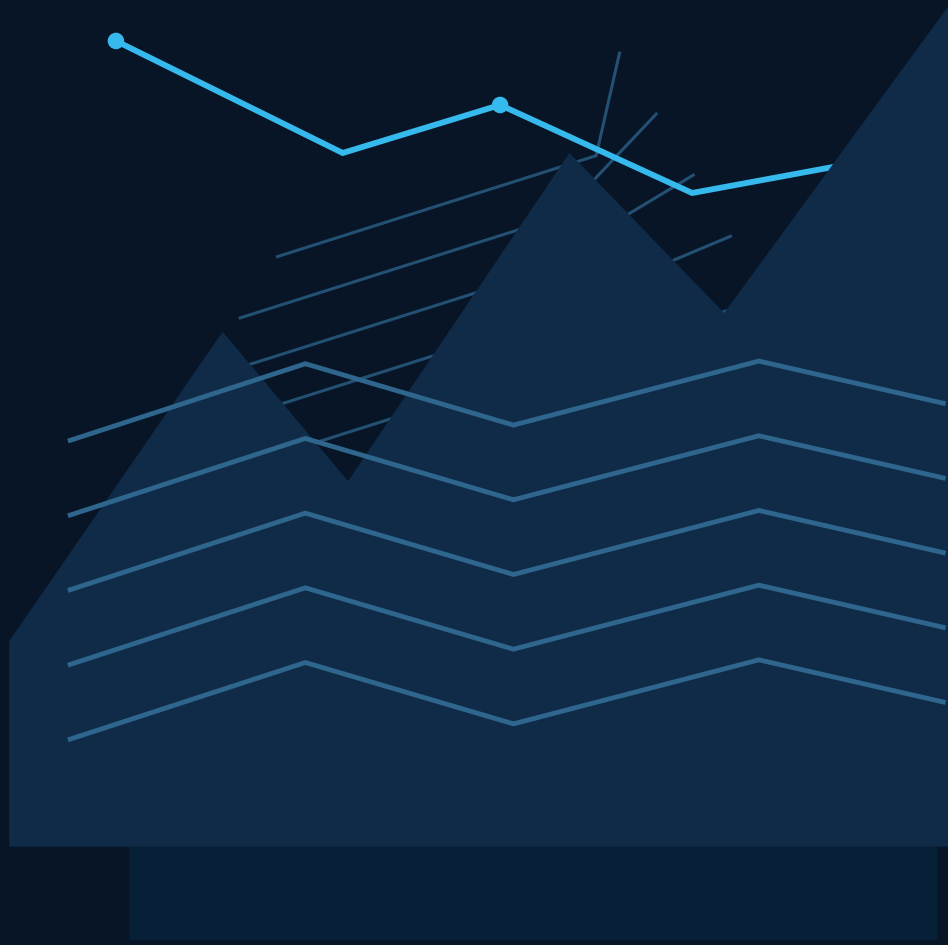
GFF AI / GLOBAL MINING

ENTERPRISE INTELLIGENCE / ENGINEERING

INTELLIGENT MINING.

MINING SOLUTIONS & OPPORTUNITIES CATALOGUE

AI-enabled mining operations, industrial data and engineering services across the full mine lifecycle.



EXECUTIVE EDITION / OCTOBER 2026

124 illustrative use cases across 15 mining domains.

Opportunity catalogue - not a declaration of 124 existing products.

01 / EXECUTIVE VIEW

One mining lifecycle. Two routes to value.

GFF AI can work with mining organizations to identify high-impact opportunities, design governed AI-assisted workflows and engineer the data, applications and integrations required for deployment.

15 MINING DOMAINS

124 ILLUSTRATIVE USE CASES

02 COMPLEMENTARY BUSINESSES

GFF AI MINING SERVICES

Operational AI and domain-led solutions

Potential solution concepts across exploration, planning, production, processing, safety, sustainability and mine-to-market operations.

GFF AI ENGINEERING SERVICES

Industrial AI delivery and integration

Enterprise architecture, OT / IT integration, data engineering, model development, deployment, modernization and managed AI operations.

02 / PORTFOLIO NAVIGATOR

Explore the mining value chain.

Select any domain below. Each section provides potential use cases, a technology design lens and practical areas of client value.

01 Exploration & Geoscience
8 opportunity areas

02 Resource & Reserve Intelligence
8 opportunity areas

03 Mine Planning & Scheduling
8 opportunity areas

04 Drilling, Blasting & Fragmentation
8 opportunity areas

05 Open-Pit & Mobile Fleet Operations
9 opportunity areas

06 Underground Mining & Ground Control
9 opportunity areas

07 Mineral Processing & Metallurgy
9 opportunity areas

08 Maintenance & Asset Reliability
9 opportunity areas

09 Workforce Safety & Operational Risk
8 opportunity areas

10 Water, Tailings & Environment
8 opportunity areas

11 Energy, Emissions & Decarbonization
8 opportunity areas

12 Logistics, Supply Chain & Marketing
8 opportunity areas

13 Commercial, Finance & Governance
8 opportunity areas

14 Critical Minerals & New Value Chains
7 opportunity areas

15 Digital Mine, Data & OT / IT
9 opportunity areas

Navigate by selecting a sector tile. All examples are subject to client discovery.

03 / OUR SOLUTION DESIGN PHILOSOPHY

Mine-grade intelligence. Engineered responsibly.

Proposed architecture principles to connect mining context, trusted operational data, advanced analytics and human-led decisions across challenging operating environments.

01

GEOLOGY TO OPERATIONS CONTEXT

Link geological models, mine plans, movement, metallurgical performance and commercial outcomes.

02

EXPERT-IN-THE-LOOP DECISIONS

Keep geologists, engineers, operators and safety leaders accountable for critical decisions.

03

OT / IT INTEGRATION FIRST

Use controlled connections to historians, dispatch, planning tools, EAM, LIMS and enterprise systems.

04

PHYSICS + ML + WORKFLOW AI

Combine engineering rules and domain models with validated ML and constrained AI assistance.

05

RESILIENCE, SAFETY & EVIDENCE

Design robust failure modes, monitoring, audit trails, data quality and cyber-security boundaries.

06

REUSABLE COMPONENTS, SITE FIT

Assess available components then configure or engineer for geology, commodities and site requirements.

Exploration & Geoscience

From regional prospectivity to better-informed exploration decisions.

DESIGN LENS

Integrate geological interpretations, sampling, geophysics and remote sensing into explainable exploration workflows.

POTENTIAL VALUE

- Exploration focus
- Faster geological synthesis
- Traceable data decisions

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

EX-01 Mineral prospectivity intelligence

Combine geoscience layers and target criteria to help rank prospective zones.

EX-02 Geophysical interpretation copilot

Assist interpretation of magnetic, gravity and electromagnetic survey datasets.

EX-03 Satellite & hyperspectral insights

Screen alteration patterns and surface features from licensed imagery.

EX-04 Geochemical anomaly discovery

Identify multivariate assay patterns with spatial and quality context.

EX-05 Exploration drilling targeting

Link target hypotheses, drill results and constraints for geologist review.

EX-06 Core logging intelligence

Structure visual and textual core observations with human validation.

EX-07 Tenement & exploration knowledge

Search permits, surveys, technical reports and prior campaign evidence.

EX-08 Exploration campaign planning

Compare survey and drilling options against access, cost and risk assumptions.

Illustrative use cases. Scope and availability subject to discovery.

Resource & Reserve Intelligence

More coherent geological models, data quality and reporting evidence.

DESIGN LENS

Connect geological databases, block models, uncertainty analysis and reporting workflows; keep competent-person sign-off.

POTENTIAL VALUE

- Model quality
- Uncertainty visibility
- Reporting confidence

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

RE-01 Resource data validation

Flag assay anomalies, missing intervals, duplicates and sampling inconsistencies.

RE-02 3D geological model assistance

Support domain interpretation and model revision from geological evidence.

RE-03 Grade estimation diagnostics

Surface model sensitivity, estimation exceptions and validation plots.

RE-04 Geometallurgical intelligence

Relate ore textures, mineralogy and hardness to processing behaviours.

RE-05 Orebody uncertainty scenarios

Compare uncertainty envelopes and sensitivities for planning decisions.

RE-06 Reconciliation of model to mine

Trace grade and tonnage differences across model, production and plant.

RE-07 Technical disclosure drafting

Assemble evidence-backed technical report sections for expert review.

RE-08 Resource-to-reserve workflow

Track modifying factors, assumptions and approval evidence across studies.

Illustrative use cases. Scope and availability subject to discovery.

Mine Planning & Scheduling

Operationally grounded plans from strategic life-of-mine to the next shift.

DESIGN LENS

Link mine models, equipment capacity, constraints and actual performance to human-approved plans and scenarios.

POTENTIAL VALUE

- Plan adherence
- Short-interval control
- Scenario transparency

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

PL-01 Life-of-mine scenario cockpit

Compare production, capital, risk and commodity-price assumptions.

PL-02 Short-term production scheduling

Refresh candidate schedules as equipment and material conditions change.

PL-03 Short-interval control intelligence

Explain deviations between dispatched, executed and planned work.

PL-04 Ore blending & feed planning

Evaluate blending options against grade, recovery and processing limits.

PL-05 Mine-to-mill optimization

Connect fragmentation, ore characteristics and mill constraints.

PL-06 Cut-off grade decision support

Assess cut-off alternatives using approved economic and operating models.

PL-07 Survey-to-plan reconciliation

Compare drone or survey surfaces with mine progress and designs.

PL-08 Production planning copilot

Summarize bottlenecks, constraints and cross-team planning actions.

Illustrative use cases. Scope and availability subject to discovery.

Drilling, Blasting & Fragmentation

Closed-loop insight from drill execution to material movement.

DESIGN LENS

Join approved blast designs with drill telemetry, geology, safety controls and measured fragmentation outcomes.

POTENTIAL VALUE

- Drill quality
- Fragmentation visibility
- Controlled variance

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

DB-01 Drill performance intelligence

Analyze penetration, availability and utilization by geology and equipment.

DB-02 Drillhole deviation analytics

Reconcile measured hole paths and geology against engineered designs.

DB-03 Blast design review assistant

Check completeness, approvals and operational constraints in blast plans.

DB-04 Blast vibration intelligence

Analyze monitored vibration and airblast trends against site limits.

DB-05 Fragmentation vision analytics

Estimate fragmentation distributions from calibrated post-blast imagery.

DB-06 Misfire & exception workflow

Organize observations, exclusion controls and expert review evidence.

DB-07 Drill-and-blast cost intelligence

Connect consumables, drilling outcomes and downstream performance.

DB-08 Blast-to-crusher reconciliation

Link blast zones, fragmentation and crusher throughput for improvement.

Illustrative use cases. Scope and availability subject to discovery.

Open-Pit & Mobile Fleet Operations

Connected decisions across loading, hauling, roads and dispatch.

DESIGN LENS

Use dispatch, telematics, material tracking and road-condition data to support supervisors without bypassing fleet safety systems.

POTENTIAL VALUE

- Productive equipment hours
- Haulage visibility
- Lower operating variability

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

OP-01 Fleet dispatch intelligence

Surface congestion, queueing and assignment opportunities for dispatchers.

OP-02 Truck cycle-time analytics

Explain loading, travel, dumping and queuing delay drivers.

OP-03 Payload compliance monitoring

Identify overload and underload patterns using calibrated payload signals.

OP-04 Haul-road condition analytics

Combine vehicle response, inspection and weather data to flag hotspots.

OP-05 Loading equipment productivity

Analyze shovel and loader utilization, match factor and idle time.

OP-06 Fuel & idle reduction insights

Detect avoidable idle, driving variability and fuel consumption patterns.

OP-07 Ore misrouting prevention

Cross-check material destinations against planned source and grade data.

OP-08 Autonomous fleet oversight

Monitor exceptions, interfaces and human escalations in approved systems.

OP-09 Shift supervisor intelligence

Generate shift summaries, loss trees and action-oriented handovers.

Illustrative use cases. Scope and availability subject to discovery.

Underground Mining & Ground Control

Production and safety visibility below the surface.

DESIGN LENS

Combine ventilation, seismic, geotechnical, equipment and workforce data into governed operational intelligence.

POTENTIAL VALUE

- Ground-risk awareness
- Underground productivity
- Ventilation insight

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

UG-01 Underground equipment tracking

Unify location and utilization telemetry across mobile assets.

UG-02 Ground-control monitoring cockpit

Trend displacement, support inspections and hazard observations.

UG-03 Microseismic event intelligence

Correlate seismic observations with excavation context for expert review.

UG-04 Ventilation-on-demand insights

Recommend energy-aware scenarios within approved ventilation constraints.

UG-05 Personnel proximity awareness

Integrate approved tagging and location data with exception workflows.

UG-06 Stope performance reconciliation

Compare design, dilution, recovery and actual mining volumes.

UG-07 Development heading tracking

Connect face progress, services, survey and schedule dependencies.

UG-08 Underground logistics optimization

Analyze ore passes, tramming delays and material movement bottlenecks.

UG-09 Shift & permit coordination

Bring permits, equipment status and inspection actions into handovers.

Illustrative use cases. Scope and availability subject to discovery.

Mineral Processing & Metallurgy

Better visibility from run-of-mine ore to saleable concentrate.

DESIGN LENS

Link lab, historian, mineralogy and process data with approved metallurgy models and operator-reviewed recommendations.

POTENTIAL VALUE

- Recovery insight
- Stable throughput
- Process variability control

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

MP-01 Crushing & grinding intelligence

Analyze power, feed characteristics, liner status and throughput constraints.

MP-02 Flotation performance advisor

Relate chemistry, froth images and control data to recovery trends.

MP-03 Leach & hydrometallurgy analytics

Track reagent, residence-time and recovery relationships.

MP-04 Ore characterization integration

Connect geometallurgical classes to plant performance and planning.

MP-05 Recovery & grade soft sensors

Estimate difficult-to-measure quality variables with validated models.

MP-06 Process anomaly investigation

Detect deviations and assemble contextual evidence for metallurgists.

MP-07 Reagent consumption intelligence

Explain dosage variability and candidate efficiency opportunities.

MP-08 Metallurgical accounting assurance

Reconcile assays, mass balance and plant production records.

MP-09 Plant operations copilot

Make SOPs, historian trends and shift logs accessible to operators.

Illustrative use cases. Scope and availability subject to discovery.

Maintenance & Asset Reliability

Move from reactive maintenance toward evidence-led reliability.

DESIGN LENS

Combine condition monitoring, work orders, inspection evidence and reliability methods for maintenance decisions.

POTENTIAL VALUE

- Equipment availability
- Lower unplanned downtime
- Maintenance effectiveness

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

AR-01 Predictive maintenance signals

Detect failure precursors from vibration, temperature and operating load.

AR-02 Reliability-centered maintenance copilot

Assist failure-mode review and maintenance strategy documentation.

AR-03 Work order triage & prioritization

Connect defects, production impact, risk and resource constraints.

AR-04 Spare-parts demand intelligence

Forecast critical spares using usage, lead times and installed base.

AR-05 Heavy mobile equipment health

Combine oil analysis, telematics and inspection findings by asset.

AR-06 Conveyor & idler monitoring

Identify abnormal vibration, temperature and inspection evidence.

AR-07 Crusher and mill asset monitoring

Analyze bearing, drive, liner and lubrication-related indicators.

AR-08 Maintenance execution insights

Surface schedule breaks, backlog, wrench time and repeat failures.

AR-09 Technical knowledge agent

Retrieve OEM manuals, defect history and verified maintenance procedures.

Illustrative use cases. Scope and availability subject to discovery.

Workforce Safety & Operational Risk

Human-centered intelligence for hazardous operational environments.

DESIGN LENS

Support qualified site teams with risk signals, permits and evidence; avoid autonomous safety-critical decisions.

POTENTIAL VALUE

- Hazard visibility
- Faster incident learning
- Accountable action closure

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

HS-01 Safety observation intelligence

Analyze hazard reports, near misses and actions for recurring themes.

HS-02 PPE & restricted-zone vision

Identify configured visual exceptions for supervised review.

HS-03 Fatigue risk analytics

Combine approved work-hour, roster and telemetry data with privacy controls.

HS-04 Incident investigation assistant

Assemble timelines, evidence and lessons learned for investigators.

HS-05 Permit-to-work intelligence

Track authorization, isolation dependencies and expiry exceptions.

HS-06 Critical control verification

Monitor evidence that defined controls are checked and maintained.

HS-07 Emergency readiness knowledge

Organize response plans, drills, communications and open corrective actions.

HS-08 Contractor safety intelligence

Connect induction, competencies, inspections and contractor exposures.

Illustrative use cases. Scope and availability subject to discovery.

Water, Tailings & Environment

Transparent monitoring and stewardship across the mine lifecycle.

DESIGN LENS

Unify sensor, inspection, laboratory and geospatial evidence; qualified engineers retain tailings and environmental decisions.

POTENTIAL VALUE

- Monitoring clarity
- Compliance evidence
- Water stewardship

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

WE-01 Tailings monitoring intelligence

Trend instrumentation and inspection anomalies for engineer review.

WE-02 Tailings governance evidence hub

Organize lifecycle records, action tracking and assurance documentation.

WE-03 Mine water balance intelligence

Reconcile water inflows, storage, recycling and discharge data.

WE-04 Water quality anomaly detection

Identify changing chemistry and sampling inconsistencies.

WE-05 Dust & air-quality analytics

Combine monitoring, weather and operating context for response planning.

WE-06 Rehabilitation progress monitoring

Compare spatial imagery with landform and revegetation plans.

WE-07 Biodiversity evidence management

Organize environmental surveys, obligations and mitigation actions.

WE-08 Closure liability planning support

Connect closure activities, assumptions, costing and monitoring records.

Illustrative use cases. Scope and availability subject to discovery.

Energy, Emissions & Decarbonization

Operational pathways to lower energy intensity and stronger reporting.

DESIGN LENS

Connect mine power, processing load, fleet fuel and carbon accounting to modeled decarbonization scenarios.

POTENTIAL VALUE

- Energy transparency
- Emissions visibility
- Better investment cases

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

EN-01 Site energy intelligence

Explain demand, energy intensity and cost by operation and equipment.

EN-02 Renewables & storage scheduling

Evaluate approved power scenarios using site load and supply forecasts.

EN-03 Haul fleet electrification planning

Model charging, duty cycles and infrastructure trade-offs.

EN-04 Ventilation energy optimization

Analyze demand drivers within approved underground ventilation constraints.

EN-05 Scope 1 and 2 emissions data

Reconcile activity data, factors and disclosures with audit trails.

EN-06 Scope 3 data collaboration

Structure supplier emissions estimates, evidence and data gaps.

EN-07 Carbon abatement scenario engine

Compare capital, operating and emissions assumptions for interventions.

EN-08 Energy procurement risk analytics

Evaluate tariff exposure, contracted supply and demand profiles.

Illustrative use cases. Scope and availability subject to discovery.

Logistics, Supply Chain & Marketing

Connected mine-to-market visibility across materials and commitments.

DESIGN LENS

Join stockpiles, rail, port, shipping, assays, inventory and contracts into reliable material and commercial workflows.

POTENTIAL VALUE

- Material traceability
- Fewer logistics breaks
- Shipment visibility

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

LC-01 Mine-to-port logistics cockpit

Track material movement, bottlenecks and handover exceptions.

LC-02 Stockpile inventory intelligence

Combine survey quantities, quality assays and material movements.

LC-03 Rail & haulage scheduling support

Evaluate routing and capacity conflicts for planning teams.

LC-04 Port & vessel turnaround insights

Explain queuing, berth, blending and load-out delay drivers.

LC-05 Shipment quality reconciliation

Match sampling, certificates, contract specs and delivery records.

LC-06 Critical spares supply intelligence

Monitor supplier risks, long lead times and inventory exposures.

LC-07 Procurement contract copilot

Extract obligations, pricing conditions and supplier performance evidence.

LC-08 Commodity sales operations agent

Coordinate nominations, documents, shipment milestones and exceptions.

Illustrative use cases. Scope and availability subject to discovery.

Commercial, Finance & Governance

Smarter capital allocation, commercial controls and executive oversight.

DESIGN LENS

Tie operational facts to financial models, contracts, capital projects and compliance evidence.

POTENTIAL VALUE

- Commercial discipline
- Decision transparency
- Governance readiness

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

CF-01 Mine profitability intelligence

Bridge tonnes, grade, recovery, prices and costs into operating margin.

CF-02 Unit cost & variance analytics

Explain cost per tonne, per ounce or per pound and key variance drivers.

CF-03 Capital project controls agent

Unify progress, commitments, claims, change orders and forecast cost.

CF-04 Royalties & contract intelligence

Interpret applicable terms and flag reconciliation exceptions.

CF-05 Commodity price scenario cockpit

Model exposure to prices, FX, freight and production assumptions.

CF-06 Operational audit workbench

Organize operational control evidence, sampling and audit workpapers.

CF-07 ESG disclosure assurance support

Link reported indicators to source data, owners and review history.

CF-08 Executive mining performance copilot

Turn site KPIs, risks and action logs into governance-ready briefs.

Illustrative use cases. Scope and availability subject to discovery.

Critical Minerals & New Value Chains

Intelligence for lithium, copper, nickel, rare earths and circular materials.

DESIGN LENS

Integrate mineral-specific process data, traceability and supply-chain evidence without overstating technical maturity.

POTENTIAL VALUE

- Critical-mineral insight
- Process learning
- Chain-of-custody clarity

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

CR-01 Battery mineral process intelligence

Track mineral-specific recovery, impurity and product-quality variables.

CR-02 Rare-earth separation analytics

Study extraction, separation and purification datasets with experts.

CR-03 Lithium brine & hard-rock insights

Combine resource chemistry, process conditions and recovery evidence.

CR-04 Copper grade-to-cathode visibility

Reconcile mining, concentrator, smelter or leach data as applicable.

CR-05 Responsible mineral traceability

Link origin, custody and declared provenance records across parties.

CR-06 Tailings reprocessing opportunity

Screen historical materials for recovery and economic study potential.

CR-07 Recycling & circular minerals data

Connect recovered materials, quality and process yields with reporting.

Illustrative use cases. Scope and availability subject to discovery.

Digital Mine, Data & OT / IT

The connected technical foundation for resilient mining AI.

DESIGN LENS

Engineer mine-grade data pipelines, integration, model operations and secure human-governed applications.

POTENTIAL VALUE

- Trusted industrial data
- Faster AI deployment
- Operational resilience

Illustrative opportunities; solution design and technical feasibility confirmed with each client.

DM-01 Mining operations data fabric

Integrate historian, MES, FMS, LIMS, CMMS, ERP and geospatial data.

DM-02 Mine digital twin foundation

Link asset, process and spatial models to trusted operating signals.

DM-03 OT / IT data integration

Design controlled interfaces across industrial and enterprise systems.

DM-04 Mine knowledge & document agents

Search engineering standards, SOPs, incident logs and technical records.

DM-05 Industrial edge vision platform

Deploy approved inspection models with local inference and monitoring.

DM-06 AI governance & model operations

Version datasets, models, evaluations, permissions and intervention paths.

DM-07 Operations control-room copilots

Build contextual dashboards and human-approved recommendations.

DM-08 Cyber and resilience intelligence

Correlate asset inventory, security events and operational dependencies.

DM-09 Legacy mining application modernization

Upgrade interfaces, integration patterns, tests and selected applications.

Illustrative use cases. Scope and availability subject to discovery.

04 / GFF AI ENGINEERING SERVICES

Engineering the connected, intelligent mine.

From industrial systems and geology data to AI applications, GFF AI Engineering Services can scope and deliver tailored technology programs across the mining enterprise.

ES-01 Mining AI strategy & value discovery

Opportunity assessment, KPI baselines, architecture and delivery roadmap.

ES-02 Mine data platform engineering

Industrial data pipelines, lakehouses, governance and model-ready information.

ES-03 OT / IT systems integration

Secure interfaces for historians, SCADA, FMS, MES, LIMS, EAM and ERP.

ES-04 Digital twin & simulation engineering

Operational models, scenario frameworks and integration of specialist tools.

ES-05 Industrial ML & MLOps

Feature engineering, predictive models, evaluation, drift and retraining.

ES-06 Computer vision & edge AI

Asset inspection, site imagery, deployment pipelines and performance monitoring.

ES-07 Mining application modernization

Platform migration, workflow refactoring, APIs, testing and automation.

ES-08 Geospatial & remote-sensing AI

Satellite, LiDAR, drone and GIS analytics with validation workflows.

ES-09 AI governance, security & resilience

Data controls, agent permissions, OT boundaries, auditability and monitoring.

ES-10 Engineering CoE & managed AI services

Design, build, deploy, operate and continuously evaluate site AI systems.

DELIVERY PRINCIPLE Integrate with existing mine systems; validate on-site; retain human operational control.

05 / CLIENT ENGAGEMENT & COMMERCIAL MODEL

From operational opportunity to measured value.

Engagements are designed around mine conditions, data readiness, technology dependencies, safety boundaries and a jointly agreed value case.

01

DISCOVER

Prioritize the problem, understand site data, systems, economics and risk.

>

02

VALIDATE

Test a bounded use case with agreed KPI baselines and expert review.

>

03

ENGINEER

Configure proven components where available; develop bespoke solutions as needed.

>

04

OPERATE

Deploy securely, monitor in production and continuously improve.

HOW AVAILABILITY IS ESTABLISHED

This is an opportunity catalogue, not an inventory of deployed GFF AI mining products. Specific assets, maturity, integrations and delivery models are confirmed during discovery.

COMMERCIAL ENGAGEMENT OPTIONS

Feasibility assessment / scoped proof of value / tailored engineering delivery / managed AI operations.

Fees, timing, technology licensing and infrastructure costs are scoped individually.

GFF AI

GARAGE | FOUNDRY | FACTORY

THE NEXT CONVERSATION

What could a connected mine do next?

Select one operational challenge. We can assess the data, technology, risk, value potential and delivery approach with your team.

GFF AI MINING SERVICES / GFF AI ENGINEERING SERVICES

www.gffai.ai

Illustrative opportunities; no claim of current product availability.