



CLIENTS | PEOPLE | PERFORMANCE

## Mining Services



GHD is a multidisciplinary engineering consultancy practice with over 6,000 employees located in more than 65 offices in Australia, New Zealand, the Middle East, Chile and the Asia-Pacific region, including China and Vietnam. GHD is wholly owned by its senior staff and has become one of the foremost consulting groups in Australasian region.

GHD's operations have expanded substantially following the integration of Egis Consulting Australia's workforce and that of Geo-Eng into our Group.

One of GHD's key strengths is our large, integrated network of local, regional and international offices so that our clients can benefit from our longevity in the market, throughout the region.

### Occupational Health, Safety and Rehabilitation Policy

The Directors of GHD are fully committed to providing a healthy and safe working environment for employees and contract staff.

GHD's policy is that equipment, workplaces and practices must comply with all relevant regulations and standards. Regular and ongoing reviews of these standards are conducted and where higher standards are practical and desirable, they will be adopted.

### Quality Assurance

All GHD offices operate under a Practice Quality Management System that is certified to AS/ISO 9001:1994.

### Capabilities

GHD has experience in design and project management service provision to a wide range of industry sectors including:

- ▶ Infrastructure
- ▶ Mining and Industry
- ▶ Defence
- ▶ Property and Buildings
- ▶ Environment

### Flexible Approach

GHD offers a flexible approach to the provision of services and will tailor service delivery to meet individual requirements. Support can be provided at various levels including:

- ▶ Project scope development
- ▶ Analysis of systems and management practices

- ▶ Strategic planning to assist in expenditure and inventory forecasting
- ▶ Detailed designs and specifications
- ▶ Project management services
- ▶ Maintenance management services
- ▶ Total management plans

## Services

GHD has a strong track record in supporting clients in the mining and industrial sector through the entire life cycle of operations. Many services can be provided by an organisation as large as GHD. Services within GHD's mining group include

- ▶ Mining, underground and open-pit
- ▶ Materials handling and storage
- ▶ Mineral processing: copper, coal, gold, nickel, lead and zinc, mineral sands phosphate, uranium
- ▶ Tailings disposal and return water management
- ▶ Power
- ▶ Water management
- ▶ Civil engineering services
- ▶ Asset management
- ▶ Maintenance management, fixed and mobile

## MINING ENGINEERING

GHD provides a wide range of engineering services for both underground and surface mining projects. The GHD mining team has extensive experience in life cycle engineering works associated with mining operations.

We carry out strategic and operational mine planning as well as infrastructure design, management assistance and environmental assessments. Our team can assist in all stages of resource geological, geotechnical, hydrological and geophysical investigations. We are actively involved in a wide range of mineral and coal mining projects in Australia, the Indian sub-continent, Southeast Asia and China.

GHD has successfully incorporated the use of integrated computerised mine planning systems for all our geological and mine modelling, and have been instrumental in helping both local and international clients set up and operate their own systems.

The following is a summary of the skill base and experience we can provide:

- ▶ Mining feasibility studies
- ▶ Due diligence and corporate governance
- ▶ Risk assessment and management systems
- ▶ System reliability evaluation
- ▶ Mine design
- ▶ Operational to long-term mine planning and scheduling
- ▶ Overburden removal and waste dump design
- ▶ Mine closure and rehabilitation design
- ▶ Equipment selection and scoping
- ▶ Design of mine infrastructure components including conveyor formations and civil works, roads, fire service systems, buildings, drainage and dewatering systems
- ▶ Geological resource assessment
- ▶ Coal quality evaluation
- ▶ Hydrogeological investigations and modelling
- ▶ Geotechnical investigation, design and slope stability monitoring and prediction
- ▶ Geotechnical and groundwater geophysical surveys and geophysical logging services
- ▶ Design, installation and monitoring of mine
- ▶ Dewatering systems
- ▶ Regional monitoring and prediction of mining environmental impacts
- ▶ Project management of design and construction activities for mine infrastructure
- ▶ Advice on contractual and legislative impacts of mining
- ▶ Mine technical training and operational advice
- ▶ Mine database/GIS and asset management services



- ▶ Quarry design
- ▶ Legislative work plan submissions

Our mining professionals provide unique, innovative solutions to mining issues. We work in multidiscipline project teams alongside our client team to add value to projects by applying quality engineering and scientific practices.

#### **Shafts and Hoisting**

GHD has excellent hoisting experience such that GHD can offer excellent system design, design review or construction management services on shaft and hoisting facilities.

#### **MATERIALS HANDLING**

GHD's services include planning, design and implementation of materials handling systems including feasibility studies, cost estimates, detailed design and project management for new projects and existing plant upgrades and trouble-shooting. Our capacity includes custom design of purpose built machinery.

#### **Experience**

- ▶ Mechanical equipment design
- ▶ Structural design
- ▶ Electrical design
- ▶ Process design
- ▶ Instrumentation and control
- ▶ Civil design
- ▶ Application of bulk materials flow properties for material handling solutions
- ▶ Finite Element Analysis (FEA)
- ▶ Contract and procurement documentation

#### **Project Capabilities**

- ▶ Conveyor design including high lift, drift, overland and variable speed
- ▶ Design of automatic equipment including boom stackers, radial stackers, shuttle heads and rail loadout facilities
- ▶ Ploughs/trippers

- ▶ Chute and bin design
- ▶ Reclaim tunnels
- ▶ Crushing and screening stations
- ▶ Storage bins and stockpiles
- ▶ Mechanical guarding and safety audits
- ▶ Mobile stockyard machinery

#### **Conveyor Systems**

GHD has extensive experience in all aspects of bulk materials handling for mines, process and industrial plants, stock yards, rail loading and unloading facilities, export and import ports and barge trans-shipment.

GHD has experience in Queensland, New South Wales and Western Australia in the design of conveyor systems handling many different material types. GHD also has engineering experience in bin design, material flow characteristics in bins, and material handling system modeling. This combination of skills is particularly useful for modeling and designing bins and transfers to match total system requirements.

GHD has provided a range of engineering services for small bulk handling projects both in Australia and overseas, including some of the world's largest bulk export port facilities.

#### **Underground Mine Conveyors**

GHD currently employs staff experienced in the detailed design and specification of underground conveyor systems. GHD engineering staff members have worked directly with underground conveyor systems, with previous employers and GHD, and possess in depth knowledge of both the technical design aspects and the practical operational aspects of underground conveyors.

#### **Pumping and Pipelines**

GHD has particular strength in the design of pumping systems due to its market leading position in the water supply and treatment industry sector. The experience in this sector has been transferred successfully to the mining and industrial sector and, increased by



the experience of new staff members, provides experience in water supply and reticulation systems, fuel pumping and distribution systems, contaminated liquid pumping and slurry pumping systems.

#### **Machine Specification**

GHD has a long history of project experience in large materials handling port facilities design and construction management.

This experience results in excellent capabilities in stockyard stackers and reclaimer specification.

The operations and project management experience of GHD's staff also provides capabilities in specification and construction management of mobile plant including haul trucks, dozers, draglines, shovels, excavators; underground mining equipment and transport vehicles; and various cranes and lifting equipment.

#### **MINERAL PROCESSING**

GHD minerals processing can provide a wide range of engineering services for any extractive metallurgical project. Our experience is built on a strong conceptual basis with extensive operational experience to provide innovative, cost-effective, practical plant solutions. We custom design processing circuits and equipment, optimise existing circuits, as well as troubleshoot specific problems. GHD offers a flexible approach to the provision of services and will tailor service delivery to meet individual client requirements.

Support can be provided at various levels including:

- ▶ Concept and Project scope development
- ▶ Feasibility and optimisation studies
- ▶ Process, testwork and design criteria reviews
- ▶ Multi-discipline engineering design
- ▶ Project management
- ▶ Procurement
- ▶ Equipment sizing and selection
- ▶ Expert witness
- ▶ Due diligence studies
- ▶ Maintenance and operations optimisation
- ▶ Study projects, plant reviews and audits

#### **Experience**

GHD's minerals processing experience include:

- ▶ Base metals (including copper, nickel)
- ▶ Light metals such as aluminium, magnesium, silicon
- ▶ Coal
- ▶ Iron ore
- ▶ Gold, silver, PGM's
- ▶ Mineral sands/ heavy minerals
- ▶ Diamonds and other gemstones
- ▶ Commercial minerals (including phosphate rock, kaolin, limestone)
- ▶ Bauxite and alumina
- ▶ Uranium
- ▶ Chemical (including phosphoric, hydrochloric and sulphuric acid, ammonia, salt)
- ▶ Solids and slurry handling, storage and pumping.

#### **Disciplines**

GHD's mineral processing group can provide a wide range of engineering services for selected extractive metallurgical disciplines.

Disciplines include:

- ▶ Mineral Processing: including crushing, comminution, classification, flotation, dense media, elutriation, ore sorting, thickening and dewatering
- ▶ Hydrometallurgical Processing: including heap leaching, HPAL, and atmospheric leach, CIP, SX, precipitation, crystallisation, purification, electrowinning and electro refining
- ▶ Pyrometallurgical Processing: including, heat and mass balances, reduction, roasting, sintering, drying, alloying and metal casting
- ▶ Other unit operations, including: gas cleaning (wet and dry), fluidised operations, condensers, heat exchange, reactor vessels, absorption columns, evaporators, granulators and dryers



### **Process Plant Design**

GHD is capable of delivering green-field plant, brown-field plant expansions or plant de-bottle necking projects. GHD's process team consists of a number of experienced people from a broad range of disciplines capable of designing testwork programs to define plant design criteria, size equipment to meet the criteria and develop flowsheets, mass balances, and P&ID's for process development design and implementation. Control philosophy and functional specifications documents based on operating and plant management experience can be compiled to develop short ramp up times to design production rates.

### **Previous Project Experience**

GHD's personnel have provided services to a large number of clients and projects with some of the recent projects including:

- ▶ Beneficiation, HPAL and refining of lateritic nickel/cobalt
- ▶ Iron ore crushing and screening plants and beneficiation of both magnetite and hematitic iron ores
- ▶ Roast, gas handling, thermal drying and acid plant modeling, with prediction of plant performance for various feedstocks
- ▶ Diagnostic leaching of gold ores and refractory gold plant design
- ▶ Nickel sulphide comminution, concentrator review, upgrade and greenfields plant design
- ▶ Heap leaching
- ▶ Coal preparation plant reviews and equipment selection
- ▶ Copper leach, electro-winning and electro-refining plant
- ▶ Review of thickening and filtration of high viscosity ores
- ▶ Diamond and heavy mineral plant
- ▶ AG, SAG and Ball mill design, review and optimisation
- ▶ Metal alloying and cast house design
- ▶ Power Station ash handling
- ▶ Alumina Refinery Red-Mud disposal

### **TAILINGS and ENVIRONMENTAL**

GHD provide a wide range of engineering services for any tailings and waste management, closure and rehabilitation project:

#### **Planning and Approvals**

- ▶ Pre-feasibility and feasibility studies
- ▶ Disposal options selection studies
- ▶ Long range disposal planning
- ▶ Approvals advice, and liaison with regulators
- ▶ Hazard and risk evaluation

Our multidisciplinary teams include:

- ▶ Process and chemical engineers
- ▶ Materials handling/slurry systems experience
- ▶ Tailings management planners
- ▶ Hydrologists and water scientists
- ▶ Geotechnical and dam engineers
- ▶ Surveyors, geologists and hydrogeologists
- ▶ Environmental engineers and scientists
- ▶ Project and construction managers
- ▶ Risk assessment facilitators
- ▶ Indigenous affairs advisers

#### **Investigation and Design**

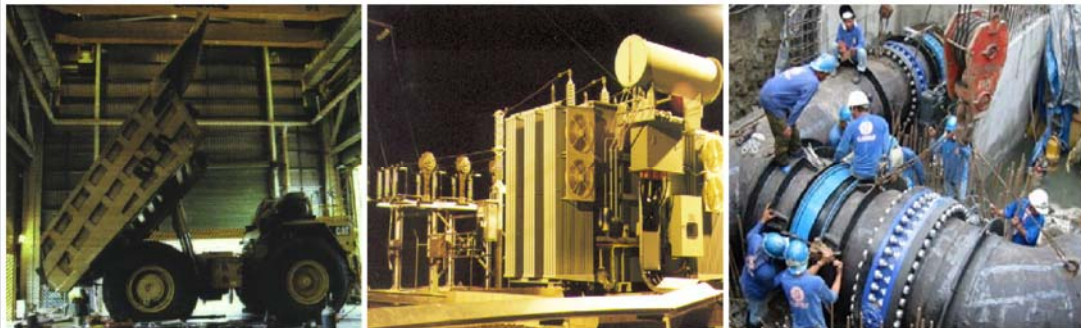
- ▶ Geotechnical investigations and site selection
- ▶ Slurry handling and processing systems design
- ▶ Tailings storage facilities design
- ▶ Seismic and liquefaction analyses
- ▶ Water management systems design

#### **Procurement and Commissioning**

- ▶ Contracts, estimating and tendering
- ▶ Project and construction management
- ▶ Certification and commissioning services

#### **Environment**

- ▶ Environmental studies and reporting
- ▶ Groundwater and seepage assessments
- ▶ Assessment and remediation of acid mine drainage



### **Closure and rehabilitation**

- ▶ Closure and rehabilitation studies and planning
- ▶ Post closure provisioning and management

### **Environmental Services**

Environmental issues are ever present in mines and industrial plants. GHD support its clients and manage these issues through services such as, statutory planning, environmental management plans, rehabilitation design and management, indigenous liaison, community consultation and tailings remediation management.

### **Tailings Management**

GHD has extensive knowledge in the design, construction and management of tailings disposal systems. Over the last 25 years GHD has been involved in more than 60 tailings disposal projects for many large mines and industrial facilities in Australia and overseas.

GHD has particular experience in tailings disposal systems, slurry pumping and pipeline systems design, tailings systems inspections and monitoring, geotechnical and dam engineering, water management, hydrogeology, environmental engineering and rehabilitation, and dam surveillance and safety assessment.

### **Groundwater Management**

Groundwater management affects a wide range of disciplines in which GHD has had a long term involvement. As a consequence, GHD has accumulated a substantial base of skills that together represent a comprehensive service for addressing situations that demand sound groundwater management. GHD has experience in groundwater based water supply systems, seepage management in geotechnical applications and landfill containment, dewatering and depressurization systems in mines and quarries, groundwater quality and contamination issues and groundwater flow and aquifer contamination modeling.

## **CIVIL ENGINEERING**

### **Planning Services**

For many years GHD has been combining experience in statutory and strategic planning, landuse and development planning,

transportation and traffic planning, and town planning to develop small mining camps to large scale residential, commercial and industrial estates.

### **Surveys**

GHD Survey Pty Ltd is the Survey and Photogrammetry division of the GHD Group with extensive experience in the survey and mapping industry. Areas of experience include all aspects of surveying, involving computerised surveying equipment and utilising a variety of computer software systems.

### **Civil Engineering Infrastructure**

GHD has a long history of civil design and construction on major bulk earthworks down to minor level correction projects. Civil engineering services offered include site preparation, bulk civils, level preparation, rail and port civils, drainage systems, hardstand and landscaping.

### **Buildings and Structures**

Our buildings and structures group offer complete services from architectural concepts through to detail design of complete facilities. Mine site facilities GHD have designed include process plant buildings, fuelling facilities, administration and amenity buildings, workshops, stores and control buildings.

### **Roads**

For more than 60 years, GHD have been involved in the surveying, engineering and project management of all types of road systems and associated works. GHD's experience includes:

- ▶ National highways
- ▶ Arterial roads
- ▶ Freeways
- ▶ Haul roads
- ▶ Subdivision roads
- ▶ Access
- ▶ Development roads



## **Rail**

GHD has extensive experience in providing a broad range of rail infrastructure services. GHD has carried out a very large number of feasibility studies for railways, spur lines and loading and unloading facilities. Many have advanced from the study phase to detailed route definition, detailed design and construction.

GHD maintains a very close relationship with all Australian Government railway authorities and a number of private rail transport companies.

## **Materials Transport Systems Operations Modelling**

GHD has extensive experience in modelling materials transportation and storage systems requiring multiple material movements. The GHD modelling system can be used to model various operating procedures of plants or materials transportation systems. This allows the designer to quickly analyse a range of operating strategies and make a selection based on rational and objective criteria.

As the design of any materials handling plant is largely dictated by the manner in which it will be operated, its internal configuration, and external constraints, GHD can model systems to assist in establishing the required project design criteria and plant operating parameters.

Existing plants can be modified and analysed to identify below-capacity equipment, bottlenecks and under-utilised equipment. GHD's computer modelling has been successful in enabling operators to rapidly assess the impact of major malfunctions of items of plant and other "what-if" scenarios.

## **MINE SERVICES**

### **Mechanical, Fire and Hydraulic Services**

GHD staff are experienced in the design, specification and construction management of building services for site facilities.

GHD has experience in the design and construction management of:

- ▶ Air conditioning and refrigeration plant
- ▶ Compressed air and vacuum systems
- ▶ Water and gas piping

- ▶ Fire detection and protection systems
- ▶ Ventilation
- ▶ Air conditioning
- ▶ Bulk air coolers
- ▶ Fume extraction and dust collection systems
- ▶ Hydraulics and plumbing

GHD can also perform compliance audits of existing and planned facilities and buildings.

### **Power and Communications**

Power services offered include:

- ▶ HV reticulation
- ▶ Sub stations
- ▶ Switchboards
- ▶ LV reticulation
- ▶ Motor control centres including VVVF drives
- ▶ DCS control systems
- ▶ Mine and plant monitoring
- ▶ SCADA telemetry
- ▶ Voice and data transmission
- ▶ IT systems

Projects undertaken include on site power supplies with reciprocating engines fuelled by diesel, heavy oil and gas, and gas and combustion turbines.

### **Water and Wastewater**

GHD provides a full range of water and related services.

Commissions can involve developing an integrated solution for water supply or water and waste management systems in the early stages of projects or for existing plant upgrades and retrofits. In-house, process experienced people can customise an industrial wastewater treatment plant for any particular application.



### **Aviation Services**

GHD is able to offer a full range of aviation services. These services include:

- ▶ Feasibility studies
- ▶ Economic and financial evaluations
- ▶ Site selection
- ▶ Master planning and airport development plans
- ▶ Design and documentation
- ▶ Project management
- ▶ Asset management
- ▶ Airport manuals and training
- ▶ Terminal planning
- ▶ Environmental assessment and environmental management plans
- ▶ Airport technical and safety inspections
- ▶ Pavement geometric design and management
- ▶ Airport lighting and navigational aids design

### **Underground Mine Services**

GHD and its staff have experience in the design, installation and operation of the majority of the services required to support underground mining operations, both in coal and metalliferous mines. GHD therefore provide services to design new mine services, or, optimise the operations of existing mine services.

Particular experience includes:

- ▶ Mine dewatering system design and optimisation
- ▶ Water supply and air supply system design with the ability to model networks to locate pressure management devices
- ▶ Design of underground power distribution systems that permit acceptable voltage drop and increased voltage control whilst consisting of cables of manageable sizes

GHD can also specify auxiliary ventilation equipment and design ventilation management devices such as overcasts, bulkheads, explosion doors etc.

### **Mine Ventilation and Cooling Systems**

GHD staff have experience in the design, specification and construction management of underground bulk air coolers, refrigeration plants and mine main ventilation fans. This experience has been in both metalliferous and coal mining environments.

GHD utilises the services of experienced people mine ventilation consultants to determine the ventilation and cooling requirements for all parts of an underground mine. GHD then specify, tender, award and construction manage the installation of major ventilation, surface refrigeration plants, underground bulk air coolers, and large surface bulk air cooler systems.

Accompanied by GHD's shaft experience, a complete ventilation solution is able to be offered to any underground mine.

### **MANAGEMENT**

#### **Construction and Project Management**

GHD has been responsible for the management of a significant number of large mining and industrial projects that have all been successfully completed. GHD has a substantial group of staff with project management experience and experienced people. A variety of software for project scheduling, cost control, procurement, contract and document management can be used.

The project management service and team are formed to suit client requirements. In some instances this has involved an integrated resource approach where team members are drawn from the client's and GHD's workforce. Our focus is on achieving the client's objectives with appropriate risk sharing.

#### **GHD Value Management Services**

Due to GHD's multidisciplinary services and GHD's staff having a broad range of backgrounds covering all stages of project delivery, GHD can provide clients GHD's Value Management Services that include Safety, Constructability, Operability and Maintainability Reviews. These services are offered on all GHD projects and can also be offered to clients in the form of an independent service.

The reviews are intended to facilitate the delivery of constructable designs to construction crews, and, operable and maintainable plant and equipment to operations personnel.



Recommended stages of design for reviews include:

- ▶ Concept development
- ▶ Site plan development
- ▶ Facility general arrangements
- ▶ Individual plant arrangements and specifications

#### ***Indigenous Services***

To demonstrate GHD's commitment to providing a holistic approach to serving our client's services to Indigenous Communities, as well as our commitment to culturally appropriate communication and consultation, we have formed GHD Indigenous Services. This group, with national representation, comprises people who are experienced in working with indigenous people, organisations, communities and funding agencies.

#### ***Asset Management***

GHD's Asset and Facilities Management Group is working with many industrial and municipal clients throughout Australia and internationally in the area of advanced life cycle asset management. In recent years GHD clients have realised the benefits of rigorous asset and facility management techniques in infrastructure procurement, operation, maintenance and depreciation.

#### ***Maintenance Management***

GHD's Maintenance Engineering and Logistics Management Services (MELMS) group has provided reliability centred maintenance analysis and training, maintenance management and technical publication services on a range of projects to mining and industrial Clients. These activities have enabled GHD's clients to realise significant and quantifiable savings in the management of their assets.

#### ***Risk Management***

GHD is able to offer services of personnel experienced in varying levels of risk management facilitation, from Safe Work Procedure facilitation workshops through to full HAZOP studies and Corporate Risk Assessments.

We can offer the services of our people to assist at whatever level desired and at whatever the stage of mine or plant development required for example during project development phase or after commencement of operations.

For more information, please contact:

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