Exploring, developing and operating a world-class mine involves complex challenges. Huge capital investments are often made in very demanding environments, hence projects need to be delivered on time, on budget, and to exacting safety and environmental standards. Fugro meets these challenges through its experience, resources, knowledge and ‘can do’ philosophy.

**INTRODUCTION**

Fugro’s expertise in the collection and interpretation of data relating to the Earth’s surface and sub-surface supports mining operations from initial exploration and feasibility, through the development and operation of facilities, to eventual closure and decommissioning.

We specialise in integrating geotechnical, environmental, hydrological, geological and survey services to acquire and interpret data and provide insight and support. Our intimate knowledge of the industry is derived from many years’ experience, working on projects throughout the Americas, Africa, Europe, Australia and Asia.

**THE FUGRO GROUP**

In diverse locations and environments, onshore and offshore, Fugro companies acquire and interpret earth and engineering data, provide specialist consultancy support, and assist in the discovery, identification, extraction and distribution of natural resources.

Fugro works with you, supporting each stage of your operation, identifying and overcoming environmental, logistical and technical challenges. Our knowledge and resources play a key role in the safe, reliable and responsible operation of facilities.

**OUR SERVICES**

Fugro provides the mining industry with numerous specialist geo-services, which are often integrated into a single-source package to streamline their delivery:

- Feasibility studies
- Satellite (InSAR) evaluation of ground stability
- Geological data processing, analysis, interpretation and mapping
- Earthquake and geohazard analysis
- Aerial photography and mapping
- Building concept studies and geotechnical design support
- Geo-monitoring
- Mine closure procedures

**QUALITY, SAFETY, AND ENVIRONMENT**

We are committed to ensuring that Fugro employees are the best in the business through training and personal development and through our world-wide culture of excellence. Thanks to continued investment in the best people, technology and equipment available, we can ensure that our operations – whether in the field or the office – are carried out with unwavering respect for quality, safety and the environment.

Every day, we demonstrate our commitment to HSEQ, not just through the application of mandated policies, regulations and laws, but in our approach to problem solving and our corporate-wide support of sustainable development.

**RISK MITIGATION**

We recognise the importance of delivering high-value, technically challenging mining projects according to the specific requirements of cost, time and HSEQ. The data that we acquire, process and interpret enables us to develop cost-effective solutions that minimise the technical risks associated with ground conditions, and to address any potential economic and political risks too.

We support mine owners and contractors not just through efficient technical solutions, but through effective project management and the provision of a total risk management service.

**MINING SERVICES**

Delivering a successful mining operation requires diverse knowledge of the composition and behaviour of substrata and a thorough understanding of conditions and factors that influence the development of infrastructure and facilities, as well as the long-term operation of the mine.
MINING SERVICES

Throughout the development of mining facilities, we acquire, interpret, model and apply data that contributes to a clearer understanding of the geological, geophysical and environmental conditions that apply. This enables our clients to evaluate strategies and proceed with solutions based on reliable measurements and assessment.

FROM PRELIMINARY INVESTIGATIONS TO SEAMLESS INTEGRATION OF MINING FACILITIES

DESKTOP STUDY
A desk study is a cost-effective way of minimising the risk of unexpected ground conditions and the impact these may have on the project.

We survey the target site using existing data to identify specific features. We review available information about the history of the site and determine the probable geological conditions, including soil and rock type, and the potential for gas emissions, groundwater, vegetation and contamination. We then assist clients in identifying the geological liability of the site, characterisation, slope stability, obstructions and/or hazardous conditions. We then carry out field studies in a timely manner, enabling us to quickly identify ground conditions and the potential effect of cyclic loads, such as wave action, wind and earthquakes.

We deploy appropriate equipment to carry out field studies in a timely manner, enabling us to quickly identify ground characterisation, slope stability, obstructions and/or hazardous conditions. We then provide clients with an appraisal of the site and any possible constructability issues.

- Interpretation of aerial and satellite images
- Exploration program design
- Country studies
- Market analysis
- Mapping

RECONNAISSANCE
At the reconnaissance stage, we conduct further research and collect additional data through observing existing conditions in the field.

We deploy appropriate equipment to carry out field studies in a timely manner, enabling us to quickly identify ground characterisation, slope stability, obstructions and/or hazardous conditions. We then provide clients with an appraisal of the site and any possible constructability issues.

- Regional geochemical and geological surveys
- Remote sensing
- Airborne geophysics
- Training
- Exploration program design

EXPLORATION
Good planning and excellent resources are vital to successful site exploration programs. We deliver these key components for any project, at any location in the world.

We plan and carry out effective site exploration to help eliminate expensive surprises during the development and operation of mining facilities. Our advanced soil and rock laboratories reveal sub-surface conditions and the potential effect of cyclic loads, such as wave action, wind and earthquakes.

- Drilling
- Wireline logging
- Geophysics
- Hydrological assessment
- High precision land surveys
- Resource modelling and classification
- Environmental and social EIS/EA
- Mine planning
- Economic analysis

PRE-FEASIBILITY/FEASIBILITY
This is a critical stage in many projects, with the quality of environmental, geological and geotechnical engineering forming the baseline for project success. Our geologic hazard assessments, engineering capability and field data collection combine to provide reliable profiles of target locations, integrating this information into a GIS system for the development of the mine.

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CONSTRUCTION/EPC
We are recognised leaders in the provision of engineering and construction support to the mining industry, with the capability to execute groundworks, conduct ongoing testing and monitoring and advise on infrastructure development.

Our experience in coastal engineering and construction, coupled with our global fleet of jack-up platforms, means we are the first choice for geotechnical investigations in ports and harbours. At the EPC stage, we provide on-site construction materials testing laboratories and deep pile foundation testing.

- Cone Penetration Testing (CPT)
- Drilling
- Wireline logging
- Geophysics
- Mine layout
- Environmental audits
- Training
- Mine closure plans
- Monitoring
- Recultivation

OPERATION AND CLOSURE
During the operational life of the mine, we provide geotechnical and geological analysis of slope stabilities, in situ geo-monitoring, periodic LIDAR surveys of open pit developments and stockpiles, tailings facilities integrity surveys and advice on water mapping, pollution control and other operational issues.

We also provide mine closure plans and ongoing safety monitoring of closed mines.

- Cone Penetration Testing (CPT)
- Drilling
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MINING CASE STUDIES

Mining developments are often multi-billion dollar investments that involve numerous complex challenges. On these two pages, we present a cross section of sample projects from different regions of the world, demonstrating our technical capability and versatility.

IRON ORE MINING
Samarco, Brazil

As part of the Vale Mining Co JV with BHP, Fugro provided soil and rock boreholes, CPT, geophysical surveys and lab testing on the Samarco open pit mine in the state of Minas Gerais, Brazil.

BHP BILLITON, MINERA ESCONDIDA, WATER SUPPLY
Puerto Coloso, Antofagasta, Chile

Fugro performed geotechnical studies for the design of intake and outfall tunnels on the Escondida mine in Chile – one of the world’s largest producers of copper. This included boreholes 40 metres below the seafloor, acoustic borehole testing, permeability tests and laboratory testing.

K+S POTASH CANADA – LEGACY PROJECT
Saskatchewan, Canada

Fugro provided geotechnical recommendations for shallow foundations, drilled shafts, and drilled-and-underreamed (belled) footings based on the information obtained from previous reports prepared by others. We were retained for field QA/QC to ensure satisfactory implantation of our recommendations.

ANGLO AMERICAN THERMAL COAL PRODUCTION WELLS
Lephalale, South Africa

As a long-term service provider to Anglo American Thermal Coal, Fugro was awarded a service-level agreement to provide diamond drilling (wireline and conventional), percussion and rotary drilling, airflush coring, reverse circulation, rotary air core, simultaneous casing and water well drilling/development. Activities are mainly focused in the Mpumalanga Province of South Africa.

JADAR LITHIUM EXPLORATION PROJECT
Loznica, Serbia

Fugro was contracted to perform a wide range of wireline logging services on the Jadar Lithium Exploration Project in Serbia – one of the world’s largest future lithium deposits. The program provided structural analysis and evaluation of petrophysical, geotechnical and hydrogeological data for the construction of the mine, 100km northeast of Belgrade.

RWE 3D SURVEY OPEN CAST MINE
Garzweiler, Germany

Fugro’s DRIVE-MAP system, which simultaneously collects accurate 3D data and imagery from a vehicle, was used by RWE to obtain a complete overview of their open-cast lignite mine in Germany. Under RWE’s supervision, part of the mine and the huge excavators used in it, were surveyed with a positional accuracy of 5cm, providing 3D data for computing volumes and identifying layers.

WATER SUPPLY STUDY, POTASH MINE
Danakil, Ethiopia

Fugro established a drilling program and supervised observation and production wells at a new potash mine development in Ethiopia. After preliminary evaluations and satellite imagery of the catchment areas, we provided meteorological and climatic data, a geophysical survey of aquifer structures and a conceptual geohydraulic model for planning well field structures.

GOONYELLA COAL MINE
Moranbah, Australia

Fugro was contracted by the BHP Billiton Mitsubishi Alliance (BMA) to provide high resolution aerial imagery and high density LiDAR at its large open cut coal mine in central Queensland. In addition, the three-year project involved us providing stock pile volumes, infrastructure mapping, pit volume measurements and berm condition reports.

Wherever we operate in the world, our policies and procedures are aligned with those of our clients, ensuring that all expectations relating to service provision, quality standards, health and safety and environmental regulations are met.