactures Safety Access Platforms, it was only natural that it should incorporate a ladder and platform option for their trailers.

The platforms are built to full mine spec and incorporate safety handrails between 900-1200mm high.

The platform option provides excellent reach when washing large machines, saves time and eliminates the need for a separate elevated platform.

Due to the size of the platform's area, it also makes a handy spot to mount a chemical storage container for those extra-tough cleaning jobs.

When it comes to dirt-shifting power, the name of the game is heat.

Genuine, Australian-made Spitwater pressure cleaners are used exclusively across the OEM range.

There are a number of quality hot wash units with diesel burners and full external bypass systems, that can produce outlet water temperatures up to 90°C at full flow.

The hot water is ideal for breaking down grease, oil residue and baked on grime — combine that with a chemical injection system and the result is a serious tool for fast and efficient wash downs. For cleaning baked-on mud, high water flow is king.

Spitwater makes a range of hot-water and cold-water pumps that deliver great water volume, with their 21 and 30l-per-minute models being most effective for the removal of stubborn red mud and clay. It is key to match the cleaner to the type of equipment to be cleaned in order to produce a better result in less time.

With 25 years' experience working with mining customers across the length and breadth of this country, OEM Group has developed a wide range of fit-for-purpose custom accessories to perform very specific roles.

For instance, there are the aerating lances that extend the range of a water stream to reach higher or harder to reach areas.

If reach is the main issue though, then there are also extendable lances up to 7m in length.

Short, long, curved and rollover lances are all available, as are foaming systems and dedicated undercarriage cleaners.

OEM Group not only sells these quality Australian-made pressure cleaners, it also offers

short and long term hire, including fully maintained hire packages.

With agencies in Perth, Karratha, Port Hedland, Kalgoorlie and throughout the Southwest of WA, providing sales, service and spare parts, it is able to service customers in a timely manner.

So, no matter the scale of the operation or how remote the location, OEM is happy to visit.

OEM's proven, fit-for-purpose solutions reduce downtime, improve safety and optimise productivity.

Speak to an OEM Group team member today to discuss your specific requirements.



Fully self-contained hot and cold pressure washing units are also available mounted on skids.



OEM Group offers tandem axle trailers with a built-in safety access platform for easy access to large equipment and big time savings.



A platform fitted to the Workmate Hottie provides a great place to mount a chemical storage tank. This trailer also features lockable storage boxes.



Single axle trailers are highly manoeuvrable and more compact than their tandem axle stable mates but still deliver big cleaning power on site.

MORE INFORMATION:

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Containment policy

NATIONAL

NOT all washdowns in the mining industry involve 100t juggernauts.

There is also a need to clean hand tools like trowels, brushes and rollers. However, just like the waste water that runs off a Haul Pac, the dirty water created in the washing of hand tools must be dealt with responsibly and in full compliance with all environmental standards.

Gone are the days when environmental responsibility was remembering to cover over the hole the waste water was unceremoniously dumped into.

It is no longer legal to tip untreated waste water into the sewers or directly into the ground.

So, how do workers deal with dirty water created by washing tools with water-soluble contaminants and remain environmentally aware and compliant?

Some attempt to use buckets, remove the offending water from site and then disposing of it elsewhere (hopefully not down the drain).

Others opt to store it on site in 1000l cubes but are forced to pay between 25c and 75c per litre to have it removed.

That expense adds up in a hurry over a long project – especially when a single brush can use 30l of water to clean it properly.

Still others take their tools away and wash them off site; not ideal when paint, plaster or cement has dried solid by then.

A slightly more advanced system uses 44-gallon drums to create a weir that allows some settling of heavy solids but it is not efficient, does not have any filtration, pH control, or means of extracting metal or hydrocarbons.

The main drum must also be manually cleaned regularly.

It is interesting to note that in the eyes of the law, waste is owned by the principal contractor – ie: the mining or construction company.

They are responsible for the disposal of all waste – regardless of how and where it is dumped – and can receive fines in the hundreds of thousands of dollars for offences unwittingly made by their contractors.



The Washbox is a self-contained washout system that operates in a controlled environment and does not discharge waste water.

Washbox is born

Back in 2006, Andrew Crimson saw the need for a self-contained washout system that operated in a controlled environment and did not discharge waste water.

Washbox is the remarkable product that was born from that vision and it successfully removes all the worry from waste water created by washing tools.

Each Washbox unit holds 600l of water and can be placed on any level surface, anywhere on site – in a work shed or on the 30th floor of a building.

All it needs to function is standard 10A, 240V power.

Once plugged in, the internal pump supplies an array of nozzles which produce a controlled, knife-like washing system to easily and efficiently clean any tool with water soluble contaminants.

The tradesperson simply picks up the nozzle and pulls the trigger to start the jets.

Immersed in the wash bay is a perforated wash tray that catches all particles greater than 5mm – which can safely be disposed of in a skip bin.

Particles smaller than 5mm pass through the mesh and are immediately dosed with a coagulant that binds them together and speeds their decent to the bottom of the tank.

The unique part of this process inside the Washbox is that it occurs in real time. Dirt and solids separate from clean water and fall to the bottom, where they are automatically removed to the inbuilt filtration system.

Washbox is fully automated and PLC controlled,

which allows a daytime cycle and an overnight cycle to run automatically for optimum performance at all times.

In daytime mode, the system purges waste water from the holding tank into the internal filtration system.

This is a batch-operated system with a capacity of 400l, or enough for one and a half hours of constant washing.

Once the solids reach the high level, the PLC triggers a refresh cycle that puts clean water back into the supply tank and moves waste into the filters. In only 15 minutes, the Washbox is ready to go again.

In overnight mode, the PLC automatically runs a full refresh cycle so that the Washbox is guaranteed to be ready for action when the site gates open.

The holding tank will be completely empty and the maximum amount of water will be available to start washing.

The PLC also enables remote access to any Washbox on site and that means run times, number of trigger pulls, total time washing, amount of waste developed, volume of water recycled and even the number of litres of water used for top-up can be logged against time and sent as a report to the site manager.

Many companies use this valuable information as part of their corporate and social governance reporting.

The Washbox makes reports like this look great from an environmental perspective because a single unit can save more than 20,000l of water per month.

On a typical 20-storey building project, that can amount to a saving of up to 500,000l per year, a staggering volume of water.

Washbox is only available for hire and can be delivered Australia-wide. Once on site, it is fully serviced and maintained to guarantee full functionality all day, every day.

There is no control of the waste input on site, in fact, any water-based adhesive, plaster, paint or chemical can be safely disposed of in the unit. It is a true multi-trade, mobile cleaning system.

A technician visits the site regularly to manage water quality and ensure that there is no waste build-up inside.

However, the client needs to perform some simple daily duties to ensure that the Washbox runs smoothly.

The five internal filters need to be emptied to remove masonry fines, dirt, sand and other small particles. As these particles have consolidated in the filter bags and are semi-solid, they can safely be disposed of in a recycling or general waste skip.

Washbox is now available in the US via a new office in New York and will soon be in London and Singapore.

It has been successfully adopted by some of the biggest construction companies in the country like Lend Lease, Multiplex and Mirvac. It has wide application in the mining industry also, especially around construction projects and where finishing trades are on site.

When it comes to Australian innovation solving global problems, Washbox has proven its mettle for over 12-years and continues to help the environment and produce significant savings for businesses that must deal with waste water disposal on a daily basis.



The Washbox can be situated in almost any location – even 30 floors up – and only needs 240V/10A power and a top-up water source to be fully operational.



Some simple systems use 44 gallon drums to create a weir that allows some settling of heavy solids. However, these are not efficient, do not have any filtration, pH control, or means of extracting metal or hydrocarbons.

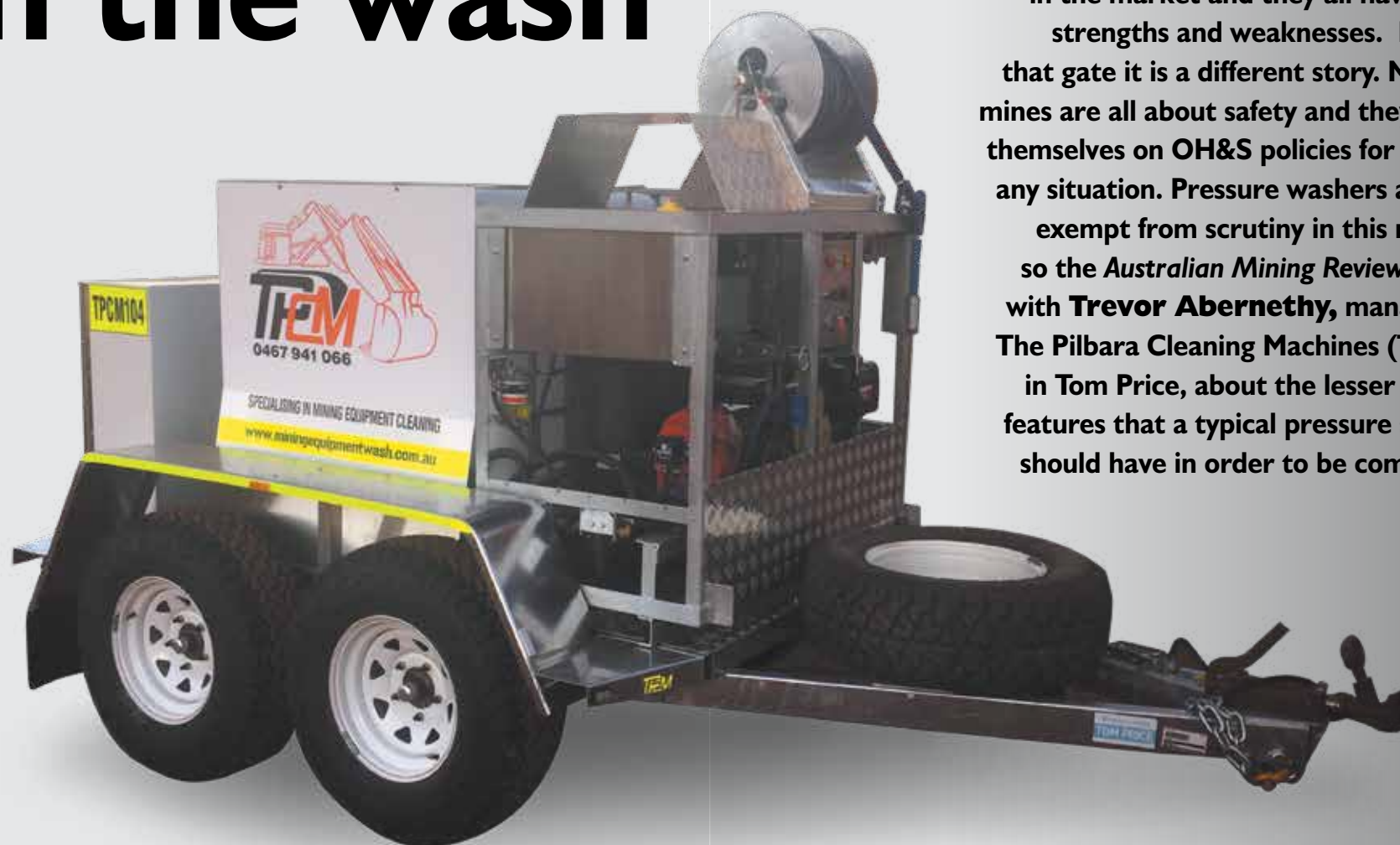


The Washbox holds 600l of water and features an array of internal filters that allow wash water to be recycled for significant water savings.



Due to its compact design, the Washbox can be located close to the job for faster turnaround of tools and greater productivity.

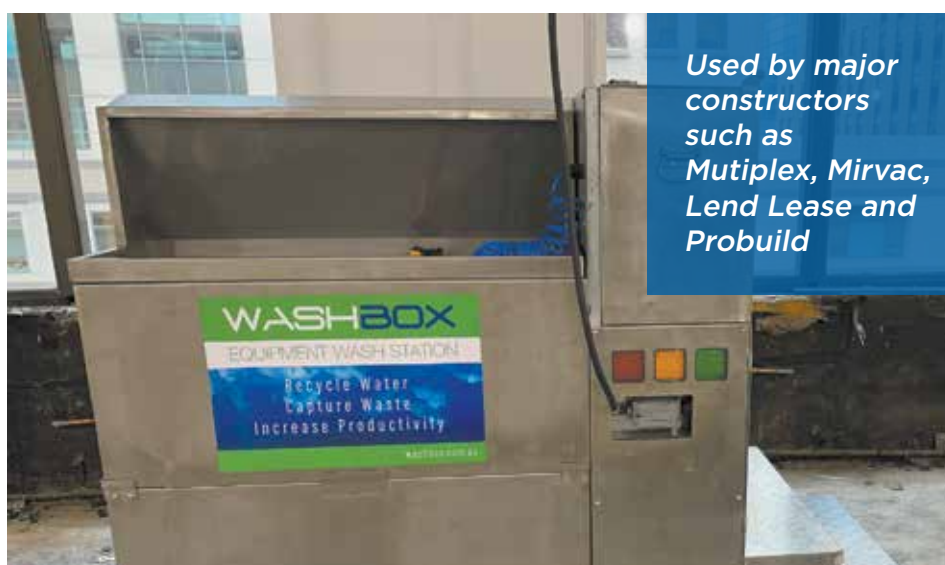
It all comes out in the wash



There is more to a mine site-ready pressure washer than first meets the eye.

Outside the mine gate, pressure washer manufacturers jostle for position in the market and they all have their strengths and weaknesses. Behind that gate it is a different story. Modern mines are all about safety and they pride themselves on OH&S policies for almost any situation. Pressure washers are not exempt from scrutiny in this regard, so the *Australian Mining Review* spoke with **Trevor Abernethy**, manager of The Pilbara Cleaning Machines (TPCM) in Tom Price, about the lesser known features that a typical pressure system should have in order to be compliant.

Used by major constructors such as Muxiplex, Mirvac, Lend Lease and Probuild



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WA

THE first feature is a zero-pressure by-pass system.

By installing a pressure activated valve into the water outlet side of the pump, as soon as the trigger is released by the operator a pressure spike causes the by-pass valve to open.

This recirculates water back through to the header tank and drops the pressure in the entire system to only a few psi.

Now, even if the lance was to be accidentally removed with the pump still running, there is no water pressure in the line, rendering it perfectly safe.

To be fully compliant, this by-pass valve must also be locked, this ensures that the pressures cannot be tampered with once set.

An added safety benefit of this system is that when the operator pulls the trigger to start washing again, the by-pass valve gives a soft-start as pressure gradually builds.

This eliminates sudden and unexpected kick-back from the gun, which has caused many injuries to date.

Another feature of fully compliant pressure washing machines is the couplings for the lances.

Conventional, pull-back, quick-release fittings (similar to those used in air lines) can be accidentally disconnected with dramatic results.

Imagine a 2m lance, cleaning a machine with 5000psi discharging from the nozzle. Picture that lance suddenly popping free of the coupling and being propelled forward like a spear with all that pressure behind it.

These accidents have and do happen.

To help mitigate this risk, pressure washers should be fitted with special disconnect fittings that must be twisted several full turns to separate the lance from the hose.

It is no revelation that mining equipment is huge and that means related consumables are also used in huge quantities.

Consider a large excavator.

The total waste washed off the entire machine can top three tonnes.

Now there is no way a cold pressure washer will shift all that solid grease and

residue in a timely fashion, so the best option is to go with a hot water washer.

Typically, these machines use a diesel burner to heat the water that can reach 100 degrees C at full flow, regulated by a variable thermostat. Some can be dialed back to actually clean with steam.

Problems can occur in hot washers if the trigger valve is damaged and the water is allowed to drizzle out, instead of being stopped completely.

By dribbling out, the diesel burner still senses water flow through the system and stays on, the problem is that there is too little water flow to bleed off the mounting pressure – despite the thermostat – and the end result can be a catastrophic explosion.

The trick here is to have a fixed thermostat that is set to a maximum of 70C, as is the case with all the ThoroughClean machines TPCM sells.

In the case of pressure building in the burner, a manual dump valve opens, allowing cool water to flow in, expelling the hot water.

This eliminates the risk of a ruptured boiler.

Another important feature of fully compliant mine specific cleaners is a spark arrestor.

This device is located inside the exhaust pipe and prevents glowing, red-hot carbon embers from being shot out of the pipe and potentially starting fires.

In the tinder-dry Pilbara heat, with fuel floating on water or in workshops strewn with oily rags, spark arrestors are a must.

Armed with this new information, many will see TPCM's fleet of 10 trucks in a new light.

They are all fitted with the same Australian-made, mine specific pressure washers from ThoroughClean.

However, some of the fleet have been re-certified to increase their GVM in order to carry their own water to jobs in the field.

This may seem logical, and it is, but it is not common.

The majority of TPCM's work in the far north of WA is focused on mobile equipment: diggers; drills and trucks.

Trevor says his team are trained to wash mobile gear and that it is certainly not a job for a rookie – especially when multi-million dollar machines with components worth



Professional results inside and out can be achieved with the right equipment and the right experience in the field.

hundreds of thousands of dollars are in the high-pressure firing line.

"Our guys take pride and ownership in their work and the end results speak for themselves," he says.

"We also specialise in cab detailing. It takes some time to get all the red dirt out of a cab but we can do it and it is worth the effort.

This boosts employee morale and job satisfaction but also now allows the employer to ask their drivers to take some ownership with their now clean work area."

A complete, professional clean inside and out is a good decision when it is time to sell off mobile plant. In dozens of cases, machines and equipment that have undergone this facelift have netted tens of thousands of dollars

more at the time of sale, more than covering the cost of the clean.

In addition to onsite cleaning, TPCM are also the Pilbara representatives for ThoroughClean and work closely with West Australian agents, Jasmine Enterprises Pty. Ltd.

In Perth, to service the North West and ensure all pressure washers shipped past the 26th parallel are mine-compliant.

They also hold a large amount of stock and spares in store at their Tom Price workshop. TPCM sell the full range of ThoroughClean hot and cold pressure washers and also have a number of trailer-mounted units for hire.

With company mottos like 'Quality is not expensive, it's priceless' and 'Over-engineered by design', it is obvious that everything comes out in the wash eventually.

MORE INFORMATION: TPCM | 0467 941 066 | www.miningequipmentwash.com.au

Spit and polish

QLD

FAR North Queensland is a rugged place with tropical heat, lashing cyclones and unforgiving terrain. It is also mining country, home to Evolution, Adani and a host of other producers with equipment that requires constant care and maintenance.

Part of that maintenance process involves wash downs but that good old spit and polish involves a lot of technology on a modern mine site.

Airless and Pressure Cleaner Services (APCS) is Townsville's and Far North Queensland's industrial Spitwater pressure cleaner and Graco Husky diaphragm pump specialist. Spitwater

pressure cleaners are Australian made and manufactured with high quality components like brass pumps and ceramic pistons.

Pressure washing options

APCS can build mine spec pressure washing systems to suit the requirements of an individual mine and an individual application. Whether trailer-mounted or skid-mounted, these large units all feature E-stops and dual or single battery isolators.

Depending on the site, the pumps can be fitted with a bypass valve and a break tank. Low pressure supply water fills the break tank first and this reservoir supplies the pressure pump.

When the lance's trigger is released, the bypass valve allows water from the pressure side of the pump to circulate through the 10-litre break tank and then back into the pump.

This recirculating process prevents the water from overheating in the pump head, turning to steam and then cavitating. Some of the larger Spitwater washers require a soft start, using the unloader/bypass valve system.

However, some operators on site prefer a hard start, with pressure to the gun at all times.

Hence the need to build a system to meet individual requirements, along with the correct hose, lance, nozzles and any other additional equipment.

The range includes hot and cold water pressure cleaners with electric, petrol or diesel power.

There are small, portable units and trailer or skid-mounted systems capable of producing up to 6000psi and delivering 50l per minute for



Mine spec washdown trailers can be custom built to suit individual requirements on site.

large cleaning jobs.

APCS recently upgraded its hire fleet, by introducing high power, diesel Spitwater pressure cleaners: trailer and skid mounted; hot and cold water; up to 5000psi and up to 23l per minute.

(CONTINUED OVER)



Spitwater's SW21200DE skid-mounted pressure washers offer hot and cold performance with 3000psi at 21l/m.

All the units come fully equipped, with a hose reel, a minimum of 20m of hose, a lance, a hand piece and nozzles.

Air-operated double diaphragm pumps

Air-operated double diaphragm (AODD) pumps have a unique place on the mine site because they are compact, have a multitude of uses and can be operated anywhere within range of an air compressor.

Their specialty is transferring liquids and materials that would seize or corrode a conventional centrifugal pump.

With housings made from polymers, coated aluminium and even ceramics, these pumps have a well-earned reputation as tough units in the field.



APCS also supplies the SW2021 portable 3-phase electric hot pressure cleaner with 3000psi at 21l/m.

AODD pumps, like Graco's Husky range, are positive displacement pumps.

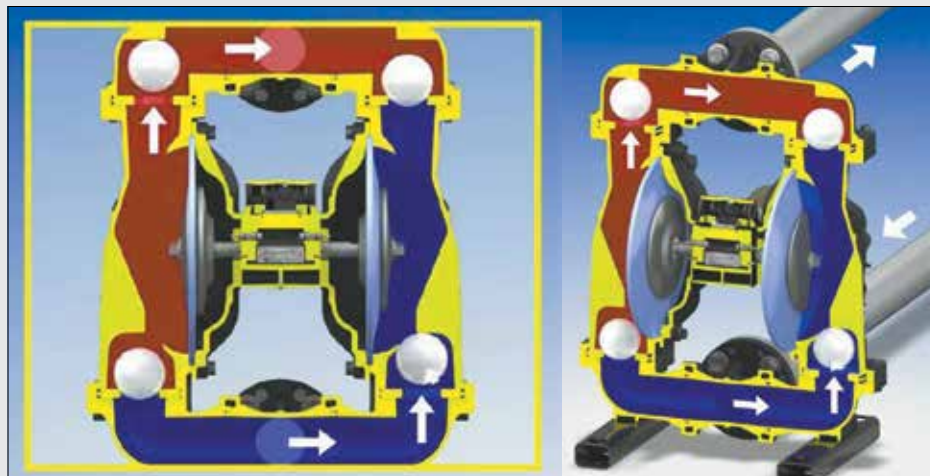
Compressed air is switched through an internal valve body via a link shaft and allows air pressure to be applied sequentially to the back of one diaphragm and then the next.

This back and forth motion creates a vacuum in one chamber – drawing fluid in from the pump's single inlet.

At the same time the link shaft pushes the other diaphragm outwards – pushing fluid out the pump's single outlet.

A series of ball valves limit fluid flow to one direction and the net result is a pulsating movement of fluid in and out of the pump through the oscillation of the link shaft operating reciprocating elastomeric dual diaphragms.

These Husky pumps have excellent suction



This cutaway shows the dual diaphragms and dual flow paths, in an AODD pump, that draw fluid from a common inlet and discharge from a single outlet. Ball valves regulate the flow direction.

lift characteristics and can handle rocks (up to 13mm in larger pumps), gravel, sludge, mud, fuel, oil, acid, solvents, detergents, waste water and almost any other fluid found on a mine site – regardless of viscosity.

Another amazing feature of these pumps is the volume of fluids they can transfer in such a short time from such a compact unit. Husky's 3300 unit can move 300gpm (1135l per minute) at a maximum pressure of 100psi (7 Bar) and still handle solids of up to 1/2-inch (13mm).

Consider the pumping power to empty a 1000l cube in less than a minute. Husky pumps can also be customised to suit the volume and characteristics of the fluid to be transferred.



Graco's Husky 3275 AODD pump can transfer an impressive 1135l/m at a maximum pressure of 100psi.

MORE INFORMATION: APCS | (07) 4774 6166 | www.airlesstownsville.com.au

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Show reel

Struggling with hoses in the workplace is tiring and frustrating. Manually rewinding hoses can require more than one pair of hands while trying to run out a hose to a job only to discover that the older spring reel's pawl will not activate is an exercise in patience. One company can solve your reel problem with the latest, safest technology.

The Australian made range of Pit Bull hose reels are hot-dip galvanised with stainless steel hubs.

NATIONAL

THE answer to these problems comes in the form of an Australian designed and built range of reels called Pit Bull.

These reels were specifically designed for mining applications and suit the transfer of air, water, oil, chemicals, fuel and are ideal for washdowns.

Internally, the drive system does not use chains or sprockets, which means fewer moving parts, less pinch points and increased safety.

Utilising Reel Tech's proven direct drive technologies, they provide stronger, safer rewind speeds with controlled torque.

The reels themselves are made from hot galvanised steel while the hubs are stainless steel for maximum resistance to chemicals and much longer life in the field.

Those hubs can be interchanged in minutes to allow a different hose diameter or fluid transfer to be used on the same reel.

Internally, there is a full-flow fluid path to minimise pressure and flow losses for greater efficiency.

it over the side of the reel, this ensures smooth, struggle free operation.

Rewind options include manual pneumatic, hydraulic and electric.

This can be upgraded to the Flat-Winder automatic hose layering system, also allowing true one-person operation.

Optional accessories like the Flat-Winder help



A four-way, swivelling hose reel roller-guide ensures smooth, struggle-free operation.

the hose track laterally as it moves in or out, and provides automatic layering technology for the tightest wrap on the hub to minimise injuries, reduce replacement costs from hose damage and increase productivity.

Flat-Winder works to synchronise with the reel's rewind speed and can be set for any reel width.

For those looking for the ultimate in single-person operations, response times and safety, there is the Reel-in-Control remote control option that has a single channel control at 915Mhz, with frequency hopping technology for reliable operation in undulating terrain.

Both government and private industries are now quantifying the pull force required to payout hose reel safely.

It has become an industrial safety issue in the mining, fire rescue, refuelling and cleaning industries to reduce the risk of operator payout fatigue or injury

from poorly-constructed or under-specified reels. Reel-in-Control meets all these new requirements to ensure the mine site is fully compliant.

When it comes to building modular or fixed wash plants, vehicle wash pads and accessories, Spray Nozzle Engineering has Australia's largest range of locally made and internationally recognised industrial spray nozzle designs available.

These nozzles have different flows, spray patterns and angles to suit any application.

They are manufactured specifically for all types of washing, environmental control, lubrication and spraying applications throughout the resource sector.

This range of nozzles delivers every conceivable water spray profile from high impact jets to knife-fans, flat fans, conical patterns, misters and foggers.

Each has been manufactured for a specific purpose and they can be combined to deliver a wash bay capable of correctly cleaning every aspect of a mobile plant.

Providing added flexibility are low-clog designs for mine water use.

For fixed wash bays, there is a range of swivel-jointed nozzles that can be easily moved to alter and fine tune the angle of spray without the need for expensive and time-consuming alterations to fixed pipe work.

Spray Nozzle Engineering has you covered for all large, medium and small vehicle washing, under-body and chassis cleaning.

Spray Nozzle Engineering also has a range of



CNC-machined spray nozzles provide a wide range of spray patterns, flow rates and water impact intensities to suit any wash-down application.

remote and manual water monitors and cannons from Stang Industries.

The manually controlled monitors have a standard tiller bar and only require a single, qualified operator. With 360 degree horizontal travel and vertical ranging up to 135 degrees, Stang monitors are perfect for direct control of the discharge stream. When supplied with a shaper-tip nozzle, they have long reach and extensive loft - perfect for large earthmoving and hard pack washdown solutions.

Also available are Spray Nozzle Engineering's high volume and mega foamers, designed to mix and deliver aerated cleaning foam over long distances, to a large area, in correct dilution ratios.

They are built for off-road vehicle cleaning.



Manual and remote-controlled water monitors and cannons are available with a variety of shaper-tip nozzles. Multiple cannons can be combined in a wash bay and operated remotely by a single user.

The remote-controlled monitors are used to flow large volumes of water and are controlled from a remote location.

These monitors can be stand-alone or part of a monitor network, with multiple units operated at once from a single control panel.

In such a configuration, they provide an excellent solution for fast and efficient fixed wash down bays or can be mounted on elevated work platforms for larger mining vehicles.

MORE INFORMATION:
Reel Tech | (03) 9583 2368
www.reeltech.com.au



A patented direct floating drive system allows the reel to be safely and quickly retracted with air, hydraulics or 12/24VDC electrics.

The Pit Bull range from Reel Tech, a member of Spray Nozzle Engineering group, has been designed to take the stress out of working with hoses all day. A four-way, swivelling hose roller-guide allows the hose to be deployed from any angle without pulling

MINERALS COMMODITIES CHIEF EXECUTIVE MARK CARUSO

Mineral Commodities (MRC) is a global exploration and mining company with a primary focus on the development of high-grade mineral deposits within the industrial minerals, base metals, bulk commodities, gold and precious metals resource sectors. Emma Davies spoke with chief executive Mark Caruso about the Munглиnup Graphite Project, the recent acquisition of Skaland Graphite in Norway and exploration plans for 2019.

Q. Can you please tell me the reasons behind the decision to acquire 51pc of the high-grad Munглиnup Graphite Project?

The acquisition of Munглиnup is part of a strategic commodity and jurisdictional diversification.

The mine is one of the highest graphite deposits in the world and had enormous latent potential.

Moreover, it offered a unique entry point into a Tier 1 jurisdiction, on a fully granted mining lease, 105 km from Esperance and close to excellent local and regional infrastructure.

The decision to acquire 51pc was the initial Farm-In and part of a larger staged transaction to acquire a further 39pc on completion of a feasibility study and the option to move to 100pc at the vendor's election.

The company has largely satisfied the conditions to proceed to 90pc ownership, which is anticipated to occur soon after the release of the feasibility study in May 2019. The company is also confident it will ultimately move to 100pc ownership of the project.

Q. How does the Munглиnup project fit in to MRC's renewable energy storage and electric vehicle strategy?

When assessing the exciting future of raw material demand for energy storage (battery) production, the company was mindful of fundamental lessons learned from decades of mining experience.

That is – where possible – mine small, open pit, high-grade ore bodies.

That ethos led us to South Africa, where we mine the highest grade heavy mineral sands in the world.

Another lesson learnt from our experience in South Africa is the challenges of funding and operating projects in emerging jurisdictions.

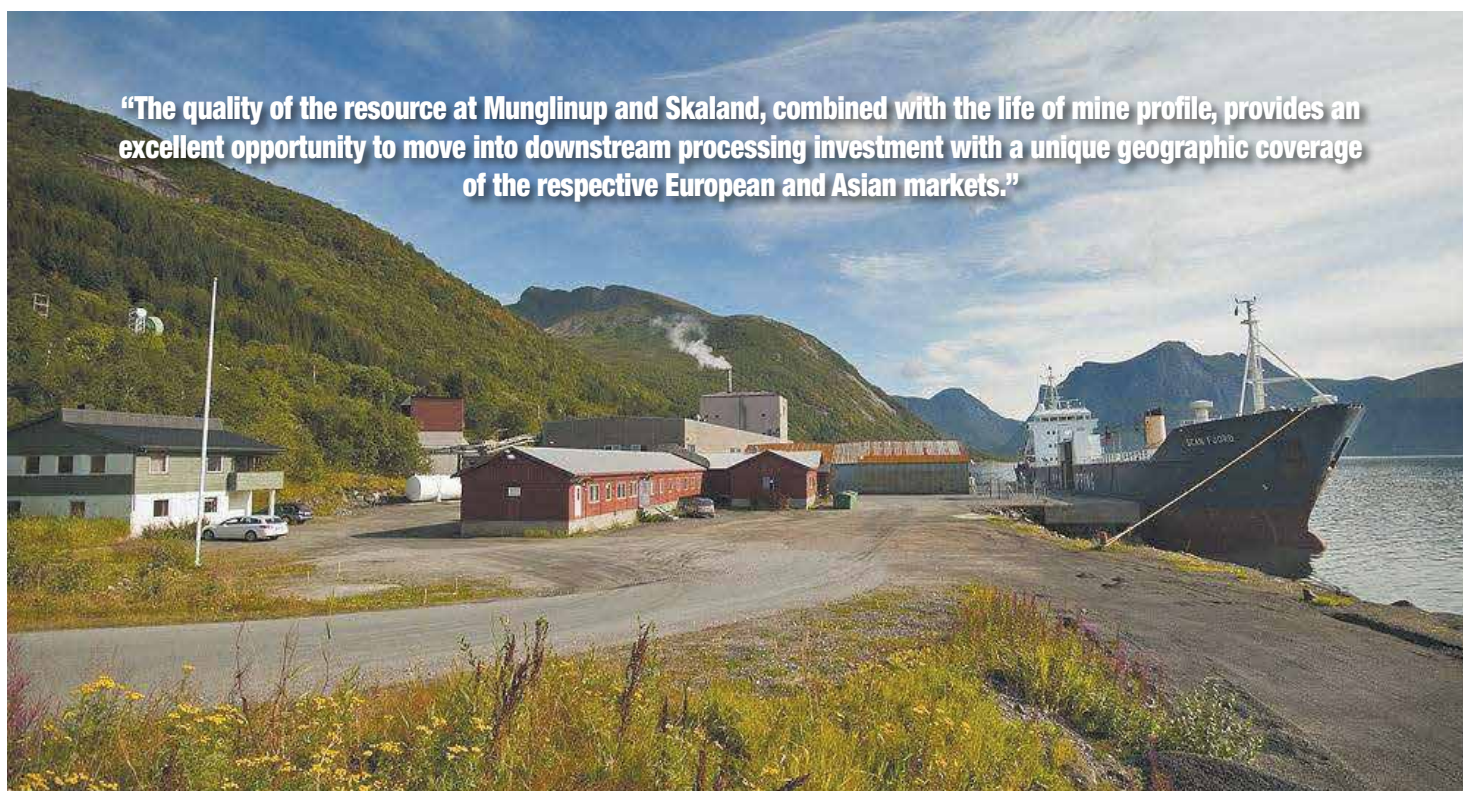
The company sought to position itself in Tier 1 jurisdictions and to operate high-grade mines.

Munглиnup fits exactly these criteria; coupled with geographical offtake advantages to Asia and combined with Skaland which services the European market, a significant part of the battery material supply is covered.

Munглиnup, due to its mine life, and which we plan to extend beyond the initial nine years, also offers an excellent opportunity to integrate downstream upgrading through purification, micronisation and spheroidization.

The asset will provide a long-term supply of quality feedstock to any downstream processing initiatives either in Australia or in other jurisdictions.

Q. What is the development timeline of the project and when do you expect it to be operational?



“The quality of the resource at Munглиnup and Skaland, combined with the life of mine profile, provides an excellent opportunity to move into downstream processing investment with a unique geographic coverage of the respective European and Asian markets.”

The acquisition of Skaland provides MRC with immediate graphite market presence that will also assist in marketing Munглиnup concentrate and de-risk the development.

The project, environmental permitting, is expected to be granted in late Q3, early Q4 2019.

The company has awarded a FEED contract to Mondium.

This is designed to be suitably advanced in the engineering design process whilst the permitting submissions are being assessed by the relevant authorities.

Based on this program, it is anticipated that the mine will be operating in Q3 2020.

Q. How will MRC value-add to the Munглиnup Project over the expected nine years of mine life?

The intention is to develop the project and increase the reserve base to extend the mine life beyond the current nine years. This will be done through a structured exploration program.

Recent drilling programs have been highly successful and it is expected that the DFS will deliver a significantly increased life of mine.

Also, it is clear that the Munглиnup project will offer the ability to cornerstone a downstream processing initiative.

The company has already invested considerable resources in developing these downstream options.

In late 2017, the company announced an MOU with Doral, a subsidiary of Japanese energy giant Iwatani Corporation to assess the Doral Fused Alumina plant in Kwinana, Western Australia as a possible site for downstream processing of Munглиnup graphite.

The MOU was extended last December and the company has made significant progress in studies to determine the suitability of the site for thermal purification, spheroidisation and coating of natural flake graphite to produce

premium downstream carbon products.

The company has also conducted comprehensive testwork on Munглиnup graphite to assess its amenability to beneficiation for downstream applications, such as the production of expandable graphite and graphene.

To date, all of this test work has been very encouraging and we see lots of opportunities to differentiate ourselves as not being just a ‘concentrate producer’.

The ultimate prize is being able to offer downstream offtake partners the opportunity to secure beneficiated carbon products outside of China.

Q. What exploration activities does MRC have planned in the region for 2019/2020?

The company will continue to infill the Whites deposit which has recently reported high-grade intercepts.

The results have confirmed the continuity of the mineralisation along strike of Halberts South and Whites/McCarthy West.

We will continue to drill out these extensions of high-grade zones along strike at Halberts South and Whites.

This drilling will likely occur later in this calendar year and in line with the project development schedule.

However, given the size of the proposed process plant and expected updated Mineral Resource, it is planned in the short term to only target areas of high potential value uplift (ie. grade and/or large flake size).

Exploration and infill drilling to add ore tonnes and hence mine life to the project will be undertaken using a staged approach as required.

In the future, should the market/economics

suggest a plant expansion is warranted, acceleration of the longer term exploration program will certainly be assessed.

Q. Where do you see MRC in the next 5 years?

MRC through its current mineral sands operations at Tormin, and near-term expansion initiatives which involve current permitting, will see the company's mineral sands operations extended for at least 10 years and integrate a magnetic separation plant for downstream processing into final ilmenite, zircon, rutile and garnet products.

Tormin minerals sands is one of the highest grade mineral sands operations in the world.

The recent acquisition of Skaland as well as the proposed development at Munглиnup positions MRC as the only multiple Tier 1 jurisdiction suppliers of high-grade graphite.

The quality of the resource at Munглиnup and Skaland, combined with the life of mine profile, provides an excellent opportunity to move into downstream processing investment with a unique geographic coverage of the respective European and Asian markets.

Q. Is there anything else you would like to add?

MRC is an established mining entity with a proven track record of development and financial performance.

The management of its capital to acquire and develop world class high grade mineral deposits and projects as well as maintaining shareholder returns is testament to the quality of its assets and managements capability and sets it aside amongst its peers in the space.

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