



CONSULTING ENGINEERS & PROJECT MANAGERS



ENGINEERING
MINES FOR THE
NEXT GENERATION



www.mintrex.com.au

“We enable mining companies to reduce their capital risk by converting ideas into effective investments”

We do this by providing:

- Project Management
- Design
- Operational Readiness
- Scoping and Feasibility Studies
- Construction Management
- Sustainable Asset Management

Mintrex = Mineral Treatment Expertise



SERVICES DELIVERY MODEL

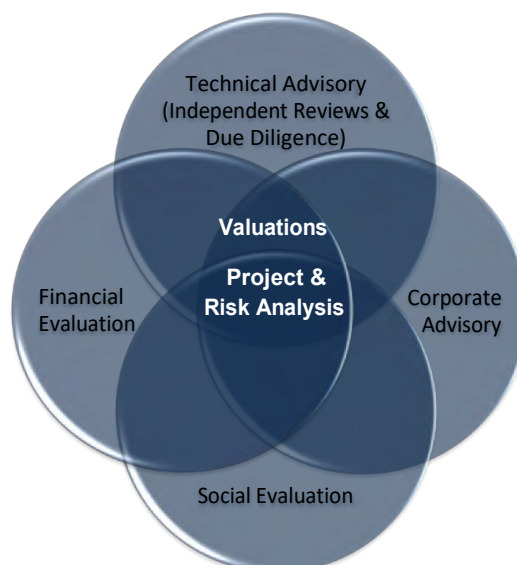
Advisory (projects and supply chain)

Project Management

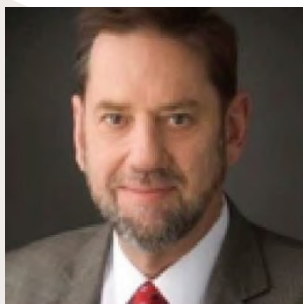


Transactions

Legal, compliance and transactions



KEY TECHNICAL PEOPLE



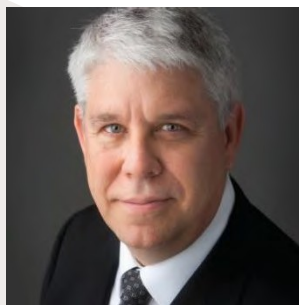
TOM KENDALL

Executive Engineer

Tom is a registered Engineer (CPEng, EngExec, APEC Eng, IntPE(Aus), NER, RPEQ) with over 45 years' of experience in the mining industry. He has postgraduate degrees in Engineering, Economics and Business Management together with Professional Certificates in Arbitration and JORC code reporting.

Tom has experience in operations management, construction management, and design of both underground and surface mining infrastructure.

Tom is a Fellow of the Australian Institute of Company Directors, the Institution of Engineers Australia, the Australasian Institute of Mining and Metallurgy, and the Institute of Quarrying.



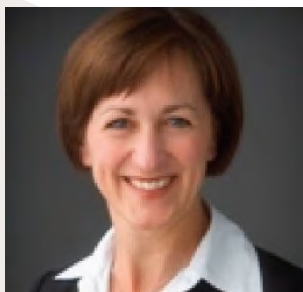
LEON LORENZEN

Senior Principal Engineer

Leon has more than 35 years' in-depth experience in mineral processing, electrochemistry, reactive systems, hydrometallurgy, and waste management treatment, particularly about the application of these technologies in the process industries. Leon has a Ph.D. in Engineering and a post-graduate diploma in management.

Leon is a Chemical and Metallurgical Engineer, and a NER registered Chartered Professional Engineer. Leon is a Fellow of the Institution of Engineers Australia, the Australasian Institute of Mining and Metallurgy and the Institute of Chemical Engineers and a Graduate Member of the Australian Institute of Company Directors.

Leon is also registered as a Chartered Engineer (UK and Europe), APEC Engineer (Asia-Pacific), Professional Engineer (Africa) and Registered Professional Engineer of Queensland.



FIONA MORGAN

Senior Principal Engineer

Fiona is a registered Chartered Professional Engineer with over 30 years' experience in the mining industry. Fiona has experience across gold, nickel, coal and iron ore and in operations management, project management, maintenance, research and design of both underground and surface mining infrastructure.

Fiona holds NER, RPEQ, APEC Engineer and IntPE(Aus) registrations and is a Fellow of the Institution of Engineers Australia, a Fellow of the Australasian Institute of Mining and Metallurgy and a Graduate Member of the Australian Institute of Company Directors. She holds Professional Certificates in Project Management and JORC Code Reporting. In addition, Fiona sits on the board of an ASX 200 listed mining company.



HIENT NGO

Senior Principal Engineer

Hien Ngo is a Chartered Professional Mechanical Engineer and has more than 30 years' experience in the design of mineral processing plants covering gold, nickel, copper, iron ore and lithium carbonate concentrate within Australia, Africa and Europe.

Hien holds NER and RPEQ registrations and is a Fellow of the Institution of Engineers Australia, Fellow of the Australasian Institute of Mining and Metallurgy, and a Graduate Member of the Australian Institute of Company Directors.

EXPERIENCED PERSONNEL

Staff	Professional Registrations	Qualifications	Years Experience
Tom Kendall	CPEng, Eng Exec, RPEQ	BE, MEngSc, MBA, MSc(MinEcon) FAICD, FIEAust, FAusIMM, FIQ	45
Fiona Morgan	CPEng	BE(Hons), GAICD, FIEAust, FAusIMM	30
Hien Ngo	CPEng, RPEQ	BE, GAICD, FIEAust, FAusIMM	30
Leon Lorenzen	CPEng, CEng, PrEng, RPEQ, APEC Eng. IntPE(Aus)	PhD (Met Eng), MScEng (Met Eng), BEng(Chem Eng), Exec Dev Prog (Business) GAICD, FAusIMM (CP), FSAIMM, FIChemE, FIEAust, FSAAE	35
Alan Kerr	CPEng	BE(Hons), MScEng, MBA, MIEAust	45
Naim Abou-Rjeily	CPEng, RPEQ	BE(Mech), MEngSc MIEAust	15
Rudolf Herbst	PMP	BE(Hons), MBA	15
Huy Nguyen		BE(Hons), MBA MIEAust	15
Adam Moffat		BE(Hons), BCom MIEAust	12
John Sobolewski		BCom, CA, GAICD	20

CAPACITY TO UNDERTAKE WORK

Capabilities	Tasks
Technical Advisory	High Level Technical Review Independent Technical Reviews Fatal Flaw Analysis Critical Process Review
Corporate Advisory	Project and Risk Analysis Preliminary Economic Assessment Due Diligence and Valuations Financial Modelling
Studies – Scoping, PFS, BFS,DFS	Process Plant and Infrastructure Capital and Operating Costs Project Management, Audits NI 43-101, JORC, SAMREC
Detailed Engineering	Process Plant Design, Drafting EP, CM, EPCM and EPC
Metallurgy	Met Testwork Design and Sampling Design Met Testwork Supervision Study Management Geometallurgical Optimisation
Infrastructure	Camps, Access Roads, Airstrips, Water Supply, Power Supply
Mintrex-on-Site	Delivery, improvement and implementation Process Optimisation Infrastructure Plant Expansions and Upgrades

STUDIES AND PROJECTS

Mintrex has completed projects in roles as varied as Client Representative and Construction Manager, although most have been either EP (engineering and procurement – typically for operating companies who owner-construct) or EPCM (engineering, procurement and construction management) roles.

Some examples of EP project estimate accuracy history are included below:

The following projects were engineering and procurement (EP) projects completed by Mintrex where the client constructed the plant. In all cases the EP was performed as a lump sum and variations were specific client requests, acknowledged as not in scope at the time they were requested. In all cases the (client requested) variations were not more than 12% of the lump sum originally contracted and in two of the contracts (Moolart Well and Garden Well) there were no variations to the contract claimed. The cost performance index (CPI = earned value/ actual cost = budget/actual cost, when complete) has been drawn from client feedback and the public record. In all cases the schedule performance index (SPI) is unknown, because the construction management was not undertaken or reported by (or to) Mintrex.

Project	EP\$	Variations\$	CPI	DFS\$	Final\$
Bonikro	\$3.45M	none	~0.9	\$36M	~\$40M#
Moolart Well	\$2.72M	none	~1.05	\$56M	\$53M
Garden Well	\$5.54M	none	~0.99	\$83M	~\$84M
Rosemont	\$850k	\$83k	+	DFS not estimated by Mintrex – scoping only	
Garden Well Upgrade	\$690k	\$79k	+	DFS not estimated by Mintrex – scoping only	

Bonikro sold into merger before completion ... negative FOREX impact upon budget
+ Shop detailing added

EP Project Estimate Accuracy

Some examples of EPC and EPCM project estimate accuracy history are included below:

The following projects were completed as detailed feasibility study (DFS) projects by Mintrex and then awarded to Turnkey/EPC contractors for project implementation.

Project	DFS\$	EPC	Award\$
Edikan (Ayanfuri)	\$78M	~\$68M	final award at higher price 5.5Mtpa --> 6.5Mtpa
Sissingue (Tengrela)	\$65M	unknown	project design-only awarded and then on hold
Sandfire DeGrussa	\$100M	\$91M	two main contracts for plant@
@ Other works also included multiple contracts ~\$80M for infrastructure such as bulk earthworks, roads, camp, airstrip, tailings storage, paste plant and underground mine support buildings.			

Most recently on the Tomingley Gold project, Mintrex performed the EPCM and the project metrics were:

Project	CPI	SPI	Budget \$	Final Cost\$
Tomingley	1.02	1.0	\$116M	\$113.7M

The SPI was 1, with ore to the plant one day ahead of schedule.

EPC and EPCM Project Estimate Accuracy

STUDIES AND PROJECTS

Mintrex has completed a number of brownfield upgrade projects in both Australia and internationally, with brownfield projects recently completed in Australia, Mali, Ghana and in the Philippines. The Mintrex scope within these projects has focused on the client requirements to complete their project. On different occasions, the engineering and support provided has included option studies, process optimization, re-engineering, equipment upgrades and replacement, remedial and repair work, procurement support for contracts, engineering design and expediting, project management, construction management and client representation.



Commissioning photo from the Mali installation, which is a low cost pebble crushing application (limited mine life). This design, including shop detailing, was completed for a lump sum price. The works were owner-constructed in Mali.

Commissioning time from connection of power and commencement of electrical and mechanical testing, until plant running was achieved in less than 5 days.



STUDIES AND PROJECTS

Studies

Mintrex has completed many studies over the years in Australia and internationally, including several projects that have been banked on the back of our studies.

Mintrex collects metrics against their study and project estimates to gain a better appreciation of how well we are performing in terms of estimate accuracy.

SELECTED MINTREX STUDIES EXPERIENCE

Company	Project	Detail	Location	Study Type	Completed
Newcrest Mining	Confidential	Cu and Au	WA	FS	2020
Norton Gold Fields	Binduli North	5 Mtpa Au	WA	PFS	2020
Breaker Resources	Lake Roe	1.5 and 2.5 Mtpa Au	WA	PFS	2019
Black Cat Syndicate	Bulong Gold	0.5 Mtpa Au	WA	SS	2019
Tasmin Mining	Blackwater	0.15 Mtpa Au	New Zealand	SS	2019
Evolution Mining	Castle Hill Option and Upgrade	Various Au	WA	SS	2019
Saturn Metals	Apollo Hill	Cu and Au	WA	SS	2019
Newcrest Mining	Confidential	Various Au	WA	SS	2018
Saracen	Carosue Dam Operations Upgrade	3.2 Mtpa Au	WA	DFS	2018
Breaker Resources	Lake Roe	2.5 Mtpa Au	WA	SS	2018
Saracen	Carosue Dam Operations Upgrade	3.2 Mtpa Au	WA	SS	2018
RED 5	Darlot Upgrade	1.8 Mtpa	WA	SS	2018
Explaurum	Tampia	1.5 Mtpa Au	WA	DFS	2018
Echo Resources	Bronzewing	1.8 Mtpa Au	WA	FS	2018
Norton Gold Fields	Janet Ivy HL	5 Mtpa Au	WA	FS	2018
Westgold Resources	Higginsville SABC	2 Mtpa Au	WA	PFS	2017
Capricorn Metals	Karlawinda	3 Mtpa Au	WA	BFS	2017
Emerald Resources	Okvau	2 Mtpa Au	Cambodia	BFS	2017
Regis Resources	McPhillamys	7 Mtpa Au	NSW	PFS	2017
De Grey Mining	Pilbara	1 Mtpa Au	WA	SS	2017
Genesis Resources	Plavica	2.0 Mtpa Au	Macedonia	SS	2017
West African Resources	Sanbrado	2.0 Mtpa Au	Burkina Faso	BFS	2017
Auzex-Explaurum	Tampia	1 Mtpa Au	WA	Scoping	2016
Capricorn Metals	Karlawinda	2.5 to 3 Mtpa Au	WA	Scoping	2016
Gascoyne Resources	Dalgaranga	2.5 Mtpa Au	WA	BFS	2016
Hot Chili	Productora	14.0 Mtpa Cu	Chile	PFS	2016
Gascoyne Resources	Dalgaranga	2.5 Mtpa Au	WA	PFS	2016
West African Resources	Mankarga 5	1.6 Mtpa Au	Burkina Faso	PFS	2015
Excelsior Gold	North Kalgoorlie	1.0 Mtpa Au	WA	PFS	2014
Roxgold	Yaramoko	0.27 Mtpa Au	Burkina Faso	DFS	2014
Sandfire Resources Oxide	DeGrussa	1.6 Mtpa Cu	WA	Scoping/PFS	2014
West African Resources	Mankarga 5	1.6 Mtpa Au	Burkina Faso	Scoping	2014

SELECTED MINTREX PROJECT EXPERIENCE (COMPLETED)

Company	Project	Detail	Location	Scope	Completed
Interquip Construction Pty Ltd	King of the Hills Gold Project	4 Mtpa	WA, Australia	EP	2021
Capricorn Metals Limited	Karlawinda Gold Project	4 Mtpa	WA, Australia	EP	2021
Emerald Resources NL	Okvau Gold Project	2 Mtpa	Cambodia	DFS and EP	2021
Gold Fields	Agnew Infrastructure Expansion - Camp	Au	WA, Australia	Engineering Design and Support	2019
Abra Mining	Bara Base Metal Project	1.2 Mtpa Pb and As	WA, Australia	EPC Support	2019
Maca/Interquip	Kirkalocka	2.1 Mtpa Au	WA, Australia	SAG Mill Design Support	2019
Geopacific Resources	Woodlark	2.4 Mtpa Au	Papua New Guinea	EPC Support	2019
Saracan	Carosue Dam Operations	2.4 to 3.2 Mtpa Au	WA, Australia	EPC Support	2019
Gold Fields	St Ives	5.5 Mtpa Au	WA, Australia	CIP to CIL Design	2019
Gold Fields	Paste Plants	Au	WA Australia	Design	2019
Echo Resources	Bronzewing Refurbishment	1.8 Mtpa Au	WA Australia	Mech/Proc Design	2018
Evolution Mining Ltd	Mt Rawdon Gravity Circuit Upgrade	3.5 Mtpa Au	Queensland	Eng/Procurement	2018
Blackham Resources Ltd (Interquip)	Matilda Gold Project (Wiluna Mine Upgrade)	1.7 - 2 Mtpa Au	WA Australia	Minor Plant Modifications	2016/7
AngloGold Ashanti Aust. Ltd	Tropicana	Optimisation ~7.5 Mtpa Au	WA Australia	Brownfields EP	2016
OceanaGold Ltd	Didipio U/G Pumping	1 Mtpa Au	Philippines	FEED	2015
McArthur River Mining Ltd	MRM Lead Upgrade Project	5.5 Mtpa Zn-Pb	QLD	Structural Design	2015
Roxgold Inc.	Yaramoko Gold Project	0.25 Mtpa Au	Burkina Faso	EP	2014
Alkane Resources Ltd	Tomingley Gold Project	1 Mtpa Au	NSW Australia	EPCM	2014
Sandfire Resources NL	DeGrussa Pebble Crusher	1.6 Mtpa Au	WA Australia	EP	2014
Endeavour Resources Ltd	Nzema Pebble Crusher	1 Mtpa Au	Ghana	EP	2014
OceanaGold Ltd	Didipio Pebble Crusher	1 Mtpa Au	Philippines	EP	2014
Endeavour Resources Ltd	Tabakoto Pebble Crusher	1 Mtpa Au	Mali	EP	2014
Regis Resources Ltd	Garden Well upgrade	7 Mtpa Au	WA Australia	EP	2014
Millennium Minerals NL	Nullagine Gold Project	1.5 Mtpa Au	WA Australia	EPCM	2013
Regis Resources Ltd	Rosemont Gold Project	1.6 Mtpa Au	WA Australia	EP	2013
McArthur River Mining Ltd	MRM Upgrade Project	5.5 Mtpa Zn-Pb	Qld Australia	Mechanical Design	2013
Regis Resources Ltd	Garden Well Gold Project	4 Mtpa Au	WA Australia	EP	2012
POAGS Pty Ltd	Port Hedland Port Storage	7 Mtpa Fe	WA Australia	EP	2012
Kimberley Metals Group Ltd	Ridges Project Windham Port	2 Mtpa Fe	NT Australia	FEED	2011
Regis Resources Ltd	Moolart Well Gold Project	2 Mtpa Au	WA Australia	EP	2010
Lynas Corporation Ltd	Mt Weld Project	0.25 Mtpa RE	WA Australia	CM	2010
Galaxy Minerals Ltd	Mt Cattlin Project	1 Mtpa Li	WA Australia	EPCM	2009
Equigold NL	Bonikro Project	2 Mtpa Au	Côte d'Ivoire	EP	2008

COMPLETED STUDIES

Mintrex has extensive experience in conducting feasibility studies and our team of experienced consultants has worked on such studies for clients in a diverse range of geological, mineralogical and physical environments. Mintrex offers recognised industry leaders high quality scoping studies (SS), pre-feasibility studies (PFS), feasibility studies (FS) and pre implementation studies. This includes work leading into, forming part of, reviewing, advising requirements and project management or review of these studies. Mintrex works closely with our clients to develop the solution that will best fit each client's unique requirements, with a focus on efficiency, productivity and profitability.

KALGOORLIE NORTH GOLD PROJECT

Client: Excelsior Gold Ltd

Location: Western Australia

Mintrex assisted Excelsior Gold Ltd in the preparation of a pre feasibility study for the 1 Mtpa Kalgoorlie North Gold Project approximately 50km north of Kalgoorlie, Western Australia. Mintrex scope of work included the preparation a capital and operational cost estimate for the processing plant with the understanding the project should be stripped of all unnecessary capital. Mintrex designed a flowsheet reflecting these minimum requirements resulting in a robust plant that is easy to operate and requires a minimum level of manpower to operate. Mintrex input to the study was completed in a six week period as a lump sum contract.

YARAMOKO GOLD PROJECT

Client: Roxgold

Location: Burkina Faso

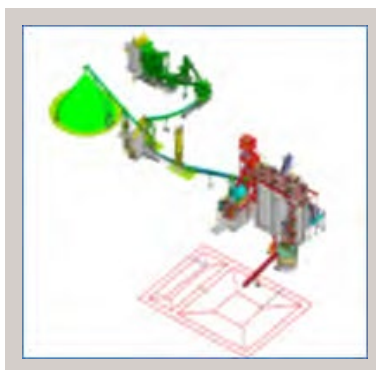
Mintrex were engaged by Roxgold, a TSX listed gold explorer, to prepare the process plant and infrastructure component of the 0.25 Mtpa Bankable Feasibility Study (BFS). The project is located in Burkina Faso, West Africa. Our scope includes the metallurgy, process plant design, TSF and WSD, capital and operating costs and document preparation.

CASTLE HILL GOLD PROJECT

Client: Phoenix Gold Ltd

Location: Western Australia

Mintrex completed the Bankable Feasibility Study (BFS) for this 2.0 Mtpa gold project located 60 km from Kalgoorlie in Western Australia, in November 2013. The process plant is based on the Moolart Well plant designed by Mintrex for Regis Resources in 2009/2010. The focus is on a simple flowsheet and a robust process plant suitable for the large tonnage operation.



COMPLETED STUDIES

GARDEN WELL GOLD PROJECT

Client: Regis Resources Ltd

Location: Western Australia

Following on from the BFS and subsequent detailed engineering design of the 2.0 Mtpa Moolart Well Gold Project, Mintrex was awarded the BFS and Engineering Design of the 4.0 Mtpa Garden Well Gold Project by Regis Resources.

The feasibility study was prepared between January and July 2011 and our scope included the Capital and Operating costs for the Process Plant and Infrastructure and compilation of the Feasibility Study Document. The project capital estimate was \$137M and the plant was commissioned on budget and on schedule in August 2012.

DEGRUSSA COPPER PROJECT

Client: Sandfire Resources NL

Location: Western Australia

Mintrex worked closely with Sandfire to prepare the Scoping, Pre Feasibility and Bankable Feasibility Studies for the 1.5 Mtpa DeGrussa Copper Project. The challenging schedule for the three study phases was agreed at the outset at 18 months commencing in early 2010 with completion in July 2011. Mintrex subsequently assisted Sandfire with the preparation and award of \$114M worth of process plant and infrastructure contracts.

BONIKRO GOLD PROJECT

Client: Equigold Pty Ltd

Location: Côte d'Ivoire, Africa

The project plan and capital cost estimates for the 2.0 Mtpa Bonikro Gold Project Feasibility Study were prepared by Mintrex in 2006. Detailed design of the plant followed and the plant was commissioned on budget in 2008. The plant was designed with incremental improvements over previous Equigold plants at Mt Rawdon and Kirkalocka.

EDIKAN GOLD PROJECT

Client: Perseus Mining

Location: Ghana, Africa

The 5.5 Mtpa Edikan (was Ayanfuri) Bankable Feasibility Study (BFS) was awarded to Mintrex in 2009. The BFS was completed in a 14 week period following the earlier completion of the PFS in 2008. The project includes rougher flotation, regrind and concentrate leach for the large tonnage low grade operation.



COMPLETED PROJECTS

YARAMOKO GOLD PROCESSING PLANT

Client: Roxgold Inc.

Location: Burkina Faso

At Mintrex nothing makes us happier than witnessing our clients' successes, and for one of our clients, Roxgold Inc. the successes just keep on coming. Since breaking ground at their Yaramoko Gold Mine on the 7th April 2015, they remarkably achieved their first gold pour just thirteen months later and have more recently declared commercial production with 32,987 ounces of gold produced in the third quarter of 2016.

"Bringing Yaramoko into production ahead of schedule and under budget is an achievement we can all be proud of, and I want to thank Roxgold's employees and contractors for their continuing hard work and dedication." commented John Dorward, Roxgold's President and CEO.

Mintrex have been involved in the Yaramoko project since 2013 when we were engaged by Roxgold Inc., to prepare the process plant and infrastructure component of the Bankable Feasibility Study (BFS). In August 2013, Mintrex engineers Ian Kerr and Naim Abou-Rjeily travelled to Burkina Faso, West Africa, approximately 180km southwest of the capital Ouagadougou to visit the proposed site for the purpose of gathering local knowledge around conditions, suppliers and contractors to support an accurate estimate.

Mintrex Project Manager Naim Abou-Rjeily commented "The site visit was of prime importance to allow the assessment of the local capabilities and the logistics requirement for access and delivery to the Yaramoko site. It provided valuable contacts for local contractors which were used to obtain pricing for the feasibility study and assessment of local labour skills to allow the construction of the processing plant. In addition the site visit was key to develop a better understanding of the social and environmental impact of the project on the local community and the various regulatory requirements to obtain project approvals."

On completion of the BFS in April 2014, Mintrex commenced the detailed design of the treatment plant. Focus was placed on supplying Roxgold with a fit for purpose design they were able to provide to contractors with confidence the plant would be built to specifications and produce desired outputs as defined in the BFS. Mintrex executed the detailed design for a fixed price, and completed it in September 2014.

The process plant was designed to process 0.27 Mtpa of underground high grade (~12g Au/t) ore. The comminution circuit includes single stage crushing, with provision in the layout for future secondary crushing should the ore characteristics at depth, or future plant expansion, require this. The crushing circuit is followed by single stage SAG grinding (SS SAG), gravity recovery of free gold from a portion of the cyclone underflow, and a five stage CIL circuit preceded by a pre-leach tank. The stripping plant includes a 1.5 tonne split AARL elution circuit with electrowinning and smelting. A tailings thickener is included to recover both water and reagents prior to discharge to the lined tailings storage facility.

Roxgold's onsite engineer commented "Many compliments were given regarding the thoroughness and completeness of the design as well as the quality of the shop detailed drawings. This was definitely a contributing factor for the construction being completed ahead of schedule."

The Yaramoko mine was built on budget, ahead of schedule and is one of the highest grade gold mines in the world. Since completion, the plant has operated at or above nameplate levels, with both plant operating time and unit throughput rates meeting or exceeding design of 91.7% and 34 tonnes per hour respectively. Similarly, gold recoveries, averaging 97.2%, have met or exceeded the design rate of 96.9%.

Yaramoko gold mine achieved commercial production as a result of the successful mining and extraction rates achieved since commencing stoping in August and September 2016, together with high processing plant availabilities and gold recoveries above Feasibility Study assumptions.

Roxgold COO, Paul Criddle stated "Mintrex have been solid partners throughout the development of Yaramoko. They have been flexible and cognizant of Roxgold's needs throughout. The finished product being our processing facility and infrastructure is one that has started up and ramped up without incident and one that Roxgold is very proud of."

COMPLETED PROJECTS

BOLEO COPPER ZINC COBALT PROJECT

Client: Minera y Metalúrgica del Boleo

Project Type: Greenfields Project, Copper-Zinc-Cobalt Atmospheric Leach – Solvent Extraction – Electrowinning Operation

Mintrex Scope: Cobalt Electrowinning Commissioning Assistance

Location: Santa Rosalia, Baja California, Mexico

Mintrex was requested to provide commissioning assistance for the Boleo cobalt electrowinning plant, based on the expertise of one of its team members (David White) in cobalt and nickel refining, particularly anode bag electrowinning.

The Boleo Copper Zinc Cobalt Project is located near the town of Santa Rosalia, on the Baja California Peninsula, Mexico. Copper production commenced in 2015, with cobalt electrowinning start-up in March 2016.

Assistance was initially provided from Perth, in the form of a design review and provision of technical data on request. On-site assistance in March 2016 was followed by a visit report in April 2016 containing a number of key recommendations around impurity removal and installation details.

Boleo's production manager Tom Gamarano commented on receipt of the report: "Thank you very much for all of your valuable help David. I especially appreciate the idea of addition of some LIX 84 in the CoSX circuit for copper removal; we will begin lab testing soon. We are now modifying the anolyte discharge header tube spacing to match the anode spacing and putting into service the IX column split elution. We'll continue to review the other recommendations included."



COMPLETED PROJECTS

TROPICANA GOLD OPTIMISATION PROJECT

Client: AngloGold Ashanti Australia Limited

Location: North Eastern Goldfields, Western Australia

Mintrex Pty Ltd (Mintrex) performed a significant role in the development of AngloGold Ashanti Australia's (AGAA) Tropicana Gold Mine. In May 2012 with the project still under construction, Mintrex was appointed to complete the scoping study to design the Mine Dewatering.

Through the successful completion of this assignment, Mintrex was appointed in mid-2014 to undertake a series of sustaining capital projects commencing with the Borefield Extension Project to increase the volume and flow rate to the plant. The scope included the intermediate Raw Water Dam. Over the past two years the business has successfully completed projects in process plant improvement, infrastructure and materials handling. Significant assignments have included the Conveyor Optimisation and Cyanide Reduction works. All projects have been completed meeting AngloGold Ashanti's safety and environmental standards.

The ability of senior Mintrex personnel to work with AngloGold Ashanti operating staff, to achieve early identification of problems and definition of associated scope in these projects resulted in the business being appointed in June 2015 to manage an important integrated Optimisation Study with a number of operational objectives. Following the completion of this study in September 2015, Mintrex was appointed to complete the detail design followed by the construction management, as part of an integrated client team, of the various optimisation projects that were defined by the study.

In much of its work at the Tropicana operation, Mintrex has applied its "Zero-Base Design" approach with its early identification of problems and development of simplified and low CAPEX solutions that, where ever possible, also improve OPEX. Mintrex looks forward to continuing the partnership with AngloGold Ashanti.



COMPLETED PROJECTS

TOMINGLEY GOLD PROJECT

Client: Tomingley Gold Operations Pty Ltd
Location: Tomingley, New South Wales

Mintrex carried out full EPCM activities on the Tomingley Gold Project for Tomingley Gold Operations Pty Ltd, a fully owned subsidiary of Alkane Resources Ltd. The Tomingley Gold Project is located adjacent to the town of Tomingley, which is 50km south of Dubbo, and straddles the Newell Highway connecting Dubbo and Parkes. The project commenced in February 2013 and will be ready for commissioning in January 2014. Apart from the conventional gold processing plant based on the proven CIL process, Mintrex assisted Tomingley Gold Operations Pty Ltd with various infrastructure activities, such as a 46km water pipeline, highway underpass, tailings dams, access roads and mine site buildings.

CARMEN COPPER CORPORATION CONCENTRATOR EXPANSION PROJECT

Client: Outotec
Location: Toledo Cebu, Philippines

The detailed design for the Carmen Copper Corporation (a subsidiary of Atlas Mining and Development Corporation – Philippines) Expansion – Portion A commenced in October 2012. The Carmen Copper mine site is located in Barangay Don Andres Soriano, Toledo City, Philippines. The expansion involves the installation of two 6MW secondary grinding ball mills, classification building (cyclones and screens) and all associated equipment to increase the plant's throughput from 40,000 tpd to 60,000 tpd.

Mintrex was awarded the detailed design by Outotec for the civil, concrete and SMP of this secondary grinding circuit.

ROSEMONT GOLD PROJECT

Client: Regis Resources Ltd
Location: Northern Goldfields, Western Australia

Regis Resources is currently building the Rosemont Gold Project. Mintrex provided lump sum design for the milling and classification sections and associated infrastructure of the process plant.

The Mintrex and Regis teams worked closely together to deliver seamlessly across supplier interfaces.



COMPLETED PROJECTS

NULLAGINE GOLD PROJECT

Client: Millennium Minerals Limited

Location: Nullagine, Western Australia

The Nullagine Gold project, designed by Mintrex in 2011, was commissioned in September 2012, and achieved design capacity immediately, producing first gold in September 2012. The Millennium Minerals Golden Eagle processing plant is a 1.5 Mtpa carbon in leach (CIL) gold extraction plant, part of the Nullagine Gold Project.

DUKETON GOLD PROJECT GARDEN WELL

Client: Regis Resources Ltd

Location: Northern Goldfields, Western Australia

The Garden Well processing plant is a 4 Mtpa carbon in leach (CIL) gold extraction plant for Garden Well ores.

The Garden Well plant includes interesting design features to reduce operating costs and improve performance. These include the use of a scrubber and tertiary crusher to achieve lower power consumption and secondary cyclones to extend the leach time for the coarser fraction of the ore. The wet plant was upgraded to 7.5-8 Mtpa as part of the Rosemont project.

UTAH POINT STOCKYARD DEVELOPMENT

Client: Qube Ports and Bulk

Location: Port Hedland, Western Australia

Mintrex provided the procurement and engineering for the eleven 900 tph truck unloading and stacking systems at Utah Point, working in a collaborative relationship with the client. The \$50M project has exceeded the expectations of the client and users.

Utah Point is a multi-user facility providing common user access to junior mining companies within the Pilbara region of Western Australia.



FLOTATION CAPABILITIES

Leveraging the expertise and knowledge of a long-standing heritage engineering business in the mining centre of Kalgoorlie, Mintrex founder Tom Kendall and Technical Manager, Hien Ngo initially provided client representative services overseeing the design of Western Mining Corporation's (WMC) Kambalda Nickel Concentrator utilising a flash flotation circuit, from 1993 to 1998. The experience and knowledge gained in flotation during this project and subsequent projects and expertise from other engineers joining Mintrex since then, has been valuable to many of Mintrex's clients and our current team has been privileged to contribute to the success of more recent projects including those highlighted below.:

Showcase Projects

- **EMERALD RESOURCES LIMITED:** The Okvau Gold Project, Cambodia, 2 Mtpa Definitive Feasibility Study was completed by Mintrex in 2017. Early works engineering detail design has commenced in 2019 and was completed in 2020 by Mintrex. The project includes the design of a rougher flotation circuit and regrinding circuit. This process plant was commissioned and is in full production since Q2 of 2021.
- **TASMAN MINING LIMITED:** The Blackwater Gold project in South Island of New Zealand scoping study was completed by Mintrex in 2019. The project includes a rougher flotation circuit and ultra fine grinding circuit as well as costing of such a circuit at scoping study level.
- **EXPLAURUM LIMITED:** The Tampia Gold Project, WA, 1.5Mtpa Scoping Study was completed by Mintrex in 2018. The project includes the design of a 2 stages gold flotation circuit and an ultra fine grinding circuit as well as costing of such a circuit at feasibility study level.
- **HOT CHILI LIMITED:** The Productora, Chile, 14 Mtpa Copper Pre-feasibility Study (Copper oxide and sulphide circuits as well as Molybdenum Circuit) was completed by Mintrex in 2016 with an update in 2018. Mintrex' main tasks were the design and management of the metallurgical testwork programme for the copper sulphide and molybdenum flotation circuits as well as overall study management of the total project.
- **SANDFIRE RESOURCES NL:** The DeGrussa Copper, WA, 1.5 Mtpa Copper Definitive Feasibility Study (DFS) was successfully completed by Mintrex in 2011 (Mintrex also completed the Scoping and Pre-feasibility Studies). As a result of the quality of the DFS, engineering support services awarded to and successfully completed by Mintrex included compiling the EPC contract, engineering data sheets for all capital equipment, procurement and early earthworks design. Mintrex added value by helping to maximise Sandfire's return on equity.



"Mintrex carried out the work with enthusiasm and always acted professionally. They were able to complete all tasks in a timely manner and cost effectively. I would have no hesitation in working with Mintrex in a similar role again."
Martin Reed, former Project Manager (DeGrussa Project)

- **LYNAS CORPORATION:** The Mt Weld, WA, 0.25 Mtpa Rare Earths Project Construction Management project was completed by Mintrex in 2010. Engineering services provided included client representation (approval and design sign-off), operational readiness and commissioning. Mintrex was able to reduce Lynas' capital risk by providing the expertise and guidance as needed throughout the construction. Subsequently in 2011 Mintrex completed the DFS for the Mt Weld Upgrade.

UNDERGROUND MINING CAPABILITIES

Mintrex leverages its key strengths garnered from years of combined experience to support its clients with innovative solutions in the most challenging of environments.

Key Strengths

- Engineering design: Mintrex has a highly-developed awareness of the limitations of designing underground. It places significant emphasis on the critical front-end thinking to solve difficult problems;
- Pump station installations: The business has designed numerous pump station installations over many years and is well-recognised in the industry for this capability;
- Paste / backfill design: Working for paste plant manufacturers, Mintrex has completed the detailed design on a number of paste / backfill plants;
- Certified Auditors for the Western Australian Mines Department; and
- Tom Kendall is a long-standing member of the Australian Standards Sub-committees ME-18-03 and ME-18-03 of Standards Australia. These sub-committees are responsible for AS 3785 and AS 3637. During Tom's involvement with these sub-committees, most of the standards have been reviewed and the following updated standards have been issued:

AS 3785.1-2006	Underground mining—Shaft equipment—Shaft overwind safety catch system
AS 3785.2-2006	Underground mining—Shaft equipment—Shaft winding arresting systems
AS/NZS 3785.6:2015	Underground mining - Shaft equipment - Fixed guides, rope guides and rubbing ropes for conveyances
AS 3785.7-2006	Underground mining—Shaft equipment—Sheaves



White Hope flasks & skip loading



Underground Pump Station at KCGM's Chaffers Shaft

UNDERGROUND MINING CAPABILITIES

During the 1980's and 1990's the Mintrex and Kendall Engineers business based in Kalgoorlie, undertook significant underground brownfields design work for major regional clients, notably Western Mining Corporation (WMC) and Kalgoorlie Consolidated Gold Mines (KCGM), as well as smaller companies and mining contractors. Mintrex completed a number of assignments at major mines including the redesign of the Jan Shaft and Junction headframes, modifications of the Revenge underground conveyor and a number of underground pump station installations at Kambalda for WMC.

For KCGM, the business completed the design of a significant modification of the Cassidy Shaft 36 level underground crushing station and optimisation of the flasks and skip loading station, and designed the underground pump station on the 23 level at the Chaffers Shaft, which at that time was established to dewater the golden mile and superpit.

For smaller companies the following were all designed by, or had a major part of the design completed by Mintrex:

- The winder and hoisting system, the headframe, skip and loading station design for the White Hope mine south of Kalgoorlie;
- The headframe design for the Paddy's Flat mine in Meekatharra;
- The headframe, skip and loading station design for the McKenzie shaft north of Kalgoorlie; and
- The hoist, headframe, skip and loading station design for the Kohinoor mine near Cue.

With the opening of the Mintrex business in Perth in 2001, it quickly became one of the preferred design groups for a number of smaller mining contractors. In the years that followed, Mintrex designed the Chariot mine emergency egress shaft sets and services layout and Chariot ventilation shaft lining for Giants Reef Mining in Tennant Creek, as well as an innovative roll-in, roll-out headframe for the ventilation shaft. Mintrex designed a highly innovative shaft lining, services and haulage / fit-out for the Copeton mine near Inverell in NSW. In this particular application, the full shaft furniture which included skids for the skip, a brattice to protect the ladderway and services and shaft sets for 60m of vertical shaft, were all able to be fully installed and fixed in two days.

Both these projects involved highly innovative solutions developed in collaboration with the client. At the North Woah Hawp mine in Ballarat in Victoria shaft sets were designed to allow sinking over a fire damaged and collapsed shaft and rehabilitation of the damaged shaft within a new shaft.

Mintrex has provided the skips and headframe design and statutory submissions for many other small mines and sample winzes and was a pioneer in the development of portable headframes in place of tripods in the goldfields of Western Australia.

Additionally Mintrex has provided Design Verification services for underground structures and mechanical equipment.

In 2008, Mintrex completed the upgrade design of the underground conveying and crushing station at the Sydvaranger magnetite project in Norway for Northern Iron. This project involved the installation of three cone crushers, recommissioning a series of conveyors in underground tunnels and design of an additional movable conveyor.

In 2014 Mintrex completed a dewatering options study for the Degussa underground mine in WA to respond to the potential for emergency water ingress. That study considered clean and dirty water pumping, plunger and diaphragm pumps, submersible and horizontal centrifugal pumps and the need for a reliable system, preferably with rotatable spare components.

In 2015 Mintrex completed the front end engineering design (FEED) for the underground primary dewatering system at OceanaGold's Didipio copper-gold mine in the Philippines. The underground mine is located under the associated open pit mine in an area with high seasonal rainfall and water is expected to enter the underground mine from the open pit as well as from regional geological structures.

MARKET ANALYSIS TOOL

Capability Statement Market Analysis Economic Tool

Using geological, geometallurgical, metallurgical, process plant layout, throughput, capex and opex, as well as mining information in various phases of a project or existing operation is of utmost importance to improve your mine value chain. These parameters can be used to describe limitations in achieving optimum process parameters during studies and in existing operations. The purpose of this capability statement is to describe the use of these various design parameters in the decision making processes in the mine value chain, and at various phases in a process and/or operation (see figure below).

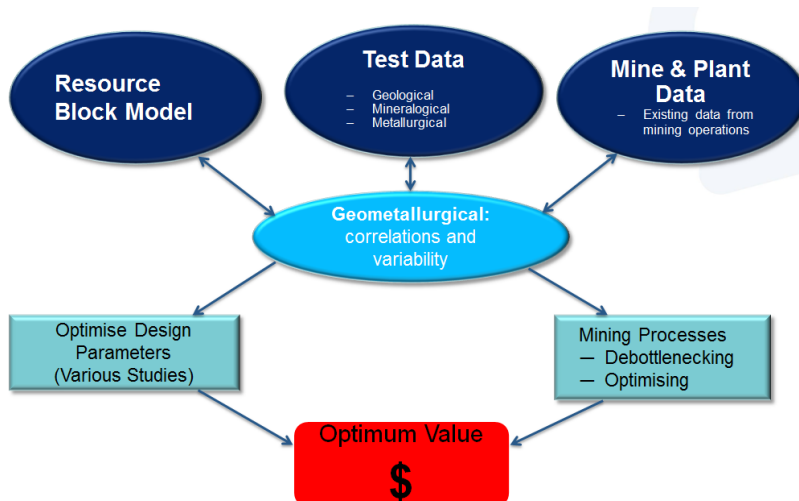


For example most mining companies (especially juniors and mid-tiers) select an optimum grind size during the various project phases purely on the metallurgical recoveries of the valuable metal in question. Very little emphasis is placed on the financial implications of such a decision in the value chain. Mintrex developed a market analysis economic tool which uses optimum parameters such as optimum grind size for the selection of the appropriate subsequent comminution circuit design. The relationships developed can then be used in geometallurgical modelling of the reserve to enable the economics of the project to be maximised via financial analysis.

The costs of conducting metallurgical testwork during study phases (scoping, pre-feasibility and feasibility) are high. However, these testwork programme costs are very small in comparison to the implications of an incorrect decision in the capital and operating costs in the long term as well as mining sequence and schedule. One of the common mistakes made during the flowsheet development of a project in the study phases is to select design parameters and optimum process parameters for process design, optimisation, modelling (financial and technical) and further testwork purely on testwork results and the metallurgical recoveries achieved. Mintrex uses the approach in their work to focus on the selection of appropriate process parameters for a project flowsheet during feasibility stages not purely based on metallurgical results and recoveries, but on the mining and processing capabilities as well as economics of the project. This approach has shown that if economic factors are used, better and more informed decisions can be made during flowsheet development, mine scheduling, resource and reserve optimisation for the benefit of the company, shareholders and overall the long term viability of the project.

MARKET ANALYSIS TOOL

The Value Proposition



It is of utmost importance to understand the response of variables throughout the process. This can be achieved by a market analysis economic tool which predicts the performance of a processing plant even at scoping level. Using relationships between these variables, mining models as well as economic models allow the project owners to make effective decisions at both a planning and operational stage. That enables Mintrex's clients to maximise economics and thus, the viability of the project at any stage of the project.

The results from a well-designed geometallurgical programme can thus be used for:

- Better flowsheet design (more flexible);
- Better use of algorithms for throughput and recovery in resource and reserve models;
- Better use of the mining schedule to optimise plant performance;
- Better plant and equipment design and sizing;
- Optimise plant performance and forecasting;
- Reduce risk in subsequent phases; and,
- Enable economics to be maximised.

Why do we want to model the process?

- Identify or test opportunities to optimise the process design without having to physically change the process
- Review potential impact of proposed changes on:
 - o Product purity
 - o Process safety
 - o Capital Costs
 - o Operating Costs
- Metallurgical Accounting
- Cost Saving – expensive testwork

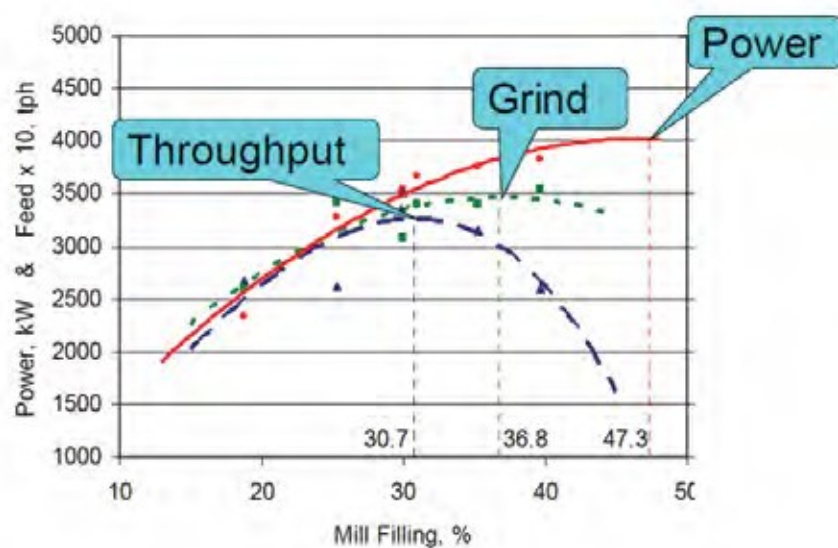
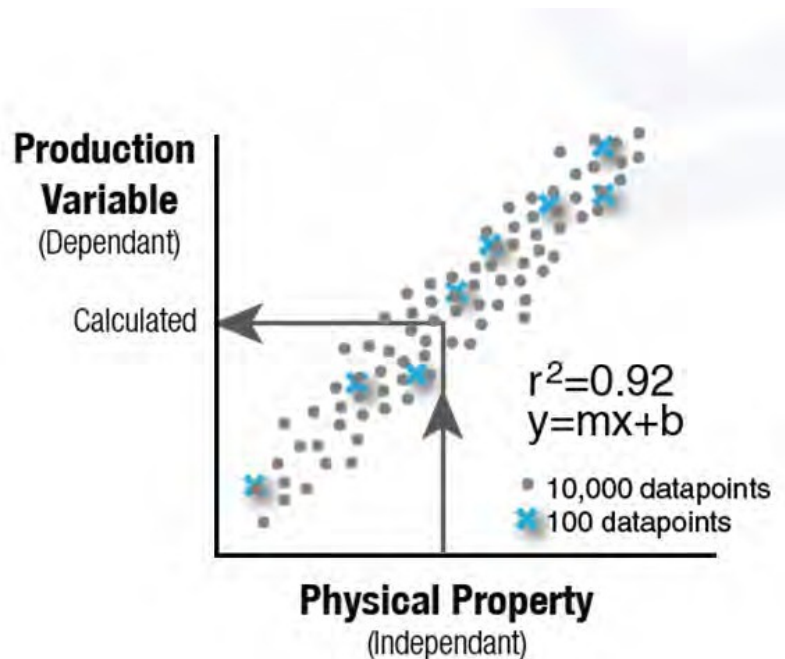
MARKET ANALYSIS TOOL

How do we understand relationships?

- By developing correlations between a small number of measurable physical properties and process parameters and use these relationships to calculate many other data

Tools:

- Test results and multivariate statistics



- In the above graph the data indicates that the mill efficiency drops off if it is overfilled.

IMPROVING GOLD RECOVERY WITH RECYCLE CRUSHERS

With the operating costs of gold producers coming under pressure, companies are seeking to improve their gold recovery from the circuit through cost effective proven solutions. The installation of a recycle crusher, commonly referred to as a pebble or scats crusher, into the milling circuit is one way to improve recovery.

Mintrex, an engineering company based in Perth Western Australia, has extensive experience in this area with clients benefitting through a fast design to commissioning process, resulting in immediate productivity gains.

Why a recycle crusher? Autogenous (AG) and ball milling circuits build up pebbles or scats. These are lumps of ore typically 25-50 mm that are very difficult to break down within a milling circuit. The pebbles are too small to break other rock or too large to be broken by the grinding media. A build-up of recirculating pebbles will result in decreased mill efficiency and so a reduction in mill throughput.

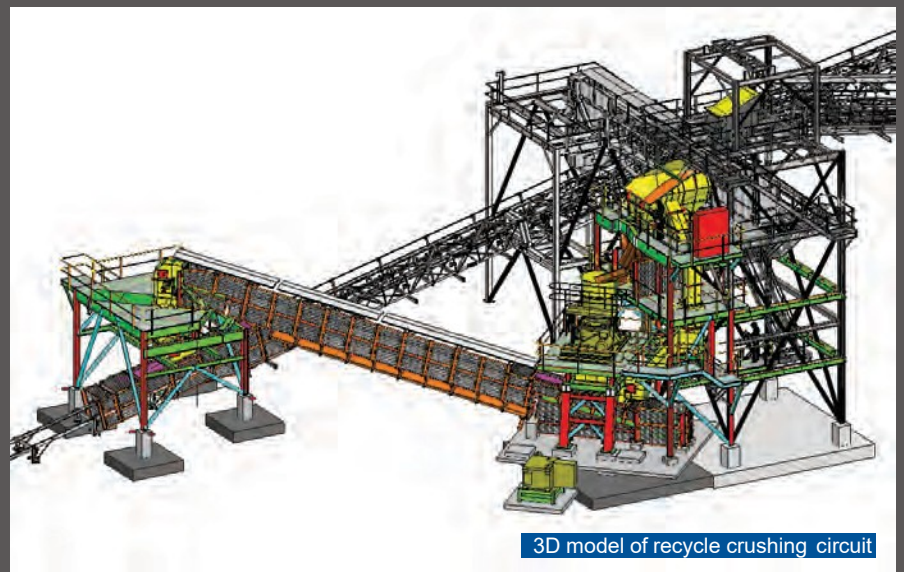
Pebble circuits are commonly installed when there is a change of ore type through the mine life. The circuit consists of a screen at the mill discharge to separate the pebbles, a magnet to remove small grinding media, a series of conveyors and a recycle crusher.

Recycle crushers are typically cone crushers and reduce the pebble size to minus 15 mm allowing them to be ground in the mill.

Mintrex has significant experience in the design and installation of new and retro-fit pebble crushers. They work with the site operations personnel and equipment suppliers to achieve the right fit-for-purpose solution and have provided innovative and low cost design solutions for four pebble



Low cost, value engineered recycle crusher



3D model of recycle crushing circuit

crusher installations in the last six months through West Africa, the Philippines and Western Australia.

A gold mine in Western Australia that had a short remaining mine life of two years was experiencing reduced production throughput due to the build-up of pebbles within the milling circuit. They required a cost effective solution for a recycle crusher.

The installation was designed as a value system using off-the-shelf conveyors to minimise installation time

and capital costs, consistent with the short remaining mine life. The installed system operated effectively and met the client's cost requirements and improved the processing efficiency of the plant. This same value concept was replicated at the mine of another client recently.

All designs are completed in 3D using site and equipment data with detailed drawings delivered direct from the 3D model to the fabricator reducing the delivery schedule.

For further information including contact details, visit the Mintrex website, www.mintrex.com.au



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