MAY 2026

CURRENT PROJECTS REPORT

This report is a summary of current and completed projects for the months February, March and April 2026

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UNDERGROUND

Reports Published This Quarter

C20033
Developing a Safer Underground Explosive
University of New South Wales
Duncan Chalmers
Link to download the final report:
https://www.acarp.com.au/abstracts.aspx?repId=C20033

C29014
Definition and quantification of long-term stability of coal pillar systems
University of New South Wales
Ismet Canbulat
Link to download the final report:
https://www.acarp.com.au/abstracts.aspx?repId=C29014

C34021
Roof Beam Support Assessment Tool
Resource Geotechnical
Terry Medhurst
Link to download the final report:
https://www.acarp.com.au/abstracts.aspx?repId=C34021

C35008
Optimum Design of Pillars with Various Sizes and Shapes at Increasing Stress Environment
The University of Queensland
Mehdi Serati
Link to download the final report:
https://www.acarp.com.au/abstracts.aspx?repId=C35008

Coal Burst

C35014 Investigation of Pre-Installation of Optic Fibre Cable in Exploration Holes for Longwall Weighting and Coal Burst Monitoring

Organisation:	CSIRO
Project Leader:	Joey Duan
Value:	$258,473
Report Expected:	May 2026
Industry Monitors:	Ian Stone
ACARP Contact:	Peter Bergin

The draft report is with the industry monitors for review.

Detection and Prevention of Fires and Explosions

C29026 Investigation into the Thermal Ignition Caused by IS Power Supplies

Organisation:	Simtars
Project Leader:	Sean Muller
Value:	$153,700
Report Expected:	June 2026
Industry Monitors:	Brad Lucke
	Jarod Chadwick
ACARP Contact:	Patrick Tyrrell

The objectives of the project are to determine the:
- Fault conditions arising in an intrinsically safe electrical circuit that could ignite combustible material on a mining machine;
- Role and extent that combustible material accumulation can cause or contribute to the risk of equipment fires, when ignited by intrinsically safe power supplies; and
- Parameters to be considered in installing an intrinsically safe circuit in an area where they could be an accumulation of flammable materials.

During the quarter, the following steps were completed:
- Trial additional setup;
- Developed new material holder;
- Sourced and added a thermocouple for temperature measuring;
- Develop method to synchronise data and video capture;
- Confirmed immersion tests process;
- Confirmed resistive wire coil size; and
- Presented the initial testing results at Resource Operators Conference (ROC) 2026.

The following steps will be addressed in the next quarter:
- Finalise modifications of testing setup and plan;
- Review Risk Assessment;
- Finalise test procedures;
- Finalise timeline;
- Conduct immersion tests for all IS PSUs with all greases, oils, coal, paper towels and Rag On A Roll (ROAR);
- Determine the minimum energy for the ignition of combustible / flammable materials;
- Analyse all data and results; and
- Commence preparation of final report.

Environment - Subsidence and Mine Water

C33021 Pilot Scale Membrane Distillation Crystalliser (MDC) with Renewable Heat Source for Mine Water Brine Management

Organisation:	CSIRO
Project Leader:	Ramesh Thiruvenkatachari
Value:	$969,195
Report Expected:	July 2026
Industry Monitors:	Paul O'Grady
ACARP Contact:	Patrick Tyrrell

This project aims to undertake a mine site demonstration of the MDC system for treating saline and acid mine drainage mine impacted water under actual mine site conditions. The main objectives are to develop a modular MDC water treatment plant to mine site specifications, install at the mine site by integrating with onsite infrastructure and to demonstrate the mine impacted water treatment performance. Through this study optimum operating process parameters for AMD treatment will be obtained in maximising reusable water recovery with reduced volume of saturated concentrate.

The pilot test unit has been constructed. The fully constructed unit has been RPEQ mechanical certified. Also, the electrical work compliance has been certified. We are awaiting inspection of the pilot by the mine site personnel. The onsite pilot testing is expected to be carried out after the inspection sign-off from the mine.

C35016 Rehabilitation Options for Ponded Areas Due to Longwall Coal Mining

Organisation:	University of Queensland
Project Leader:	Louisa Rochford
Value:	$397,200
Report Expected:	June 2026
Industry Monitors:	Jason Fittler Michael Moore
ACARP Contact:	Patrick Tyrrell

There has been limited research on the most appropriate options for rehabilitating land subsided by longwall mining in Australia. This project is investigating the implications of retaining ponded areas from longwall mining, including their contribution to environmental values. The approach is to select a study site and conduct the research at that location over a three year period, providing a template for the assessments that are required to make decisions on rehabilitation options for ponded areas at other mines.

All four rounds of field work have been completed, with the final round completed in May 2025. Mine site representatives have been recording pond water levels using staff gauges in three ponds. The Site Characterisation Report will be delivered at the end of Quarter 2 2026 is in the final stages of technical review. This report will provide details of the field and analytical work undertaken for the project. Post-processing of the fauna data from the camera trapping is complete and the findings have been incorporated into the Site Characterisation Report.

The Rehabilitation Options Analysis report which will be delivered at the end of Q3 2026 is underway. Soil hydrological modelling to predict how the ponded areas will affect soil moisture (and therefore potential post-mining land uses) has been completed. Refinement of the water balance model to include soil physical properties from the field program is underway.

Maintenance and Equipment

C33017 Specialised Instrumentation and Data Processing for Real Time FEA Condition Monitoring of AFC Chain

Organisation:	Vayeron
Project Leader:	Ryan Norris
Value:	$185,000
Report Expected:	May 2026
Industry Monitors:	Brad Lucke Jarrod Sampson
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

C33026 Prototype Battery Electric Load Haul Dump

Organisation:	3ME Technology
Project Leader:	Lewis Grainger
Value:	$1,431,295
Report Expected:	January 2026
Industry Monitors:	Brad Lucke Dave Young Matt Wang
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

C35013 Ex.P Enclosure Designs

Organisation:	CSIRO
Project Leader:	Peter Reid
Value:	$248,500
Report Expected:	August 2026
Industry Monitors:	Brad Lucke Colin Hoyle Dave Young
ACARP Contact:	Patrick Tyrrell

Flameproof enclosures enable the use of electrical equipment in coal mining operations where there is risk of exposure to explosive atmospheres. However, existing enclosures are not suitable for all contexts. This project will develop a system that employs pressurisation of the enclosure in conjunction with facility to de-energise

enclosure equipment if the pressure is compromised. The resulting design/s will represent a new approach to quickly designing and manufacturing enclosures for use in zone 1 environments.

During this quarter, work has progressed on the evaluation and refinement of Ex.P rated enclosure concepts for hazardous area instrumentation. Long-term testing — conducted over a three-month period — has now been completed on an off-the-shelf enclosure with minor customisations, demonstrating the ability to retain adequate pressure to support both detection approaches under evaluation: absolute and relative (differential) pressure sensing techniques. This represents a significant milestone, validating that a commercially available product with targeted modifications can meet the functional requirements of an Ex.P pressurisation system across both sensing modalities.

A vented breather system — designed to enable the use of differential pressure sensors within the enclosure while maintaining Ex.P compliance — has been successfully tested. The design adapts existing certified Ex.D rated breathers suitable for M20 gland entries, reducing certification risk and improving integration flexibility.

A technique for introducing power and communications into statically pressurised enclosures has also been developed and validated through initial testing, with discussions now underway with OEM connector manufacturers to assess applicability to existing commercial products.

Building on this progress, opportunities have been identified with alternative enclosure manufacturers and SME system integrators to progress toward a full system integration test, broadening the supplier base and de-risking the path to certification.

C38003 Optically Powered Gas Monitoring Network - Yellow Finch - 2000

Organisation:	PhoenixZ
Project Leader:	Zourab Brodzeli
Value:	$810,332
Report Expected:	May 2027
Industry Monitors:	Ben McCamley
	Brad Lucke
	Dave Young
	Jonathan Harris
ACARP Contact:	Patrick Tyrrell

The objective of this project is to prototype and proof-test existing designs of the Yellow Finch. Establish the supply and continued development of this innovative telecommunication technology, ensuring its successful market adoption by verification its performance in three underground mines, conducting its design registration and laying a foundation for widespread adoption by the industry.

PhoenixZ is pleased to report that the Yellow Finch Gas Monitoring Network project has made significant progress during the quarter. All hardware manufacturing, embedded software development, and interface software development have been completed. The system has been fully assembled, integrated, and successfully demonstrated at the lab bench level.

During system-level testing, it was identified that the Gas Monitoring Station (GMS) power consumption is higher than originally anticipated due to an undocumented specification of one of the electronic components. In its current configuration, the system is capable of continuous operation in an underground mine environment for approximately four and a half months.

To address this limitation, PhoenixZ has initiated the development of a second-generation Gas Monitoring Station (GMS MK2) with significantly reduced power consumption. The new design is expected to achieve a target operational lifetime of more than 12 months under continuous operation.

The updated design has been developed in consultation with EX Testing to ensure intrinsic safety (IS) compliance. PhoenixZ expects to produce an IS-certified GMS MK2 by mid-June.

Work during this quarter is as follows.

Hardware development and system integration:

- All hardware components, including GMS, DAM, PDU, LSM and backplane, have been manufactured and assembled;
- The complete system has been integrated and tested at the lab bench level;
- Functional performance of the system, including signal transmission and data acquisition, has been successfully demonstrated.



Software development:

- Embedded software development has been completed and fully integrated with hardware;
- Interface software, including system dashboard and control functionality, has been finalised;

- Full system operation, including sensor data acquisition and visualisation, has been demonstrated.

Power consumption analysis and design update. During integrated system testing, it was identified that:

- The GMS consumes more power than originally anticipated; and
- This increase is due to the use of an electronic component whose actual power consumption was not fully specified in the manufacturer's datasheet.

As a result the current system (GMS MK1) is capable of approximately four months continuous operation in a mine environment. This performance is acceptable for short-term trials but below the target specification for long-term deployment.

To address this PhoenixZ has designed a second-generation GMS (GMS MK2) with significantly reduced power consumption. The new design targets 12 months continuous operation under standard mine conditions.

The MK2 design has been developed in consultation with EX Testing to ensure intrinsic safety compliance. Status MK2 design finalised.

Deployment options - to maintain project momentum and enable early validation, PhoenixZ proposes the following approach:

- Phase 1 (Immediate Deployment – MK1):
  - deploy the current system (GMS MK1) to the customer (May 2026),
  - conduct ~3 months of field testing,
  - validate system functionality, software performance, and integration;
- Phase 2 (Upgrade to MK2):
  - replace MK1 units with GMS MK2 following completion of testing,
  - enable extended operational performance (<12 months).

This approach allows early validation while ensuring long term system performance goals are achieved.

All major development milestones have been achieved within the planned schedule. System integration and demonstration have been successfully completed. The identified power consumption issue has been addressed through proactive redesign without impacting overall project objectives. The introduction of GMS MK2 represents an enhancement rather than a deviation from the project plan.

During the next quarter PhoenixZ will:

- Submit GMS MK1 for IS certification;
- Proceed with early deployment of the system for field validation;
- Manufacture GMS MK2 hardware;
- Submit GMS MK2 for IS certification;
- Replace MK1 units with MK2 following initial field trials.

Mining Technology and Production

C28018 Longwall Floor Horizon Sensing

Organisation: CSIRO
Project Leader: Andrew Strange
Value: $269,680
Report Expected: June 2026
Industry Monitors: Jarod Chadwick
ACARP Contact: Patrick Tyrrell

The draft report is with the industry monitors for review.

C34003 Self-Drilling Bolt Automation

Organisation: OKA Rock Bolt Technologies
Project Leader: Mark Levey
Value: $2,987,744
Report Expected: September 2026
Industry Monitors: Roadway Development Task Group
ACARP Contact: Patrick Tyrrell

The extended project objectives are as follows:

- Design an improved Installer lid and test it;
- Test the technology on a rib bolter, remedy any issues found; and
- Prepare and conduct an underground trial during face production.

Progress during the quarter is noted as follows:

- A mine site has been confirmed for the underground production trial, timing is variable and is likely to be within six to eight months;
- A new lid design for the installer has been completed. A plastic model has been printed and checked; all appears to function well. A metal 3D print prototype has been commissioned and will be tested once completed;
- A review and measurements have been conducted on a rib bolter and some modifications are to be made to accommodate the installer and system. There are only small changes, mainly to accommodate the larger diameter of the installer;
- Preparations have begun to produce the consumables for the underground trial:
  - hollow bars to be used to make the self-drill rock bolts have been ordered,
  - drill bits have been ordered,
  - plastic components for assembling the capsules have been ordered and produced. They have also been treated to prevent migration of the resin and styrene from the filled capsules,
  - O-rings for the capsule pistons have been ordered,
  - chemicals have been ordered;
- The water pumping system has been checked and high-pressure delivery hoses ordered;
- The HMI software has yet to be modified to accommodate the spinning of the bolt to ensure the installed chemical cures as quickly as possible after injection/placement.

C34015 Assistive Shuttle Car: Development of an Industry Ready Guidance System: Stage 3

Organisation: CSIRO
Project Leader: Andrew Strange
Value: $205,395
Report Expected: May 2026
Industry Monitors: Roadway Development Task Group
ACARP Contact: Patrick Tyrrell

Most development operations in Australia utilise manual line-of-sight radio-controlled miners to cut roadways, and operator driven shuttle cars to transfer coal from the working face. These levels of technology are not able to achieve the goal of safe remote operation of roadway development. Two issues have been identified that inhibit progress in the domain of remote development:

- Continuous miner self-steering technology to maintain desired roadway headings has not yet reached the required level of performance required for sustained remote operation; and
- No automated options currently exist to guide shuttle cars while tramming through roadway systems and whilst avoiding ribs, cut-through corners and other infrastructure.

An assistive guidance system based on CSIRO's ExScan technology and simultaneous localisation and mapping (SLAM) techniques has been developed to address these issues.

The draft project report is almost complete and will be submitted to the monitors in the next quarter.

C34024 Effects of Rock Weathering on Life-of-mine Roadway Stability

Organisation: University of Queensland
Project Leader: Zhongwei Chen
Value: $312,534
Report Expected: January 2026
Industry Monitors: Brian Vorster
Matt Tsang
ACARP Contact: Patrick Tyrrell

The draft report is with the industry monitors for review.

C35004 Advancing Remote and Automated Capability for Longwall and Roadway Development

Organisation: CSIRO
Project Leader: Andrew Strange
Value: $2,517,000
Report Expected: June 2026
Industry Monitors: Roadway Development Task Group
ACARP Contact: Patrick Tyrrell

This project responds to the industry need to accelerate remote and automated longwall and roadway development capability. The project utilises the flexible industry directed project model to deliver research impacts to industry through well scoped work packages.

Assessment of the new CM navigation approach that uses dead-reckoning with Komatsu miners (WP6) has proceeded since the last report as planned. Two key sensor components (pointing and ranging) have been assessed through a set of rigorous performance tests. For pointing performance, tests routinely used in CSIRO INS acceptance testing have been tailored to the industry requested CM navigation requirements of less than 100mm error after 100m of RWD advance. Summary findings indicate promise and suitability notwithstanding additional analytics and calibration treatment that has been identified to meet these requirements. For ranging performance, validation experiments have narrowed sensor selection to two candidates. The preliminary findings and the intended deployment configuration will be summarised for industry and guidance sought for suitability in production operating conditions and recommendation as a potential future work package.

With regards to CM navigation for Sandvik miners, the updated MPMS software that utilises a pre-movement alarm to inform the INS that the miner is about to commence movement has not been tested because the miner has been operating in an area where network communications are unavailable. This has recently been resolved and the production trial will commence shortly.

Preparation of the project report has commenced. The results of the WP3 trial, WP5 trial and WP6 will be presented to the industry monitors and included in the report for submission over the coming two months.

C36013 Scalable/Ruggedised Planar Reflecting Radio Antenna (PRRA) for Underground Coal Mines

Organisation:	Roobuck
Project Leader:	Tommy Chaung
Value:	$700,000
Report Expected:	March 2028
Industry Monitors:	Dave Young Jarod Chadwick Jonathan Harris
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

C36014 Roof Support Location using Wireless Ranging

Organisation:	CSIRO
Project Leader:	Matt van de Werken
Value:	$212,543
Report Expected:	October 2026
Industry Monitors:	Brad Elvy Tom Hudson
ACARP Contact:	Patrick Tyrrell

This project aims to develop a prototype system capable of real-time localisation of longwall roof supports using wireless ranging technology. The core objective is to alleviate the roof support left behind problem, improving operational efficiency and reducing downtime.

This quarter we focused on work around the visualisation and continued the refinement of the localisation engine.

On the embedded software front, two-way ranging was achieved and integrated with the existing hardware design. We completed investigations into persistent failure in startup sequence FIRA ranging stack for the UWB project, identified and resolved issues with the sequencing of hardware/software peripheral initialisation of the UWB chip and the two-way ranging stack. Additional progress was made into two-way ranging using the FIRA ranging stack.

We began design of the next embedded board, capturing the V2 tag hardware requirements.

Looking ahead to the next quarter, we will continue the next board design iteration ready for IEC Exia certification. Additionally, commercialisation activities will be ramped up to prepare the system for industry deployment.

C38001 Investigating 5G Networks for Longwall and Development

Organisation:	CSIRO
Project Leader:	Mark Dunn
Value:	$90,750
Report Expected:	June 2026
Industry Monitors:	Roadway Development Task Group
ACARP Contact:	Patrick Tyrrell

This project is assessing the feasibility of deploying standalone 5G NR cellular networks in Australian underground coal operations, with a focus on longwall and development environments.

Progress this quarter was limited, as the planned underground field trial has been rescheduled to 26 May. Project activity therefore focused on maintaining trial readiness, confirming the forward schedule, and continuing engagement with suppliers and industry contacts as required.

A discussion with another underground communications integrator identified potential next steps beyond the current project. The integrator is actively working on 5G implementations, providing a possible pathway for follow-on work after this project is completed.

The next phase will focus on preparing for the scheduled May field trial, including final confirmation of site access, trial architecture, equipment readiness and the test plan. Following the trial, results will be analysed to assess the practicality and performance of 5G deployment in underground coal longwall and development settings.

Health and Safety

C24010 Proximity Detection Systems Specification for Underground Coal Mining Machines

Organisation:	Simtars
Project Leader:	Sean Muller
Value:	$565,988
Report Expected:	May 2026
Industry Monitors:	Brad Lucke Frank Fulham Michael Barker
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

C28029 Personal Real Time Dust/Particulate Monitor (Direct Mass Based Measurement)

Organisation:	Lear Siegler Australasia
Project Leader:	Peter Phaedonos
Value:	$1,521,730
Report Expected:	June 2026
Industry Monitors:	Brad Lucke
	Glenn Owens
	Ian Marshall
ACARP Contact:	Patrick Tyrrell

The PDM real time dust monitor is a device that allows miners to accurately track their dust exposure levels in real time. This will allow operators to make decisions on whether to withdraw to areas of lower/no exposure or continue working based on the readings of the device. Standards exist for limiting exposure to the respirable fraction of coal dust in most industrial settings, the PDM will provide the miner with the means to monitor and manage such exposure. It will have a very low detection limit that will meet or exceed current and anticipated exposure limits, and AS2985-2009 requirements for such continuous testing.

Status of project with latest updates are following:

- Initial hardware assembly of PDM3800 complete, with minor revisions to hardware and PCAs for better fit and fixing noise issues to LCD screen;
- Initial bench testing complete with mechanical, hardware and software components (operational test); and
- Initial firmware validation complete. Significant upgrades to firmware were completed following an LCD glitch due to excessive series resistance on SPI lines causing signal integrity and timing violations.

C33001 Silica Analysis of Dust on PDM filters: Phase 2 Optimisation and Field Demonstration of the Developed Methodology

Organisation:	CSIRO
Project Leader:	Yonggang Jin
Value:	$516,700
Report Expected:	September 2026
Industry Monitors:	Andrew Lau
ACARP Contact:	Patrick Tyrrell

A methodology has been developed to enable respirable crystalline silica (RCS) analysis of PDM-collected coal dust in Phase 1 of this project. Phase 2 aims to progress the developed methodology towards industry implementation through optimisation of the methodology by analysis of a variety of laboratory-generated and mine-collected dust samples, setup of dust detachment-redeposition apparatus and compact FTIR spectrometer at the mine site, and field trials and demonstration of the methodology for RCS analysis of PDM3700 samples at the end of the shift.

During the quarter, numerical correction models were further developed and validated to improve RCS quantification by accounting for non-uniform dust deposition across the filter membrane and for the potential presence of minerals that may interfere with FTIR-based silica analysis. Extensive laboratory experiments were conducted, including parallel sampling using different mixed-dust feeds, a range of dust loadings, and subsequent silica analysis using multiple approaches (re-deposition, direct-on-filter analysis, and ashing). A substantial dataset was generated to support development of the correction models and optimise the methodology. The team also identified that the results may be applicable to RCS quantification for direct-on-filter analysis of gravimetric compliance samples collected on PVC filters.

The team continued to engage mine-site stakeholders to enable collection of PDM samples from an operating mine and to demonstrate the methodology under field conditions. A site visit and meeting with a Queensland mine were held in late April to discuss the proposed site-work plan. Due to delays in commencing site activities, an updated schedule for the remaining project tasks has been submitted to ACARP for feedback and approval.

C33012 Respirable Dust Reference Testing Method and Dust Chamber Facility

Organisation:	Simtars
Project Leader:	Sean Muller
Value:	$215,950
Report Expected:	July 2026
Industry Monitors:	Andrew Lau
	Tony Egan
ACARP Contact:	Patrick Tyrrell

The aim of this project is to establish the methodology for the respirable dust chamber as a reference tool for cyclones and devices used in the industry. This will be achieved through three objectives:

- Establish that the respirable dust chamber conforms to international testing methodology and accuracy;
- Verify the methodology utilising a selection of respirable dust cyclones and impactor plate devices currently used in underground coal mines; and
- Compare the accuracy of the devices when using a different dust types and dust mixtures (stone dust, coal dust, silica).

During the quarter, the project progressed as follows:

- Commissioning of the system control box was completed;
- Specialised components for the system for running air through the samplers have been acquired and installation of the bulk vacuum line is underway;
- Installation of the TEOM suction line is underway;
- Commissioning of the flow, temperature and humidity controller, and the chamber environment monitoring instruments has commenced; and

- Initial draft of the chamber validation procedure has been completed.

The following steps will be addressed in the next quarter:

- Completion of TEOM suction line;
- Implementation of the chamber and bulk vacuum line pressure alarm systems;
- Completion of the system for running air through the samplers;
- Testing and commissioning of remaining test instruments and subsystems; and
- Detailed risk assessment for the entire system and finalisation of the chamber validation procedure.

C34006 Resilience and Mental Health in Mining Pilot Program

Organisation: Macquarie University
Project Leader: Rebecca Mitchell
Value: $476,099
Report Expected: October 2026
Industry Monitors: None
ACARP Contact: Patrick Tyrrell

The primary objective of this project is to investigate the work related factors that influence the resilience of coal mining employees. This endeavour aims to design and evaluate interventions that bolster the resilience of these individuals, thereby improving work practices that directly contribute to employee resilience in the Australian coal sector.

Our partner mine pulled out of the project as regrettably, they could no longer support this project. We thank them for their initial support and for the collaborations that we did engage in, including working with focus groups at their mine. We would like to acknowledge the many supportive and informative interactions we had, particularly with our principal contact at that mine. We have sought the support of a larger mining company with initial discussions held. As noted in our previous reports, this will extend the project timeline; however, we do not seek any additional funds and will absorb any ongoing cost ourselves to deliver outcomes as we strive towards enhancing resilience and mental health within the coal mining sector. We are liaising with our industry monitors to ensure that the project moves forward.

C34023 Advanced Breathing Apparatus with Gas Membrane Modules

Organisation: Monash University
Project Leader: Victor Chang
Value: $298,436
Report Expected: May 2026
Industry Monitors: Lee Earnshaw
Paul Wild
ACARP Contact: Peter Bergin

The self contained self rescuer (SCSR) is an essential supporting device for underground employees encountering adverse conditions. In a previous project, researchers developed a lightweight membrane that is able to separate oxygen and carbon dioxide, which enables carbon dioxide to be removed from the closed loop breathing system. This means that no exothermic heat is released and that the device can be smaller and lighter than existing SCSRs. This project will further develop the membrane technology with the aim of integrating it into an existing SCSR design.

The project is reaching completion, with all experimental results compiled and verified.

The final draft report is currently being circulated internally for feedback and the official draft report will be submitted shortly. Building on the strong foundation established in this project, the team has successfully leveraged the project outcomes to secure a new research grant from the Australian Research Council, enabling the continuation and further expansion of this important line of research.

C36006 Advanced Lung Function Assessments for Diagnosis of Coal Mine Dust Lung Disease (CMDLD): The Next Step Towards a Better Health Surveillance Program

Organisation: I-MED Radiology Network
Project Leader: Catherine Jones
Value: $186,832
Report Expected: June 2026
Industry Monitors: Andrew Lau
Shane Apps
ACARP Contact: Patrick Tyrrell

This project aims to evaluate a novel CT-based ventilation-perfusion (CT:VQ) technology for assessing lung function impairment in workers at risk of Coal Mine Dust Lung Disease. The project will investigate whether CT:VQ-derived functional measures from inspiratory and expiratory high-resolution CT (HRCT) scans can reliably identify impaired lung function, using spirometry as the reference standard. The overarching goal is to assess the potential of CT:VQ to enhance current health surveillance programs by providing additional functional insights beyond conventional imaging.

During the quarter, significant progress has been made in project setup and governance. A senior researcher commenced in early March to support the project execution. An ethics amendment was successfully completed and approved, ensuring compliance with updated study requirements. All necessary institutional approvals, including IT risk assessment, have also been finalised, enabling secure data handling and analysis.

Current work is focused on cohort preparation, involving the retrospective review of patient data to identify eligible participants based on predefined inclusion and exclusion criteria. The project is progressing as planned, with the next phase involving extraction of HRCT and spirometry data, followed by CT:VQ processing, comparative analysis against spirometry-derived measures, and report preparation.

C37009 Role of Particle Surface Characteristics in CWP Risk

Organisation:	University of Tasmania
Project Leader:	Graeme Zosky
Value:	$413,709
Report Expected:	April 2027
Industry Monitors:	Andrew Lau Brad Lucke Frank Fulham Shane Apps
ACARP Contact:	Patrick Tyrrell

An update has not been provided.

Roadway Development

C27076 Underground Coal Mine Gateroad Development Continuous Haulage System

Organisation:	Premron CHS
Project Leader:	Mick Whelan
Value:	$9,773,528
Report Expected:	August 2026
Industry Monitors:	Roadway Development Task Group
ACARP Contact:	Patrick Tyrrell

This project is on hold as it awaits a site trial.

Strata Control and Windblasts

C29022 Mechanical Investigation of Two Critical Standing Support Systems (Timber Chock and Pumpable Crib) in Underground Coal Mines

Organisation:	Monash University
Project Leader:	Hossein Masoumi
Value:	$295,000
Report Expected:	April 2026
Industry Monitors:	Bob Coutts Brian Vorster Dan Payne Patrycja Sheffield
ACARP Contact:	Peter Bergin

Timber chocks and pumpable crib are two standing supports used in almost all the underground coal operations in New South Wales and Queensland. However, the performance of timber chocks, particularly under complex shear and/or vertical ground movements, is not well understood. Researchers will provide an update on the mechanical behaviour of timber chocks currently in the market and identify the extent to which each type of timber chock and pumpable crib is used in Australia. In addition, a testing standard will be developed for the selected standing supports based on mechanical parameters, such as loading rates, offset loading, torsional loading, compressive and shear loadings.

For the timber part or Volume I, a revised version was submitted last year. The report is under review by the industry monitors.

As for the second part or Volume II on pumpable cribs, so far we have completed six tests out of 18 and we are planning to do the next round in May/June so hopefully by the mid this year half of the experiments will be completed.

C34022 Risk Based Model for Forecasting Longwall Face Cavity Development

Organisation:	University of New South Wales
Project Leader:	Chengguo Zhang
Value:	$173,200
Report Expected:	February 2026
Industry Monitors:	Matt Martin Matt Tsang Ravindu Goonawardene
ACARP Contact:	Peter Bergin

The draft report is with the industry monitors for review.

C35008 Optimum Design of Pillars with Various Sizes and Shapes at Increasing Stress Environment

Organisation:	University of Queensland
Project Leader:	Mehdi Serati
Value:	$172,000
Report Expected:	May 2026
Industry Monitors:	Brian Vorster John Grieves Peter Corbett
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

C35010 Causes for Swelling and/or Bearing Capacity Floor Failures in a Pillar System Under Varying Geological and Geotechnical Environments

Organisation:	University of New South Wales
Project Leader:	Serkan Saydam
Value:	$298,300
Report Expected:	May 2026
Industry Monitors:	Brian Vorster Peter Corbett
ACARP Contact:	Peter Bergin

This project aims to investigate the conditions of swelling and bearing capacity floor failures through an experimental program, in-situ monitoring program, and analytical and numerical approaches and determine the timing of failure. Based on the learning from projects C26064 and C29041, an analytical model will be developed to evaluate the bearing capacity of soft floor strata in underground coal mines. The cutting-edge numerical modelling framework will be developed that will enable us to better understand the swelling failure mechanisms. The research team will develop a framework for the assessment and prediction of floor heave. This approach will provide comprehensive guidelines to assess and predict floor heave failures.

All experimental and numerical work have been completed to address the project objectives. The final report is being drafted and will summarise the research findings and the associated implications for floor heave management in underground coal mine roadways.

C35011 Revolutionising In-Situ Stress Measurement: Extension - Field Trial of the DilaStress Tool

Organisation:	University of New South Wales
Project Leader:	Hamid Roshan Ismet Canbulat
Value:	$419,000
Report Expected:	April 2027
Industry Monitors:	Brian Vorster Patrycja Sheffield
ACARP Contact:	Patrick Tyrrell

Understanding in-situ stress conditions is paramount for the safety, efficiency, and productivity of coal mining operations. Currently, overcoring is the preferred technique to measure-situ stress in underground mining. However, it is often hindered by the considerable time, investment, operational complexities, and high costs. This challenge was tackled in a previous stage of this project by developing DilaStress to create an efficient downhole stress measurement technique and associated Tool. This study will field test the DilaStress tool for insitu stress estimation.

Over the quarter, our focus has been on designing a mast capable of deploying the tool downhole. The mast has been designed for easy assembly and disassembly, and its design has now been finalised and released for fabrication. In addition, the fabrication of a steel cover for the tool is in progress.

In parallel, work on integrating and connecting the system components has been progressing. Once these connections are complete, we will conduct a pressure test with the DilaStress tool attached to field equipment. This testing is primarily scheduled for the next quarter and finalises the setup. Provided there are no issues during high-pressure testing, the system is expected to be ready for field trials by the end of the next quarter.

C37012 Field Investigations on the Optimum Design of Pillars at Increasing Stress Environments

Organisation:	University of Queensland
Project Leader:	Mehdi Serati
Value:	$249,720
Report Expected:	August 2027
Industry Monitors:	Brian Vorster Peter Corbett
ACARP Contact:	Patrick Tyrrell

This project seeks to develop a modified pillar load estimation methodology for optimal pillar design under increasing stress conditions, supported by field stress measurements. It will verify the design of main pillars based on a load less than the tributary area load, potentially providing significant financial and operational benefits.

The work program includes a review of in situ load measurement techniques, laboratory benchmark testing, field measurements in selected mine sites, numerical modelling, and development of an improved design methodology.

During the quarter a detailed literature review was undertaken on stress measurement and monitoring techniques used in both Australian and international coal mining applications. The review focused on methods relevant to pillar load or stress change assessment in operational mining environments. Based on this work, a number of potential methods were identified and shortlisted, including vibrating wire stressmeters, borehole pressure/stress meters, overcoring-based techniques such as ANZI and CSIRO HID systems, microseismic monitoring, laboratory acoustic emission coupled with strain gauge measurements, and terrestrial 3D laser scanning for indirect deformation-based assessment.

Following the literature review, several equipment suppliers were contacted to obtain indicative pricing, system details, and technical information for the shortlisted methods. This process has assisted in comparing the likely practicality, cost, and applicability of the different approaches for field use in deep coal mine pillars. The current focus is on identifying the most reliable and cost-effective technique, or combination of techniques, for subsequent laboratory and field-based stages of the project.

C37015 Investigation to Determine the Influence of Stress Magnitude on the Growth Rate of Hydraulic Fractures

Organisation:	SCT Operations
Project Leader:	Ken Mills
Value:	$200,000
Report Expected:	May 2027
Industry Monitors:	Ben Forrest
	Brian Vorster
	Michael Barker
ACARP Contact:	Patrick Tyrrell

Hydraulic fracturing is a technique that can be used to pre-condition the overburden strata to improve longwall face conditions and caving behaviour when mining below massive sandstones and conglomerates. The effectiveness of this technique is well proven in favourable in-situ stress conditions. Cost-effective implementation of pre-conditioning hinges on being able to optimise the layout of injection boreholes based on an understanding of the shape of hydraulic fractures as they grow away from the injection borehole. This project aims to investigate, in a laboratory setting, the influence of horizontal stress magnitude on the shape of hydraulic fractures inferred from field observations.

Initial focus has been on developing the detail of the testing procedures, working with CSIRO. Monash to develop a practical testing procedure in their poly-axial cell and working with a diamond coating business to manufacture small diameter drill bits suitable to drill monitoring holes in the rock cubes hosting the hydraulic fracturing trial.

C37020 Cost Effective, Low Water Sensitivity, and Fast Curing Geopolymer Grout for Cable Bolt Encapsulation to Enhance Cable Bolting Installation Practices

Organisation:	University of Southern Queensland
Project Leader:	Ali Mirzaghorbanali
Value:	$148,010
Report Expected:	November 2026
Industry Monitors:	Ben Yang
	Samantha Grimsey
ACARP Contact:	Patrick Tyrrell

The objective of this project is to develop a geopolymer grout with improved water resistance and pumpability, comparable to conventional cement-based grouts used in underground coal mining. The project focuses on optimising binder systems, activators, and mix proportions to produce a cost-effective and durable material suitable for field application, with the aim of enhancing the reliability and safety of cable bolt installations in Australian coal operations.

The selection of the optimised geopolymer grout was carried out through a comprehensive experimental program comprising 33 geopolymer mix designs and more than 200 UCS tests, with the objective of identifying a formulation that delivers high strength while maintaining practical workability (Fig. 1). The optimisation confirmed that a Water-to-Binder ratio (W/B) of 0.38, an Activator-to-Binder ratio (Act/B) of 0.10, a Silica Sand-to-Binder ratio (SS/B) of 5%, and a binder composition of 60% GGBS and 40% fly ash, together with an activator system of 30% NaOH solids and 70% Na_2SiO_3 solids, provide the most optimum performance. The optimised geopolymer demonstrated strong and reliable mechanical properties, achieving UCS values of 36 MPa on Day 1, 60 MPa on Day 14, and 86 MPa on Day 28. When benchmarked against Stratabinder HS and TD80, the geopolymer exhibited 4% higher strength than Stratabinder at Day 1 (36.02 vs 34.51 MPa) and 51% higher strength than TD80 (36.02 vs 23.85 MPa), highlighting its strong early-age performance, particularly relative to TD80. At Day 14, the geopolymer strength (60.16 MPa) remained slightly higher than both Stratabinder (57.83 MPa, 4% lower) and TD80 (58.69 MPa, 2.5% lower), demonstrating comparable mid-term behaviour. By Day 28, the geopolymer reached 86.38 MPa, which is 7% higher than Stratabinder (80.73 MPa) and 22% higher than TD80 (70.53 MPa), confirming its superior long-term strength development. Also, the UCS results indicate that the optimised geopolymer not only matches but consistently exceeds the performance of the

commercial grouts, particularly at later curing periods. The benchmarking results across shear, tensile, fresh, and volumetric properties further reinforce this performance. In the double shear test, the geopolymer grout reached 1.85 MPa at Day 28, which is 11% lower than Stratabinder (2.07 MPa) but within 2% of TD80 (1.89 MPa), indicating broadly comparable bond performance with the added advantage of a smoother, more consistent strength progression. In the V-notch shear test, all materials exhibited significant strength gains between Day 7 and Day 14; the geopolymer increased from 1.0 MPa to 2.58 MPa, representing a 158% increase, closely matching the trend observed for Stratabinder (167%) and substantially exceeding the relative increase observed for TD80 (24%), indicating strong and progressive bond development despite the inherent variability of this test. The Brazilian tensile strength results show that the geopolymer reached 6.6 MPa at Day 28, comparable to TD80 and higher than Stratabinder at later ages, confirming its competitive tensile capacity. Similarly, the briquet tensile strength results indicate that the geopolymer achieved values in the range of 1.6–1.7 MPa at Day 14, which are comparable to, and in some cases slightly more consistent than, those of the commercial grouts. All specimens for double shear, Brazilian, shrinkage, V-notch, and briquet tensile tests were cured at 1, 7, 14, 21, and 28 days; however, Day 21 and Day 28 results for the V-notch and briquet tensile tests are still ongoing. In terms of fresh properties, the flow table results show that the geopolymer's spread decreased from 24.9 mm to 21.5 mm over 30 minutes, a 14% reduction, comparable to Stratabinder and lower than TD80, indicating improved retention of workability. Shrinkage measurements, conducted over an extended curing period from Day 1 to Day 28, indicate that the geopolymer exhibited dimensional changes of 0.2–0.35%, comparable to or slightly lower than those of Stratabinder and TD80, suggesting improved volumetric stability and reduced risk of microcracking.

In the next phase of the project, the experimental program will complete the outstanding V-notch and briquet tensile tests at later curing ages. In addition, further characterisation will be undertaken to support the benchmarking study, including measurements of density, setting behaviour, and viscosity, to provide a more comprehensive assessment of fresh and hardened properties relative to TD80 and Stratabinder HS. In parallel with these laboratory investigations, the project will progress towards the design and casting of large-scale pull out test cable-bolt samples, enabling evaluation of the optimised geopolymer grout under more representative, field-relevant conditions.



Figure 1: UCS specimens - TD80, optimised geopolymer, Stratabinder HS

C37024 Longwall System Health and the Implications to Strata Control and Automation – Improving Industry Understanding, Monitoring Techniques and Numerical Model Validation

Organisation:	SCT Operations
Project Leader:	Adrian Rippon
Value:	$427,200
Report Expected:	September 2027
Industry Monitors:	Samantha Grimsey Stephen Giese
ACARP Contact:	Patrick Tyrrell

This project will improve industry understanding of how longwall hydraulic system health influences strata control, support performance and automation. The project addresses the limitations of relying on pressure-only monitoring, particularly where internal leg faults, blipper valve bypass or other hydraulic issues may downrate the actual force applied to the roof while still giving apparently acceptable pressure readings. The study is intended to improve practical monitoring and interpretation methods, support model validation using achieved rather than theoretical support density, and provide guidance that reduces face control issues, production delays and operator exposure during remedial work.

During the quarter, the main work completed was the Stage 1 literature search and review. This work consolidated the historical and current understanding of longwall powered support behaviour, strata-support interaction, support density and stiffness, set-to-yield ratio, tip-to-face distance, canopy attitude, convergence, load-rate response and the practical limitations of existing monitoring systems. The review also collated the basis for an indicator catalogue covering hydraulic condition, operating practice and strata-control response, and confirmed the technical gap between monitored leg pressure and actual applied support force.

Work on detailed data analysis, AI-assisted monitoring review, site deployment planning and trigger-action tables has started only at a scoping level. Initial attention

has been given to defining the data streams required from de-identified host operations, the structure of future AI-assisted review modules, and the monitoring parameters most likely to support hydraulic system assessment and model validation.

Work in the next quarter will focus on closing out the indicator catalogue and draft monitoring protocol, securing suitable de-identified datasets, recommencing industry and OEM engagement, and developing the first practical data review workflows for pressure, load-rate, convergence-related indicators, yield behaviour and canopy attitude cues.

Ventilation, Gas Drainage and Monitoring

C25072 New Approaches to Mine Gas Analysis and Ratios

Organisation: Simtars
Project Leader: Sean Muller
Value: $416,192
Report Expected: July 2026
Industry Monitors: John Grieves
ACARP Contact: Patrick Tyrrell

The aim of the project is to identify additional gases for the detection and monitoring of spontaneous combustion. This will be achieved through three objectives:

- Using a medium scale reactor, profile the gases evolved from the heating of a Queensland coking coal with a methane/ethane seam gas composition and a New South Wales coal with a carbon dioxide seam gas.
- Compare these gas profiles to the normal carbon dioxide seam gas and methane/ethane seam mine fingerprints identified in the first stage of this project and project C10015.
- Expand the current "Fire Ladder" to include additional alkanes below the ethylene point which can be used to give earlier warning of a developing heating/spontaneous combustion and incorporated into TARPs.

The work status as of May 2026 is as follows:

- VOC data from Coal 2 test has been processed and graphed.
- Micro GC data from Coal 2 test has been processed and graphed.
- Aldehyde and GC-MS samples have all been analysed for Coal 3. GC-MS samples have been peer-reviewed. Aldehyde samples a currently being reviewed.
- Processing of the micro-GC results and identification of additional peaks is 90% completed for Coal 3. Approximately twenty (20) new components (peaks) have been identified as present in the micro-GC analysis. A number of these are confirmed as aldehydes which have previously not been identified as detectable by the micro GCs in use by the project. Nominal calibrations have been applied to these peaks to allow assessment against known coal gas/spontaneous combustion components and relationships across temperature ranges. Data has been collated and graphed as data processing progresses.
- Comparison of Micro GC data with GCMS data has been undertaken for Coal 2.
- Comparison of the micro GC data to the aldehyde results is in progress.
- Validation of the X-Pid components is in progress. All accessible aldehydes, alkanes and aromatic compounds have been run. Collected data is in the process of being reviewed.
- Preliminary Fire Ladders from coal 2 have been established.
- Preliminary Fire Ladder (micro GC components) from coal 3 has been established.

The following steps will be addressed in the next quarter:

- Processing of data gathered from Coal 3 test will continue.
- Graphing of Coal 3 data for Aldehydes and VOCs will be undertaken.
- Assessment of the additional micro-GC peaks from Coal 2 test will be undertaken using the same strategy as for Coal 3 test with review for aldehyde components incorporated. The additional peaks will be graphed and evaluated as per Coal 3 test format. Coal 2 test and Coal 3 test additional peaks will be compared to each other GC-MS and aldehyde data.
- Comparison of X-Pid data with results generated from micro-GC, GC-MS and HPLC analytical techniques will be undertaken for Coal 3. In addition, comparison of the micro-GC and GC-MS data will be undertaken to identify additional peaks observed in the micro-GC analysis.
- Compilation of the report will be progressed.

C28027 Effect of Occlusions by Coal and Stone Dust on the Sensitivity and Time Response of Methane Gas Detectors in Underground Coal Mines

Organisation: Ampcontrol
Project Leader: Ian Webster
Value: $90,000
Report Expected: May 2026
Industry Monitors: John Grieves
Patrick Tyrrell
ACARP Contact: Peter Bergin

The overall objective of this research is to:

- Establish the existing degrees of occlusion of real time methane sensors in service in underground coal mines by qualitative survey and hence determine the potential compromise in performance; and to
- Verify and quantify the susceptibility of real time methane detectors to occlusion by coal and stone dust by controlled laboratory testing of typical methane sensing devices.

During the quarter, the following tasks were undertaken or completed:

- Testing of Gas Detectors -
  - testing and data analysis completed for effect of occlusion for six gas detectors under dust conditions within the purpose-built test chamber.
  - results of testing correlated and aligned with established terminology and methodology.
- Reports
  - draft report on comparison of calibration masks, effects of blockages and occlusion by dust on the gas detectors has been completed.
  - the final report is in preparation.

In the next quarter we plan to:

- Consider comments from peer reviewers;
- Revise draft report as and where needed to form final report;
- Submit final draft report for Industry Monitor review.

C34014 Borehole Tools to Deal with Outbursting, Coal Bursting and Gas Drainage

Organisation: Sigra
Project Leader: Ian Gray
Value: $2,176,576
Report Expected: July 2026
Industry Monitors: Ventilation Task Group
ACARP Contact: Patrick Tyrrell

This aim of project is to produce a survey system for drilling, including a rock recognition system and a packer system to enable coal seam permeability and pressures to be determined. The project is multi-facetted as it involves drilling hardware, sensing equipment, downhole and at the drill rig sensing and electronics. This is in both IS and flameproof form and it also involves a lot of software development.

The technical work this quarter has involved the getting over magnetometer and accelerometer chip damage problems associated with soldering and thus improving the accuracy of the survey component of the tool. In addition, both the electronics and the physical torque, thrust and differential pressure sensor have been built and tested and appear to be working satisfactorily.

From a project viewpoint there has been much progress in working towards an agreement with a mine to test the equipment in an underground coal environment.

C35015 Studies of Coal Toughness and Gas Sorption Dynamics for Outburst Risk Management

Organisation: University of Wollongong
Project Leader: Ting Ren
Value: $275,000
Report Expected: June 2026
Industry Monitors: Ventilation Task Group
ACARP Contact: Patrick Tyrrell

The objective of this project is to improve industry knowledge and management of potential outburst risks by conducting systematic studies of coal toughness, geo-mechanical properties and gas sorption dynamics with different coals sourced from underground coal mines.

We have been revising the project report and clarifying the interpretation of research results, incorporating additional gas data from different core samples provided by industry partners, and undertaking further analysis to strengthen the overall quality of the report. The report will be submitted to the industry monitors very soon.

C36003 Practical Implications of Oxygen Deficiency on the Determination of Graham's Ratio in Longwall Goafs

Organisation: Simtars
Project Leader: Sean Muller
Value: $64,350
Report Expected: January 2027
Industry Monitors: David Webb
John Grieves
ACARP Contact: Patrick Tyrrell

Graham's ratio is a commonly used indicator for measuring the intensity of the oxidation of coal in underground mine atmospheres. The basis of Graham's ratio is the conversion efficiency of oxygen to carbon monoxide. Graham's ratio uses the nitrogen from a sample for the calculation of oxygen deficiency. This allows for dilution by methane and carbon dioxide seam gases. This calculation is made on the basis that nitrogen is an inert gas which is not consumed or created.

The aim of this project is to investigate the practical implications for the interpretation of Graham's ratio and other indicators in the presence of an oxygen deficient atmosphere (due to natural processes and both added nitrogen or exhaust gases via inertisation). This will be achieved through the following objectives:

- Investigate the magnitude of oxygen deficiency measured in various longwalls and variations due to location, inertisation and longwall retreat over time;
- Provide practical guidelines to assist with using appropriate and effective gas indicators and ratios in longwall mines.

During the quarter, data has been acquired from Mine 1. The following steps will be addressed in the next quarter:

- Data is being sourced from an additional two mines;
- Data processing will commence.

C36005 Optimisation of Goaf Management Strategies

Organisation: CSIRO
Project Leader: Rao Balusu
Value: $1,443,557
Report Expected: May 2027
Industry Monitors: Ventilation Task Group
ACARP Contact: Patrick Tyrrell

The objective of this project is to develop optimum goaf management strategies to maximise goaf gas drainage, reduce oxygen ingress into the longwall goaf, and minimise fugitive emissions. The main focus of the project are to:

- Obtain a fundamental understanding of goaf gas distribution; obtain an understanding of the impact of various geological, mining and operations parameters;
- Investigate the feasibility of various goaf gas drainage designs and strategies to maximise gas drainage and minimise oxygen ingress;
- Develop optimum inertisation strategies to minimise oxygen ingress on both maingate and tailgate sides of the longwall goaf; examine the impact of various additional goaf management strategies; and develop optimum adjacent goaf gas drainage strategies to minimise greenhouse gas emissions into the main return airways.

Over the quarter, project studies have investigated the impact of various additional goaf management strategies on goaf gas distribution and oxygen ingress patterns into the longwall goaf. These studies include curtains near the maingate corner and over the first few shields, barriers in the goaf near the maingate corner and at different locations in the goaf, pressure balancing via low flow inert gas injection into all seals on the maingate side, and combination of pressure balancing and goaf inertisation strategies. Results of all the above modelling studies are being analysed in detail to evaluate the effectiveness of various goaf management strategies and to assist in the development of optimum goaf management strategies.

In the next quarter, studies will focus on investigating the effect of barometric changes on goaf gas distribution patterns, and in particular its effect on longwall return gas levels.

C36011 Borehole Tools – Caliper Log

Organisation: Sigra
Project Leader: Ian Gray
Value: $424,160
Report Expected: June 2026
Industry Monitors: Ventilation Task Group
ACARP Contact: Patrick Tyrrell

This project objective is to produce a caliper log to permit the logging of boreholes. The reason for building this is to detect overbreak such as may occur due to the washout of gouge material, indicative of outburst conditions and breakout which is indicative of high stress. The latter being important from a rockburst and general stability viewpoint. In non-intrinsically safe near vertical holes these measurements would be made using an acoustic televiewer. This is not an option in wet and gassy horizontal boreholes.

Work this quarter was conducted in common with project C34014. These two projects share the same electronics so the torque and thrust electronics and survey electronics are used in both tools.

C36012 Rotary Steering System Field Trial and Developments

Organisation: Sigra
Project Leader: Ian Gray
Value: $449,600
Report Expected: June 2026
Industry Monitors: Ventilation Task Group
ACARP Contact: Patrick Tyrrell

This project will enable field trials and necessary modifications to be made to the Sigra rotary steering system (RSS) tool that was developed as part of project C28022, which completed in 2020 during COVID lockdowns and hence without an underground field trial. During this period a drilling trial was conducted using a civil engineering horizontal directional drilling rig and many changes have been implemented as a result of this.

The Sigra RSS is designed to replace down hole motors in underground in seam drilling and in particular to overcome problems faced with ‘boggy ground’. The latter is caused by cuttings bed build up around the drill string. The rotary steering system involves the use of a rotating drill string with a non rotating sleeve fitted with pads that deflect the drill bit. The rotating drill string has been shown, in oilfield use, to prevent cuttings buildup. The RSS should also permit greater power at the bit compared to downhole motors that are currently used underground. It is hoped that this will enable faster penetration rates when drilling through stone.

During this period there has been no progress. The main progress has been on project C34014 Borehole Tools to Deal with Outbursting, Coal Bursting and Gas Drainage.

C36015 Intelligent Integrated Distributed Fibre Optic Sensing Technologies

Organisation:	CSIRO
Project Leader:	Yi Duan
Value:	$568,317
Report Expected:	August 2026
Industry Monitors:	Ben Yang
	Dennis Black
	Peter Corbett
	Steve Winter
ACARP Contact:	Patrick Tyrrell

Temperature, strain, and seismicity monitoring are crucial for managing geotechnical hazards (e.g., spontaneous combustion (spon-com), pillar failure, and strata instability) in underground coal mines. This project aims to advance remote underground mining operational capabilities by targeting specific technological developments in areas of high strategic need and opportunity for industry. Key project components are:

- Continuous temperature profiling using distributed temperature sensing (DTS);
- Combined continuous pillar strain and microseismic measurement using optical fibre; and
- Real-time distributed acoustic sensing (DAS) data processing based on deep learning pipelines.

This quarter, main activities for each key component included:

- Continuous temperature profiling using distributed temperature sensing: the underground temperature monitoring trial has been put on hold pending IECEx certification of the DTS interrogator. The supplier of the DTS interrogator is preparing the hardware drawings and test reports. The Non-Disclosure Agreement (NDA) has been agreed by the supplier and the Australia certification body. The certification will commence after the NDA is signed and fully executed by both parties.
- Combined continuous pillar strain and microseismic measurement using optic fibre: The environmental chamber has not been available due to site works in the building. Testing will commence when the chamber is available. The mathematical calibration routines have been advanced. The process for installing the system has been devised. Some of the installation components have been 3D printed and will be tested on the test rig.
- Real-time distributed acoustic sensing (DAS) data processing based on deep learning pipelines: as fibre optic cables are installed in boreholes, heterogeneity introduced by different lithologies must be considered in seismic source location, particularly when direct source coordinates cannot be determined from the apex of arrival time curvatures. A source location method that incorporates sectional average seismic velocities based on borehole logging and Monte Carlo simulations is being developed to enhance location accuracy and quantify associated uncertainties.

C37004 Determination of New Criteria for the Approval of P5 Type Permitted Explosives

Organisation:	University of New South Wales
Project Leader:	Duncan Chalmers
Value:	$273,000
Report Expected:	November 2026
Industry Monitors:	Andrew Rose
	Brad Elvy
	Paul O'Grady
	Paul Wild
	Russell Thomas
ACARP Contact:	Patrick Tyrrell

This project aims to develop permitted explosives with a lower power delivery during detonation. If successful, industry with the support of the researcher will engage with the Queensland Explosives Inspectorate to seek permission for P5 permitted explosives to be used in underground coal mines. A change in the criteria would allow for the continued development of emulsion-based permitted explosives, further improving the safety of underground coal mine operations.

The project team, the explosives manufacturer representative and an industry representative have been working on the documentation to get trial approval for the new explosive so that it can be imported into Australia.

A technical data sheet for this explosive is being prepared as this is a new formulation. The final report from the previous trial is also being completed to support the next approval application.

Discussions have also been held with the manufacturer about a second formulation with a view of an extended shelf life, however no date for the manufacture of it has been confirmed.

Until trial approval is given, little research progress can be made. A progress meeting was held in April so that the documentation for the approval is being assembled and the team are seeking meetings with the regulator in Queensland as soon as possible, with a main meeting scheduled in May.

C37006 Frictional Ignition – Water Spray Standards, their Basis and Effectiveness with Modern Mining Environment

Organisation: CSIRO
Project Leader: Yong Sun
Value: $89,814
Report Expected: March 2026
Industry Monitors: David Webb
Dennis Black
Steve Winter
ACARP Contact: Patrick Tyrrell

Stage one complete, stage two yet to commence.

This project aims to identify the requirements for which drums/sprays should be designed to optimise the use of water sprays to minimise the FI risk for modern mining equipment. In the first stage of the work program the researchers collated the history, base data and type of equipment used to generate the original, subsequent and up to the current generation British Coal standards via literature review and interviewing the relevant personnel involved in drafting the original and subsequent UK standards. Outcomes developed a program of works that determines the applicability or otherwise of the standards to current operations and formulate understanding of the nature of the variance from the existing standards.

Stage 2 of this project involves testing water spray combinations to improve ignition control. This stage will use lab experiments to study spray effects on cutting temperature. Results could lead to updated standards and safer mining practices.

C38007 Spontaneous Combustion Hazard Likelihood Assessment and Operational Management for Australian Coal Mines

Organisation: B3 Mining Services
Project Leader: Basil Beamish
Value: $182,000
Report Expected: September 2027
Industry Monitors: Ventilation Task Group
ACARP Contact: Patrick Tyrrell

Over the past ten years there have been significant advances in hazard likelihood assessment and operational practices for monitoring, control and mitigation of spontaneous combustion in coal mines. This project aims to document these advances in practical modules that can be delivered to industry personnel in a short course format as well as being made available online. The modules will be concise and directed at helping industry to apply leading practice that maximises the reduction of the spontaneous combustion hazard risk for site-specific conditions.

The project has very recently commenced and as such there is no progress update this quarter.

OPEN CUT

Geology

C35023 Recovery of Critical Minerals from Coal and Coal Production Waste

Organisation: CSIRO
Project Leader: Nerrida Scott
Value: $154,000
Report Expected: June 2026
Industry Monitors: Andrew Lau
Caroline Lang
Jeremy Byrnes
Shaun Booth
ACARP Contact: Patrick Tyrrell

This project investigated potential rare earth sources in a coal mine waste and then identified possible techniques for beneficiation. Samples of mine waste were provided from an Australian coal mine site. These samples were then analysed using various processing methods and it was found that some dilution was evident in the samples affecting mineral concentrations.

Techniques were considered for physical separation, and a range of options tried. Testing included physical separation, flotation and leaching trials. All sample results have been received and are being compiled into the draft report. The report is in the final stages of preparation for this project and will be submitted for review very soon.

C35047 Real Time Prediction of Coal Top Through Guided Borehole Radar Wave Imaging for Open Cut Blast Hole Drilling

Organisation: CSIRO
Project Leader: Wayne Stasinowsky
Value: $496,730
Report Expected: August 2026
Industry Monitors: Gareth Johnson
Jack Woollett
Troy O'Reilly
ACARP Contact: David Drakeley

The project objectives are to:

- Develop a fully functional real-time coal top guidance system prototype suitable for field demonstration trials where it is fitted to a blast rig drilling production holes;
- Extend and mature the technology and engineering developed in Phase II; and to
- Develop a prototype to the stage that the technology is ready to engage a commercial partner.

Progress during the quarter:

- Several redesigns of the system have been completed and tested;
- A significant advance was made in design of the antennas with reverberation time at least halved. Further work on antenna design is progressing using 3D printed models;
- Components for a 4.2m model borehole have been ordered and the preliminary mechanical design has been completed. The model borehole will allow a more consistent testing environment to allow changes to the design to be measured quantitatively. It will also allow different scenarios to be tested such as increasing the overburden conductivity; and
- The model borehole will accommodate a full-size stabiliser and a model of this is being constructed to allow refinement of antenna designs.

C36022 Validation of LIBS Technology for Downhole Resource Evaluation

Organisation: CSIRO
Project Leader: Joe Perkins
Value: $276,020
Report Expected: July 2026
Industry Monitors: Gareth Johnson
Jason Schumacher
Mark Laycock
Sudipta Nag
ACARP Contact: David Drakeley

This project is a follow-up from project C34029 and aims to further validate Laser-Induced Breakdown Spectroscopy (LIBS) as a rapidly deployable technology through expanded lab testing and field trials.

The project aims to:

- Using state-of-the-art laboratory LIBS hardware and multivariate analytical methods, build upon the preliminary findings of project C34029 to develop a comprehensive coal core derived calibration model;
- Integrate LIBS spectral information into washability models using processed core samples; and to
- Conduct field testing using a prototype/pre-commercial LIBS downhole tool to determine the potential and challenges of optimising LIBS technology specifically for the evaluation of coal resources.

During the quarter report writing has commenced, following completion of the coal core LIBS scan analysis and associated traditional laboratory testing datasets. Discussions regarding a suitable field demonstration site are ongoing. In parallel, CSIRO has completed the design of a custom LIBS device for shallow borehole deployment and fabrication has now commenced, pending confirmation of the final trial details. By the next reporting period, researchers aim to progress fabrication and be in a position to confirm the field demonstration pathway.

C37027 Automated Optical and Acoustic Televiewer Drill Data Mapping for Improved Subsurface Analysis

Organisation:	University of New South Wales
Project Leader:	Simit Raval
Value:	$206,875
Report Expected:	April 2028
Industry Monitors:	Ben Forrest Matt Tsang Myf Godfrey
ACARP Contact:	Patrick Tyrrell

This project focuses on developing an automated procedure for interpreting televiewer data tailored to mining applications. The primary objective is to design a machine learning–driven framework for analysing Optical and Acoustic Televiewer data from borehole drilling to detect and classify structural and lithological anomalies. Over the quarter, the research team has developed a methodology to crop and annotate large borehole images without losing key geological features. Overlapping sliding windows are employed to preserve steeply dipping fracture traces across patch boundaries.

The team is currently evaluating traditional image processing algorithms, including Fast Fourier Transform, Local Binary Pattern, and the Sobel operator, to assess image complexity and the quality of the cropped images. These methods quantify structural variation through texture analysis and assign quality scores based on observable borehole image characteristics. The resulting image complexity map highlights regions best suited for automated structure detection while flagging poor-quality zones that algorithms should ignore. The next phase involves using traditional edge detection and morphological algorithms to assess fractures within the cropped images, before developing custom ML models for automated anomaly detection and classification.

C37028 Multiscale Fracture Analysis and Modelling for Improved Geomechanical Assessments

Organisation:	GMEK
Project Leader:	Michael Munro
Value:	$197,250
Report Expected:	July 2026
Industry Monitors:	Leigh Bergin Matt Tsang
ACARP Contact:	Patrick Tyrrell

This project demonstrates a geology-driven DFN workflow for slope stability analysis. It focuses on integrating borehole, televiewer, and mapping data within realistic fracture models, showing how geology-based interpretation improves the accuracy and usefulness of kinematic and geotechnical assessments.

Work in this quarter has focused on advancing the discrete fracture network (DFN) workflow through the application of a slope stability assessment demonstration, consolidating outputs from previous phases of the project. The geology-driven DFN modelling framework developed over previous quarters has been applied in a practical slope stability context, enabling evaluation of its performance relative to conventional stochastic approaches.

The DFN workflow was applied to a slope stability demonstration case, drawing on conditioned fracture models and data-handling procedures developed in previous quarters. Borehole, televiewer and face mapping data were integrated within a realistic fracture model, with larger structurally significant fractures represented explicitly and smaller-scale populations treated within the rock mass characterisation framework. Geology-based conditioning, including damage zone controls and rock unit dependencies, was carried through into the stability modelling, enabling direct comparison against conventional stochastic DFN realisations.

Best-practice guidance for the decision-tree workflow has been progressively formalised, covering variable-quality core, televiewer and mapping datasets and incorporating data-driven domaining and fracture size distribution methods demonstrated using data from Mine Site A and Mine Site B.

Key activities planned for next quarter include:

- Completion of the slope stability assessment demonstration, including review and interpretation of DFN-informed stability outputs;
- Comparative review of geology-conditioned versus conventional stochastic DFN model performance within the slope stability context;
- Preparation of the project report, documenting the full DFN workflow, methodology, data-handling guidance, and demonstration outcomes;
- Engagement with industry monitors to present findings and collect structured feedback on the workflow and its practical applicability; and
- Incorporation of industry monitor feedback into the final report and workflow documentation.

C38006 Transforming Coal Tailings into Sustainable Concrete for Transport Infrastructure

Organisation:	Central Queensland University
Project Leader:	Hassan Baji
Value:	$208,801
Report Expected:	January 2028
Industry Monitors:	Andrew Lau Luke Dimech Nigel Seto Shaun Booth
ACARP Contact:	David Drakeley

This project offers a transformative solution by repurposing coal tailings as a supplementary cementitious material (SCM) for use in concrete for transportation infrastructure, thereby converting a waste liability into a high-value resource.

During the quarter work has focused on investigating the variability of coal tailings properties from samples collected at different times. The research team is characterising this variability in terms of chemical and physical properties, following initial coordination with industry partners at BMA, from whom five coal tailings samples collected on different days have been received. Laboratory characterisation of these samples is currently underway, and preparation for the broader experimental program for coal tailings characterisation is ongoing.

C38021 CSR Predictions and Correlations Definition – Moranbah and Fairhills Coal Measures

Organisation:	McMahon Coal Quality Resources
Project Leader:	Chris McMahon
Value:	$26,680
Report Expected:	February 2027
Industry Monitors:	Graeme Harris Myf Godfrey Shaun Booth
ACARP Contact:	Patrick Tyrrell

This project extends earlier research on predicting Coke Strength after Reaction (CSR) from routine coal quality tests, focusing now on the Moranbah and Fairhill Coal Measures. CSR is a key pricing factor for coking coal but difficult and costly to test directly, especially from borecore samples. Existing prediction models will be evaluated, and new ones developed with better accuracy using statistical analysis of coal quality proxies. Outcomes will help producers assess resource value more confidently and reduce reliance on expensive lab testing. The final guide will support improved marketing, reserve estimation, and technical decision making for Queensland coking coal deposits.

The project is an extension of project C35025, “CSR Predictions & Correlations Definition”, completed in May 2025. That project evaluated Rangal Coal mine based data and shipping data, with application to generic Australian coking coal specifications. The outcomes have created further industry interest for key coking coal mining sequences not enacted in that initial study, namely the Moranbah and Fairhill Coal Measures. Similarly to the initial project, the objective here is to statistically evaluate CSR Predictor performance from various coal quality CSR proxies (CSR Predictors) for the Moranbah and Fairhill Coal Measures.

Data sets for multiple deposits will be attained (two to be provided by industry) containing borecore ply/seam based information and accompanying production/despatch (shipping) data.

At the start meeting a request for information memorandum was issued, at a follow up meeting a further follow up requests was issued. Two borecore databases are likely to be received within the next month.

The outcomes of the project will be the definition of accuracy (precision and bias) information for varying CSR Estimators (both published and MCQR developed) with differing coal types, and method rules for creating new CSR Predictors for new deposits. This aids industry in correct resource representation and/or lower analysis costs and better quality control. The outcomes then providing a financial risk reduction and/or evaluation enhancement.

The initial project final report also produced a guide for use in industry to create and define CSR Predictor methods and accuracy and thus resource/reserve/marketing product potential and confidence and will be augmented in this current project.

Drilling and Blasting

C27024 Evaluation of Production Trials of HP Explosives

Organisation:	Mining3
Project Leader:	Alan Tordoir
Value:	$477,920
Report Expected:	July 2026
Industry Monitors:	Andrew Lau Brett Domrow
ACARP Contact:	Patrick Tyrrell

The objective of this project is to evaluate the on-site on-demand manufacture and delivery of Hydrogen peroxide (H_2O_2)/oil-based emulsion-style explosive and blast performance in surface mine-site operations with increasing scales of production. This project progresses the research plan for H_2O_2-based emulsion explosives from confirmation of first viable formulations meeting sleep-time and detonation performance (reported in project C27023) towards implementation and adoption by focussing on on-site on-demand manufacture and delivery procedures to meet mine-site operational requirements with a central and critical focus on safety.

During the quarter we have been working with industry collaboration partner on restoring project realignment proposal developed to support scaled site-based trial programs linked to projects C27024, C33041, and C35028 after delay in submission. The revised proposal provides a clear basis to resume coordinated progress and drive practical site-based trial delivery.

C33041 Production Trials in Two States of HP Explosives with Custom MMU

Organisation: Mining3
Project Leader: Alan Tordoir
Value: $342,034
Report Expected: December 2026
Industry Monitors: Andrew Lau
Brett Domrow
ACARP Contact: Patrick Tyrrell

This project is on hold.

C35028 Mining Explosive Sensitisation using Chemical Free Methods

Organisation: Mining3
Project Leader: Alan Tordoir
Value: $297,256
Report Expected: November 2026
Industry Monitors: Andrew Lau
Brett Domrow
ACARP Contact: Patrick Tyrrell

This project is on hold.

C37010 Segregation Testing of Category 2 Explosive Transport Boxes

Organisation: Blast Ability International
Project Leader: Lee Julian
Value: $155,750
Report Expected: May 2026
Industry Monitors: Andrew Rose
Tim Gray
ACARP Contact: Patrick Tyrrell

The draft report is with the industry monitors for review.

Environment

C29049 Saline Pit Lakes as Aquatic Ecosystems: A Design Manual for Closure

Organisation: Edith Cowan University
Project Leader: Mark Lund
Value: $1,089,226
Report Expected: May 2026
Industry Monitors: Andrew Lau
John Watson
ACARP Contact: David Drakeley

The draft report is with the industry monitors for review.

C34025 New Landscape Evolution Model for Assessing Rehabilitation Designs

Organisation: University of Newcastle
Project Leader: Greg Hancock
Value: $875,391
Report Expected: May 2026
Industry Monitors: Chris Quinn
Jason Fittler
ACARP Contact: Patrick Tyrrell

The draft report is with the industry monitors for review.

C34027 Microalgae Cultivation as a Low Cost Method for Desalinating Void Water and Generator of Post Mining Bioeconomic Activity from Final Voids

Organisation: University of Queensland
Project Leader: Ben Hankamer
Value: $3,155,904
Report Expected: July 2026
Industry Monitors: Andrew Lau
Jason Fittler
John Watson
Trudy Mazucco
ACARP Contact: Patrick Tyrrell

The objectives of stage 3 of this project include:

- Pilot scale production of microalgae using void water;
- Development and confirmation of downstream processing methods to deliver quality target products;
- Target product testing to confirm product quality, market prices and demand; and
- Advance business modelling for the proposed void PMLU.

In the quarter, the project has conducted the following work.

Pilot scale biomass production:

- The production of Chlorella biomass for the pet food trial has been completed (100%);
- The production of Arthrospira biomass for the pet food trial has commenced (10%). This was delayed due to the unsuitability of the current harvesting system; however, a new system has been purchased and is awaiting delivery; and
- Biomass production for sequential bio-refinery extraction has been successfully completed for all 5 strains (100%).

Target product testing:

- Downstream processing (DSP) for the multiple product biorefinery has been completed for 5 out of 6 strains (83%): Monoraphidium sp., Chlorella CS-41, Chlorococcum sp., Desmodesmus sp., and Arthrospira platensis;
- The second version of the downstream processing method, which involved lipid and pigment extraction

as the initial step, has been successfully conducted on Chlorella (90% completion);
- The dual stream analysis is approximately 70% complete, encompassing both biochar/activated carbon and EPS; and
- Biomass testing to meet regulatory requirements for initiating pet field trials has been conducted for Chlorella, with testing for Spirulina biomass still pending (50% complete).

Advanced business modelling:
- Activated carbon produced from microalgae biomass undergoing laboratory evaluation to support technoeconomic analysis;
- Biomass has been carbonised for testing in sodium ion batteries at UQ's AIBN;
- Evaluation of harvested and dried biomass as a petfood supplement has been delayed by storm damage at UQ's Pinjarra Hills pilot facility; and
- The project has published peer-review articles on alignment of product commercialisation process and regulatory frameworks.

C35021 Delineating Water Tables and Flow Pathways Inside Spoil Piles to Support Water Quality Predictions

Organisation: University of Queensland
Project Leader: Mansour Edraki
Value: $297,420
Report Expected: May 2026
Industry Monitors: Andrew Lau
ACARP Contact: David Drakeley

The draft report is with the industry monitors for review.

C35026 Management Strategies for Invasive Leucaena on Coal Mine Sites

Organisation: University of Queensland
Project Leader: Shane Campbell
Value: $531,528
Report Expected: January 2027
Industry Monitors: Andrew Lau
Craig Bushell
Hardy Wincen
Melissa Brunner
Morné van Zyl
ACARP Contact: Patrick Tyrrell

The primary objective of this project is to develop strategies to effectively manage the invasive species leucaena (Leucaena leucocephala) in rehabilitation on mine sites in Queensland.

A rate–response trial is in its final phase, with one remaining assessment required to complete the evaluation of dose-dependent treatment effects and confirm treatment trajectories over time. A timing of application foliar trial has been established at the University of Queensland (Gatton Campus) to assess seasonal differences in herbicide efficacy. Applications for spring, summer, and autumn have been completed, and the trial is currently under post-application monitoring, with only the winter application remaining to complete the seasonal component. A pot-based boom spray experiment is ongoing at the Tropical Weed Research Centre (TWRC), with final assessment scheduled for October 2026. A drone-based herbicide trial is currently being established in the field and is expected to be conducted within the next two weeks. Additionally, a second pot-based experiment investigating the fumigant dazomet is planned for July this year, building on the initial trial and incorporating methodological improvements.

A further dose response trial of four soil persistent herbicide formulation is also underway at the Gatton Campus using both dormant and non-dormant seeds. The competition trial at TWRC, where the growth and recruitment of leucaena is being monitored monthly in plots containing four soil types and sub-plots with either bare soil or full grass cover is nearing its conclusion with multiple distinctions in growth and recruitment visible across treatments. A crash grazing trial continues to be monitored post grazing at the Gatton Campus. The aim is to see if strategic grazing in combination with a residual herbicide can reduce the population density of leucaena compared to untreated conditions. The final field survey for the Limestone Creek fire trial in Rockhampton was also completed this quarter providing final ground truthing for a dNDVI fire severity map (Figure 1) and the remaining data for that trial. Additionally, the seedbank study of samples from pre and post fire has also concluded and is currently awaiting analysis.

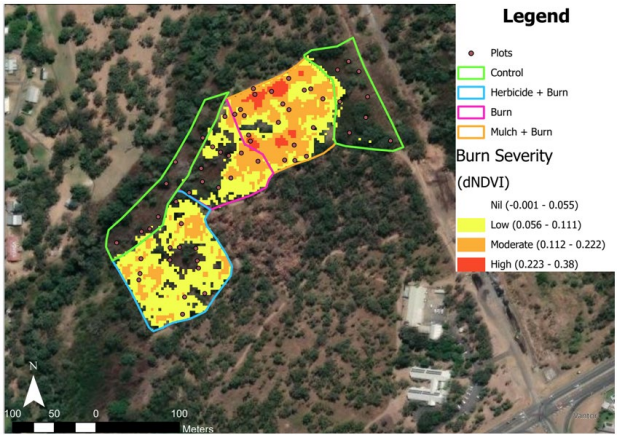


Figure 1. Fire severity map of the trial at Limestone Creek Conservation Park in Rockhampton, Queensland. Pre fire image captured September 24th 2025, post fire image October 3rd 2025. The burn was conducted on September 25th, 2025. Basemap provided by ESRI World Imagery

C35030 Erosion and Sediment Control Framework for Queensland Mines – Calibration and Validation

Organisation:	University of Queensland
Project Leader:	Robynne Chrystal
Value:	$347,196
Report Expected:	December 2026
Industry Monitors:	Andrew Lau
	Jason Fittler
ACARP Contact:	Patrick Tyrrell

This project aims to verify the soil loss rates calculated using the GIS-based RUSLE tool accurately represent site conditions at different catchment scales and land uses and that the guidance provided in project C29046 is applicable and reflects approaches that ensure compliance.

The soil and spoil were collected from mine site one and transferred to UQ Erosion Laboratory. Four flumes were prepared for the erosion studies in the laboratory. Two erosion flumes (80 × 300cm) were filled with spoil materials, in which one spoil filled flume was amended with gypsum (20 t/ha) and the other one was not amended. Two flumes (80 × 300cm) were filled with spoil at the bottom (4cm) and soil at the top (10cm) to replicate the rehabilitated areas in the mine site one. The soil of one of these flumes was amended with gypsum (6t/ha) and the other one was not amended. The four flumes were subjected to three wet and dry cycles for consolidation and then saturated before the erosion study using a rainfall simulator. The rainfall simulator was calibrated for the 10% and 35% slope, and for the Intensity-Frequency-Duration (IFD) curve of the mine site one. Consequently, the rainfall has been applied to the flumes (10% and 35% slopes) for the rainfall events with annual exceedance probability (AEP) of 50, 20, 10, 5 % at 30 minutes. The amount of material loss from each rainfall event was collected to dry and calculate soil loss from each flume.

The next step of the project is to conduct a series of erosion studies in field at mine site one to calculate the soil loss at the field scale.

C36018 Predicting the Long Term Erosional Behaviour of High Walls

Organisation:	University of Newcastle
Project Leader:	Greg Hancock
Value:	$443,980
Report Expected:	July 2026
Industry Monitors:	Andrew Lau
	Chris Quinn
	Jason Fittler
ACARP Contact:	Patrick Tyrrell

The project objective is to:

- Better understand the process and rates of mine highwall erosional failure;
- Develop parameters for input into numerical models for high wall erosional failure; and to
- Calibrate and validate a predictive model (SIBERIA) for the erosion of highwalls.

Several mine sites have provided highwall DEMs in Queensland and New South Wales with data collection complete. Five sites in Queensland were found to be suitable with one in New South Wales suitable. All site survey data processing is now complete.

Erosion and hydrology parameters have been developed for application at four sites in Queensland and one in New South Wales. A fifth site in Queensland is yet to have parameters developed. Initial modelling for the Queensland has been conducted with positive outcomes in terms of model application. More detailed parameters for highwall materials are being employed and results explored. The site in New South Wales has been completed and results are now being finalised. Results demonstrate that a highwall can be subject to erosion from external runoff as well as developing gullies internally. The methodology using a LEM provides plausible outcomes and from this a work flow has been developed. The need to manage external runoff is an initial key finding.

C36020 Semi Autonomous Bulldozers for Mine Site Rehabilitation

Organisation:	University of Queensland
Project Leader:	Ross McAree
Value:	$498,218
Report Expected:	July 2026
Industry Monitors:	Allan Mackaway
	Andrew Lau
	Brian Neilsen
	Jonathan Miln
ACARP Contact:	Patrick Tyrrell

This project is developing and demonstrating semi-autonomous bulldozers based on Caterpillar's SATS platform, targeting substantial reductions in emissions and costs during mined land rehabilitation. The project extends the SATS Tactical Automated Mission Planner (STAMP) to rehabilitation applications and develops a Bulk Movement Planner (BuMP-R) to autonomously generate work-block and slot layout sequences from the overall rehabilitation plan, reducing reliance on operator decision making and improving compliance with the final landform design.

A baseline performance assessment was completed in a prior period, with the field trial of the SATS and STAMP system generating important new knowledge of the operational context, including previously unrecognised use cases that have informed ongoing re-engineering.

Work on the enhanced mission planning system STAMP-R continues, with the key Q1 milestone being integration

of BuMP-R and STAMP-R so that the two components operate together as a unified planning suite.

Development of the bulk movement planner BuMP-R advanced substantially during the quarter. Planning algorithms were demonstrated across three different rehabilitation scenarios, and a workshop with industry rehabilitation planners provided confidence in the generated work-block sequences and yielded practical insights for further improvement.

Progress on the productivity and efficiency evaluation was limited by site availability. The original sponsor site has advised that a suitable rehabilitation area will not be available in the foreseeable future. The project team is in discussion with an alternative site to provide a trial opportunity.

Work on the interim project report is underway.

C36042 Validation of a Landform Design and Management System for Sloped Grazing PMLU

Organisation:	Valarion
Project Leader:	Leigh Trevaskis
Value:	$688,080
Report Expected:	March 2028
Industry Monitors:	Andrew Lau
	Hardy Wincen
	Melissa Brunner
	Morné van Zyl
ACARP Contact:	Patrick Tyrrell

The project's primary objectives are to:

- Characterise the impact livestock behaviour has on stability indicators for sloped grazing PMLU in the Bowen Basin;
- Provide statistical confirmation of an adaptive grazing management system for maintaining the stability of sloped grazing PMLU;
- Obtain evidence that justifies the use of stability indicators for the approval of grazing PMLU rather than a slope gradient ceiling per se;
- Assess the feasibility of using integrated behavioural, landform elevation, and sustainability indicator data for developing a grazing PMLU landform evolution model;
- Use stability indicator data from replicated treatments to evaluate recommendations from previous grazing PLMU studies; and to
- Publish a best-practice guide for managing livestock on sloped grazing PMLU.

In this quarter, the project has continued to work with the partnering mine site to progress planning for the grazing trial's belated commencement in mid-2026.

The partnering mine site is engaging contractors to install trial fencing.

A second round of pasture cuts has been scheduled for July to calibrate remotely sensed groundcover and pasture biomass.

Livestock that will be used in the trial are being prepared for the application of on-animal sensors.

C36043 Using Large Floating Islands to Promote Aquatic and Terrestrial Biodiversity in Pit Lakes

Organisation:	Edith Cowan University
Project Leader:	Mark Lund
Value:	$697,290
Report Expected:	March 2027
Industry Monitors:	Andrew Lau
	John Watson
ACARP Contact:	David Drakeley

Previous projects (C27043 and C29049) has demonstrated that closure of pit lakes as aquatic ecosystems is likely a viable, sustainable, and economically responsible option for post-mining land use. Riparian vegetation and littoral areas are critical ecosystem components that cannot be established before the lake is full.

Artificial floating islands (AFIs) can provide habitat for waterbirds and other fauna. Therefore, AFIs may be used to encourage waterbird usage, create habitat for fauna (including turtles, fish, frogs, macroinvertebrates, and terrestrial organisms) and as a source of plant propagules, and general habitat for fauna (aquatic and terrestrial) in pit lakes. Waterbirds are particularly important to aquatic biodiversity because they are vectors of plants, invertebrates, bacteria, fish eggs, and major sources of nutrients (N and P) through excreta. Propagules from AFIs can continually seed the pit lake during filling, potentially removing the need for companies to return after the lake fills to plant a riparian zone, especially as the upland vegetation is normally well-established by then limiting access to the shore.

The broad goal of this research is to develop the use of large-scale AFIs as a tool that can deployed by miners to develop or improve biodiversity in their pit lakes making them suitable for closure as aquatic ecosystems or demonstrating improvement for NUMAs.

We will investigate the effectiveness of AFIs by testing pairs of pit lakes across Western Australia, New South Wales and Queensland. In each pair, one lake will be treated with an AFI and the other left as a control. Using previous data collected at the sites in C27043 and C29049 and extending this monitoring in this project we can test the effectiveness of AFIs using a Before/After/Control/Impact study design.

Islands have been installed at all three sites in Western Australian, Queensland and New South Wales. We have also completed the first four rounds of monitoring at all pit lakes. The fifth and final monitoring round is

scheduled for June/July. Most sampling processing is up to date. Presently we are seeing strong growth of plants on all three islands, accompanied by extensive use of the islands by waterbirds.

C38002 Investigating Pittosporum Angustifolium for Mine Rehabilitation: Key Strain Identification, Medical and Environmental Applications and Germplasm Propagation Investigation

Organisation:	RNA Environmental Services
Project Leader:	Leigh Trevaskis
Value:	$235,548
Report Expected:	March 2027
Industry Monitors:	Andrew Lau Andrew Micallef
ACARP Contact:	Patrick Tyrrell

This project has three objectives:

- To confirm the prevalence of anticancer compound producing individuals within natural Gumby Gumby populations;
- To undertake statistical analysis of the project's genomic and soil parameter datasets to clarify the relative contribution these variables make to the presence of anticancer compounds in tested Gumby Gumby plants; and
- To undertake a grafting exercise to create hygienic plant material from the most potent plants identified to safeguard these genetics for future tissue culture propagation.

During this quarter, the following project work has been conducted.

Confirmation of the prevalence of anticancer compound–producing individuals:

- Plant material has been collected from individuals previously verified as containing anticancer compounds, as well as from additional plants that were genomically sequenced but not assayed for anticancer activity in the earlier research phase;
- Collected material has been frozen and is being freeze-dried prior to further anticancer evaluation.

Propagation to support grafting activities:

- Gumby Gumby seedlings were acquired to support the grafting of materials from plants verified as medicinal;
- A tissue culture specialist will use this rootstock to establish hygienic grafted plants sourced from shrubs confirmed to contain anticancer compounds. This work aims to preserve superior genetics for future PMLU applications.

C38018 Reducing Coal Tailings by Valorisation of Coal Measure Clays for Low Carbon Concrete

Organisation:	Central Queensland University
Project Leader:	Hassan Baji
Value:	$115,325
Report Expected:	April 2027
Industry Monitors:	Andrew Lau Shaun Booth
ACARP Contact:	David Drakeley

This project proposes a new framework for the coal industry by investigating feasibility of utilising coal-measure clays as supplementary cementitious materials (SCMs) in production of low-carbon concrete, rather than discarding them as waste in tailings dams.

During the current reporting period work has focused on characterisation of clay samples taken from coal mine sites. Initial coordination with industry partners at Glencore has been completed and clay samples from a mine site in Central Queensland have been received. Laboratory characterisation of these samples is currently underway, and preparation for the broader experimental program for characterisation is ongoing. Further communications with industry partners to secure additional samples from other mine sites are also ongoing.

C38019 Reducing Low Frequency Noise Emitted from Heavy Vehicles and Enclosures in Open Cut Coal Mines

Organisation:	University of Technology Sydney
Project Leader:	Paul Williams
Value:	$235,466
Report Expected:	March 2027
Industry Monitors:	Brendan Wilkins Tim Gray
ACARP Contact:	David Drakeley

The goal of this project is to reduce low-frequency noise (31–500 Hz) emitted by heavy machinery in open cut coal mines. A key finding of project C34031 was that conventional acoustic louvres are ineffective at mitigating noise below 500 Hz. This project addresses that gap by developing novel acoustic louvre designs, incorporating metamaterial elements to target the low-frequency range. The objectives of this project are to identify efficient materials and designs for reducing low frequency noise, empirically demonstrating the effectiveness of the material in laboratory testing, and the development of a manufacturable low frequency louvre design.

During this quarter, the project commenced with the literature review and computational modelling stages. A review of metamaterial techniques for low-frequency noise reduction was completed, covering a range of approaches including sub-wavelength resonators, coiled

geometries, and reactive silencer concepts. Computational models were developed in COMSOL Multiphysics and verified against louvre configurations from C34031.

A parametric optimisation study was then conducted using 2D computational models to evaluate metamaterial integration within the louvre geometry. Multiple configurations were explored, varying the number, size, and placement of resonant elements. Among the designs investigated, a Helmholtz resonator configuration showed significant improvement over the frequency range of interest when compared to an equivalent dissipative louvre. The optimised designs were then extended to 3D models with realistic baffle geometry, confirming close agreement with the 2D predictions. Further work is needed to investigate alternative metamaterials configurations.

While investigation into novel materials is ongoing, an opportunity to measure the performance of louvre designs and validate the calculation has presented itself. The transmission loss of selected dissipative and hybrid dissipative-reactive louvres will be measured in a transmission loss suite at UTS Techlab. These results will be used to validate the model and inform further optimisation. This work brings forward part of WP3.

Rock Mechanics

C29005 System for Rock Fall Analysis Field Trial

Organisation: CSIRO
Project Leader: Marc Elmouttie
Value: $321,268
Report Expected: May 2026
Industry Monitors: Matt Tsang
ACARP Contact: Patrick Tyrrell

The draft report is with the industry monitors for review.

C33040 Machine Learning for Rockfall Analysis

Organisation: University of Newcastle
Project Leader: Klaus Thoeni
Value: $342,240
Report Expected: May 2026
Industry Monitors: Matt Tsang
ACARP Contact: Patrick Tyrrell

The draft report is with the industry monitors for review.

C35022 Quantifying Hoek-Brown Disturbance Factor (D) for Coal Measures Through an Integrated Laboratory and Numerical Modelling Approach

Organisation: University of Queensland
Project Leader: Italo Onederra
Value: $672,162
Report Expected: November 2026
Industry Monitors: Matt Tsang
Peter Chern
ACARP Contact: Patrick Tyrrell

The primary aim of this project is to validate the blast damage predictive model proposed in previous stage of this project through a targeted monitoring campaign. Validation trials will be designed to not only assess the effectiveness of the proposed method, which links peak particle velocity, scale effects, and damage extent with disturbance factors (D); but also, to demonstrate its practical application.

During this quarter, a web-based tool has been developed to predict the D-factor behind highwall slopes. The D-factor is calculated from peak particle velocity (PPV) contours generated using the Heelan–Blair model. The tool allows users to input a wide range of parameters, including charge design details (multiple holes, multiple decks, and hole inclination), model resolution, site-specific attenuation constants, the damage-threshold PPV, and the highwall geometry (multiple bench configurations and slope angles). With these inputs, users can define various blasting scenarios to estimate damage profiles and the resulting distribution of D-factors behind the final wall. The objective is to support slope-stability analyses by providing a simpler and more objective method for defining blast induced disturbed rock mass zones.

In parallel, procurement of site monitoring equipment has been completed. A meeting with the mine site has confirmed monitoring locations and a site visit scheduled for early May. During this visit, three accelerometers and two geophones will be installed at different distances from the last row of blast holes. The recorded data will be analysed to assess PPV attenuation behind the highwall blast. At the same time, field procedures will be refined and improved.

C36017 From Open Pit to Pumped Hydro Energy Storage, a Focus on Low Wall Stability

Organisation:	University of Newcastle
Project Leader:	Olivier Buzzi
Value:	$405,500
Report Expected:	October 2028
Industry Monitors:	Andrew Lau Shaun Booth Troy O'Reilly Tyron Domenici
ACARP Contact:	David Drakeley

The objectives of the project are to identify the fundamental failure mechanisms of a low wall in the context of pumped hydro energy storage (PHES), and provide guidance to mitigate the geotechnical failure risks. In the last quarter, we have:

- Progressed on the preparation for shipment of the material to Southwest Jiaotong University, Chengdu, China. A suitable freight company has been identified, quotes have been obtained and laboratories who can issue required material certificates have been identified.
    - Completed a series of permeability tests in a triaxial cell on the scalped material (maximum clump size of 20 mm) under different confining stress, to assess the effect of overburden stress on permeability. These tests are required to assess the degree of similitude between the real spoil pile and the reduced scale pile tested in the centrifuge. In absence of in situ permeability test data, the field permeability was approximated as the infiltration rate (~10 mm/hr~3*10-6 m/s), on Mine B. Figure 1 shows the results of the permeability tests for different applied stresses, from 2kPa to 460 kPa. The laboratory permeability is at least one order of magnitude lower than the in-situ infiltration rate, which can be explained by differences in particle size and possibly, density. The permeability ratio between site and material selected for the centrifuge test will be used to assess the scaling factor for time.
    - Conducted a series of direct shear tests on spoil material to obtain a consolidated undrained (CU) strength envelope and assess the effect of collapse on the undrained strength. To do so, two testing sequences were tested:
- Sequence 1: the material was loosely placed in the direct shear box (wo~3%, eo=0.9), saturated and loaded to the target normal stress. Application of the normal load induces consolidation of the saturated material. Shearing starts when the consolidation phase is complete. These tests are referred to as standard consolidated undrained tests.
- Sequence 2: the material was loosely placed in the direct shear box (wo~3%, eo=0.9), loaded to the target normal stress and then flooded. Flooding the loaded specimen induces collapse. Shearing starts when the collapse induced settlement has reached equilibrium. These tests are referred to as collapsed undrained tests.

Figure 2 suggests that a higher undrained shear strength is mobilised for specimens that have undergone collapse prior to shearing, which is not an expected result. The tests are currently being analysed to explain this observation. Among other things, this might be due to differences in void ratio prior to shearing as well as to pore pressure/suction effects, as suggested by the fact that the effective strength envelop is located in between the two series of undrained tests. It is proposed to repeat those tests to ascertain the reliability of the data.

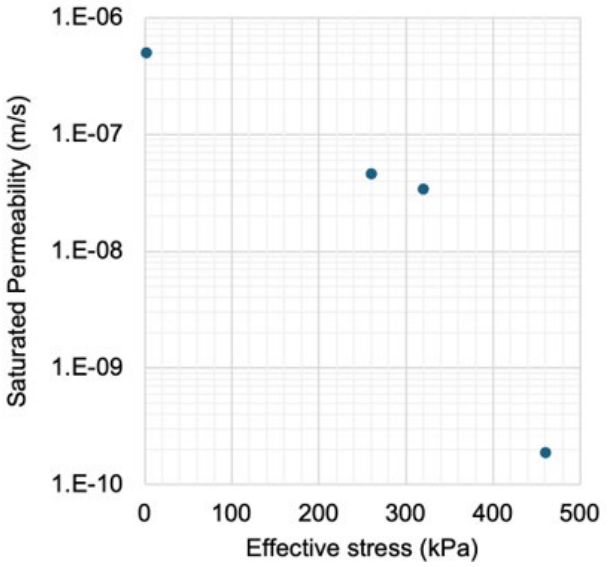


Figure 1: Saturated permeability of scalped material from Mine B as a function of effective stress applied to the specimen.

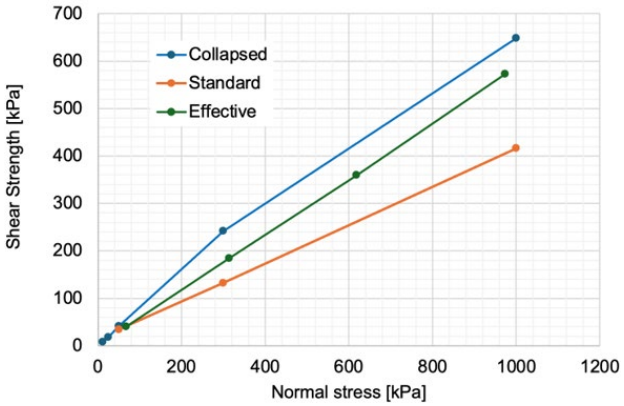


Figure 2: Shear strength envelope for standard consolidated undrained tests and collapsed undrained tests. In both cases, shearing is undrained (1mm/min). For completeness, the effective strength envelop is also represented.

C36021 Measuring the Tensile Strength of Thin Units in Coal Measure Rocks using a Comminution Approach

Organisation:	University of Queensland
Project Leader:	Katerina Savinova
Value:	$214,100
Report Expected:	May 2026
Industry Monitors:	Andrew Lau Jianping Li Matt Tsang
ACARP Contact:	David Drakeley

The draft report is with the industry monitors for review.

C36023 "SCANDY" - A handheld Imaging System for Real Time Spoil Categorisation

Organisation:	University of New South Wales
Project Leader:	Simit Raval
Value:	$178,050
Report Expected:	May 2026
Industry Monitors:	Jacques Strydom Tim Vangsness
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

C37011 Improved Change Detection for Low Cost Terrestrial Photogrammetric Monitoring Based on Deep Learning

Organisation:	University of Newcastle
Project Leader:	Klaus Thoeni
Value:	$273,196
Report Expected:	June 2027
Industry Monitors:	Ben Forrest Gareth Johnson
ACARP Contact:	David Drakeley

This project aims to develop a low cost, AI-enhanced photogrammetric monitoring system to detect rockfalls and potentially also slope instabilities in open cut mines. Building on project C29050, it addresses the current system limitations by integrating Deep Learning (DL) to improve detection accuracy, reduce false positives, and eliminate manual analysis. The result will be a reliable, low-cost, near real-time solution that enhances safety, reduces operational delays, and supports long-term geotechnical risk assessment.

Progress during the quarter was slower than originally anticipated, primarily due to delays associated with the installation of the monitoring system at the selected mine site. A meeting was convened with the industry monitors to discuss the causes and implications of the delay and it was agreed that the project timeline would be extended by six months. This extension will ensure sufficient time is available to undertake meaningful data collection and analysis once the monitoring system is fully operational.

The project team has maintained regular communication with the mine site to progress installation planning. A site visit was conducted, during which three suitable installation locations were identified in consultation with site personnel. The mine has since completed the necessary preparatory works at these locations, and installation of the system is currently scheduled for May.

Two monitoring systems will be installed in parallel to maximise data acquisition during the remaining project period. In addition, alternative mine sites have been contacted as contingency options, and discussions are underway to support the potential installation of a third system, which is currently in the final stages of development.

C38004 Guideline for Groundwater Pressure Measurement, Interpretation, and Modelling for Slope Stability

Organisation:	Sherwood Geotechnical and Research Services
Project Leader:	John Simmons
Value:	$40,500
Report Expected:	May 2026
Industry Monitors:	Matt Tsang
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

Maintenance and Equipment

C37021 Concept to Produce Pure Plant Oil Economically for Captive use at Mine Site to Replace Diesel

Organisation:	Green Biofuels Australia
Project Leader:	Charles Easton
Value:	$265,000
Report Expected:	May 2026
Industry Monitors:	Andrew Lau Myf Godfrey Shaun Booth
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

Health and Safety

C36033 Live Monitoring of Workplace Exposures In Surface Mobile Equipment

Organisation: SafeOperate
Project Leader: Andrew Westaway
Value: $152,000
Report Expected: July 2026
Industry Monitors: Shane Apps
ACARP Contact: Patrick Tyrrell

This project primarily aims to establish real-time whole body vibration monitoring of operators in mining equipment, with secondary objectives of real-time seat suspension and haul road health monitoring. This achieved through the creation of seat covers containing embedded accelerometers fitted to equipment, accelerometers mounted to the cab of equipment, and all collected data to be GPS tagged.

Progress during the quarter:

- SafeOperate system fully functional onsite;
- Five further systems planned to be installed via maintenance scheduling onsite;
- Six additional systems being manufactured as requested by site for installation on specific haul truck class;
- Development of Grafana front end underway with data from online unit;
- Installation of additional units and finalisation of Grafana front end expected to be completed in June;
- Real-time monitoring of VDV(8) and A(8) implemented for working for operators of online system;
- Mapping of haul roads enabled for online unit;
- The mine has been provided access to the front end and backend data for use in their own internal reporting systems;
- Alerts for seat suspension monitoring to be incorporated into site maintenance alerting system;
- Final report for project expected to be completed in Q3 2026.

General

C37013 Thermally Enhanced Floating Solar Still System for Reducing a Mine's Reliance on Raw Water Allocations and Achieving a Drought Resilient Post Mining Land Use for Final Voids

Organisation: Valarion
Project Leader: Leigh Trevaskis
Value: $83,000
Report Expected: February 2027
Industry Monitors: Andrew Lau
Angus Ball
Shaun Booth
ACARP Contact: Patrick Tyrrell

The project objective is to design and performance test a modular and potentially thermally enhanced floating solar still prototype that:

- Has capacity to scale for application on voids of varying water surface areas and water quality;
- Produces commercially relevant volumes of water (i.e. > 12ML/ha) to supplement mine operational requirements and PMLU agricultural applications;
- Requires minimal maintenance;
- Provides ease of access and functionality for safe system maintenance; and
- Delivers a cost-effective means for avoiding expensive backfilling of final voids.

In the quarter, the project has conducted the following work.

Mini-still design, testing and evaluation:

- The project has collaborated with a computational fluid dynamics modeller to create a calculator to guide prototype design features (e.g. condensation pipes, fans etc);
- A mechanical/structural draftsman was engaged to draw the workshop ready design. The designs will be ready by the end of May;
- An engineering firm has been engaged to manufacture the prototype;
- Materials exposed to mine water in the Bowen Basin will soon be retrieved to confirm material selection or prototype construction; and
- The project has commenced ordering specific materials for prototype manufacture.

COAL PREPARATION

Reports Published This Quarter

C35031
Demonstrating Better Classifying Cyclones
Elsa Consulting Group
Andrew Vince
Link to download the final report:
https://www.acarp.com.au/abstracts.aspx?repId=C35031

Maintenance and Equipment

C36027 Coal Stockpile Management for Remote Bulldozers through Enhanced Situational Awareness

Organisation:	University of Queensland
Project Leader:	Ross McAree
Value:	$734,000
Report Expected:	June 2026
Industry Monitors:	Bryce Ayscough
	Clinton Vanderkruk
	Michael Booth
ACARP Contact:	Patrick Tyrrell

This project is developing enhanced situational awareness and decision support tools for remotely operated bulldozers on coal stockpiles. It addresses a significant practical barrier in non-line-of-sight teleoperation, where operators lack the perceptual cues needed to work effectively and safely. Building on a series of collaborative projects between the University of Queensland and Caterpillar, the project develops and evaluates two core capabilities: real-time topography mapping of the stockpile surface using on-board and infrastructure-mounted sensors combined with material movement models, and generation of efficient material movement missions to support operator decision making. These capabilities are integrated with Caterpillar's NLOS teleoperation technology to provide operators with situational awareness and decision support, including suggested push and transition paths, draw-valve location, crest identification, and coal bridging predictions. The effectiveness of the system will be assessed through evaluation trials comparing operator performance with and without the decision support system against a computed optimal material movement schedule, with operator workload gauged through NASA TLX surveys.

Good progress was made during Q1 2026. The topography mapping system and autonomous mission planner are both largely complete, with recent work focused on traversability algorithms and site-specific planning improvements respectively. System integration work is underway, with effort directed at data flow protocols and operator display design. Trial planning has advanced, with sensor installation agreements and experimental protocols under discussion with the trial site. The assessment methodology and reference models have been refined and validated. A proposal to add a downward-looking lidar around the draw point is under feasibility investigation, with dust in the operating environment identified as a key challenge.

C36028 Continuous Stockpile Cavity Warning System - Feasibility Assessment

Organisation:	CSIRO
Project Leader:	Wayne Stasinowsky
Value:	$191,600
Report Expected:	July 2026
Industry Monitors:	Connor Gregory
	Michael Booth
	Tom Buckby
ACARP Contact:	Ben Gill

The project objectives are to:

- Conduct a feasibility assessment for a system that will allow the mine to monitor the stockpile continuously in real time and give real-time warning of a developing void to the dozer operator;
- Model the responses numerically to determine that there is sufficient resolution to detect dangerous voids; and to
- Test the technique using scale models.

During the quarter, a Bowen Basin mine has agreed in principle to allow access for testing a radar over a full-size stockpile. This test was in addition to the original scope but considered important additional information ahead of phase 2 full scale design and development. We are waiting for the mine site to confirm access and arrange a site visit.

Dewatering

C33051 Hybrid Microwave Technology for Dry Stacked Tailings Applications

Organisation:	University of Queensland
Project Leader:	Christian Antonio
Value:	$121,335
Report Expected:	July 2026
Industry Monitors:	Connor Gregory
	Frank Mercuri
ACARP Contact:	Ben Gill

One of the most pressing challenges facing the mining industry today is the increasing frequency of catastrophic tailings dam collapses. Such events are known to cause significant environmental damage as well as loss of life. There is a strong industry push to move away from wet tailings dams to drier and safer options. A viable alternative to tailings storage in dams is Dry Stack Tailings (DTS) technology.

This project proposes a new approach that could reduce tailings moisture contents to levels required for dry stacking – the use of Hybrid Microwave (MW)

Technology. This approach combines microwave treatment with conventional dewatering techniques. This method could bridge the moisture content gap between conventionally dewatered material and Dry Stack Tailing requirements.

The project aims to evaluate the feasibility of a continuous process and measure the energy requirements to achieve different product moisture content. Finally, it will provide a concept for a microwave-assisted dewatering process for future research studies.

Work during this quarter focused on the final report preparation.

C34051 Cost Effective Approach for Coal Tailings Dewatering using Semi Inverted (SIV) Hydrocyclones

Organisation:	University of Queensland
Project Leader:	Christian Antonio
Value:	$174,500
Report Expected:	August 2026
Industry Monitors:	Connor Gregory
	Jenny Goh
	Tom Wilson
ACARP Contact:	Ben Gill

The application of coagulation, flocculation, and mechanical dewatering units such as belt press filters, centrifuges, and horizontal belt filters is currently used by industry as a practical approach for dewatering coal tailings. However, there are still challenges that limit dewatering of coal tailings which affects the performance of these dewatering processes. These include the presence of clay materials, elevated fines and ineffective coagulation and flocculation methods, amongst others.

This project aims to develop a technologically and economically viable approach to reduce moisture content and capture fine clay particles in tailings to improve tailings dewatering outcomes, by using Semi-Inverted Hydrocyclone Technology, followed by coagulation, and flocculation. The study aims to use the SIV to split a tailings sample into a coarse stream (underflow product), with reduced moisture content, and a clay-rich fines stream (overflow product). This will enable targeted processing of the two streams that could consequently improve the efficiency of downstream dewatering units. A potential tailings sample has been received for evaluation for use in this project.

Work during this quarter focused on the final report preparation.

C36025 Green and Effective Reagents for Centrifugal Dewatering

Organisation:	University of Queensland
Project Leader:	Liguang Wang
Value:	$198,982
Report Expected:	June 2026
Industry Monitors:	Chris Denyer
	Connor Gregory
	Jenny Park
ACARP Contact:	Ben Gill

The objectives of this project are to:

- Screen and develop green reagents for dewatering of coals and tailings over a broad size range to achieve low product moisture level and high solids recovery; and to
- Provide a guide for reagent selection in dewatering of Australian black coals and tailings.

The team has secured a flotation tailings sample from a participating CHPP. The sample is currently being tested under the established experimental framework. This includes settling tests, single-leaf filtration, and both screen bowl and solid bowl centrifuge evaluations using selected flocculants.

In next quarter, testing of the tailings sample will continue. In parallel, screen bowl centrifuge testing for the thermal and metallurgical flotation concentrate samples will be finalised. Upon completion of the experimental program, the project will focus on correlating dewatering performance across thickening, filtration, and centrifugation processes for both tailings and product coal datasets, with the aim to deliver a comprehensive reagent selection framework. The project team will also finalise the draft project report.

Environmental Improvement

C29042 Tailings to Topsoil

Organisation:	University of Newcastle
Project Leader:	Ken Williams
Value:	$765,300
Report Expected:	September 2026
Industry Monitors:	Bill Baxter
	Paul O'Loughlin
ACARP Contact:	Patrick Tyrrell

The original Tailings to Topsoil project commenced in 2020 to develop a co-utilisation and soil improvement program that addresses the environmental challenge of tailings management for mining operations. This transformational alternative for tailings management research optimises existing technologies for dewatering, delivery, and soil remediation processes into an integrated "pit to paddock" mobile plant emplacement and cultivation system.

Field Trials – two site trials:

- Field trials at Site 1 and Site 2 continue to show ongoing plant growth across all established plots;
- Growth trends remain consistent with previous reporting periods, with no significant divergence between treatment ratios at this stage; and
- Plant assessments are scheduled following the 2026 summer growth period.

Ex-Situ Trials – Glasshouse (Sticky Hopbush):

- The glasshouse trials using sticky hopbush (Dodonaea viscosa) have now been completed for all tailings treatments, including mixed tailings-to-soil ratios, 300C pyrolysed tailings and pelletised tailings products.

Final destructive harvest data for fresh shoot and root biomass have been assessed. The results of the shoot and root weights for the control and each treatment can be seen below in Figure 1 with the ration between shoot and root weight shown in Figure 2.

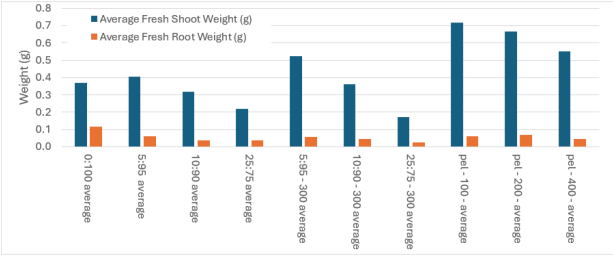


Figure 1. Sticky Hopbush shoot weight and root weight

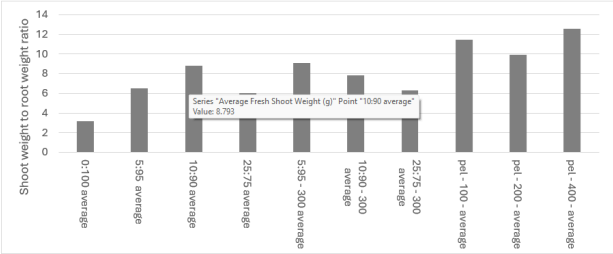


Figure 2: Sticky Hopbush shoot to root weight ratio

- Low-level mixed tailings at 5:95 improved shoot and root biomass relative to the control treatment;
- Pyrolysed tailings, particularly 5:95 at 300 C, further enhanced shoot growth compared with the control and untreated equivalents;
- Pelletised treatments produced the strongest shoot response, with pel-100 recording the highest above-ground biomass; pel-100 and pel-200 were the highest-performing pellet rates;
- Findings indicate that sticky hopbush responds positively to selected coal tailings amendments. Pelletised products can support rapid early establishment, while incorporated tailings support balanced shoot-root development.

Column leaching and chemical analyses:

- Chemical assays on leachates and solid phases have been completed and will be reported in Q3 2026.

Regulatory progress – resource recovery exemption (RRE):

- The Resource Recovery Order and Exemption (RROE) submission to the NSW EPA was formally lodged in December 2025;
- Supplementary information was provided as requested for the RROE assessment in February 2026, which was accepted as sufficient to proceed to the draft RROE;
- The NSW EPA are currently drafting the RROE for review.

C35033 Non-invasive and Real Time Monitoring of Slurry Tailings Density and Velocity in the Transmission Pipeline using Electrical Resistance Tomography Method

Organisation: University of Queensland
Project Leader: David Williams
Value: $259,000
Report Expected: June 2026
Industry Monitors: Peter Shumack
ACARP Contact: Patrick Tyrrell

The objectives of the project are to:

- Develop a resistivity inverse model that converts the longitudinal and cross-sectional resistivity tomography of coal slurry to its density and velocity, accounting for the effects of temperature, EC, air content and coal tailings mineralogy;
- Test the system at a coal transmission pipeline for in situ and real-time monitoring of the slurry transport conditions; and to
- Verify the monitored results with those obtained using concurrent technologies.

This quarter the following improvements were achieved.

Settling column experiments using coal tailings slurry were analysed to investigate solids concentration evolution during batch gravitational settling. The interface level method was applied to extract settling interface trajectories from experimental observations. A one-dimensional Kynch-type settling model was then implemented using an implicit numerical solution scheme to simulate concentration profile evolution and estimate key solids transport parameters. The solids flux function adopted in the model follows:

$$f(\phi) = v_0\phi(1 - \frac{\phi}{\phi_{max}})^n$$

where v_0 is the initial settling velocity parameter, n is the flux exponent controlling hindered settling behaviour, and ϕ_{max} represents the maximum solids packing fraction. Using this approach, key settling behaviour parameters governing solids transport were successfully identified:

- initial settling velocity parameter $v_0 \approx -1.31 \times 10^{-4}\ m/s$
- flux exponent $n \approx 11$
- maximum solids volume fraction $\phi_{max} \approx 0.48$

The simulated interface evolution shows good agreement with experimental observations, with an overall RMSE of approximately 0.02 m (~2 cm) (Figure 1). Mass conservation was verified throughout the simulations, with maximum absolute numerical mass-balance error remaining below $3 \times 10^{-6}\, m$ (equivalent solids-height error level), confirming the stability and reliability of the implicit solution scheme.

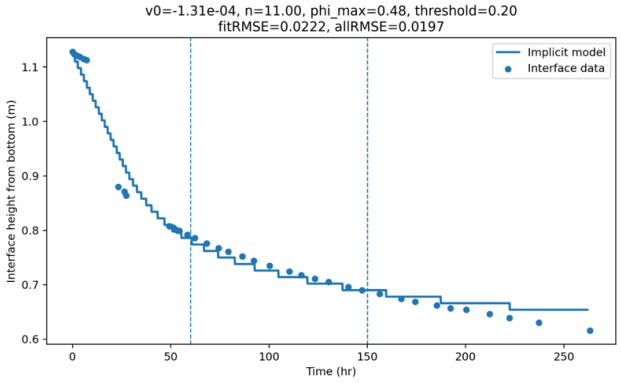


Figure 1 Comparison between measured and modelled interface evolution

The model also reproduces physically consistent concentration profile evolution during settling (Figure 2), demonstrating its capability to describe hindered settling behaviour in coal tailings slurry systems.

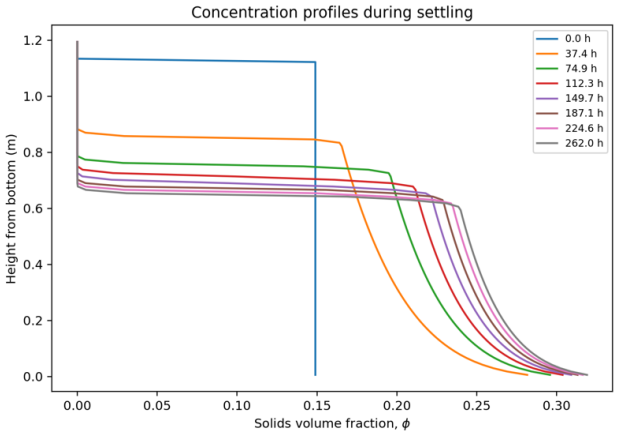


Figure 2 Concentration profile evolution during settling

In addition, Electrical Resistance Tomography measurements collected at a fixed elevation 0.26m above the column base are currently being incorporated as an independent internal concentration constraint to further refine the inversion framework. This additional constraint is expected to improve parameter identifiability and enhance model robustness for future pipeline monitoring applications. This work is currently ongoing.

C35048 Cost Effective Rehabilitation of Tailings Dams

Organisation:	CSER Research
Project Leader:	Mike Cole
Value:	$973,580
Report Expected:	March 2027
Industry Monitors:	Andrew Lau
	Brooke York
	Pearl Garrett
	Shaun Booth
ACARP Contact:	Patrick Tyrrell

This program of research incorporates the work undertaken in projects C27009, C29041, C34030 and thus far in this project towards developing cost effective rehabilitation and closure of tailings dams. It aims to assist in developing mine specific final land use plans, and further test tailings amelioration techniques to maximise success for the native vegetation used. In addition, it will work towards maximising plant and soil biodiversity of the dams and their surrounds.

Closure of our long term study site was preceded by a successful site tour with 24 participants representing a variety of organisations, including industry monitors, NSW Department of Primary Industries and Regional Development, Queensland Mine Rehabilitation Commission, Corporate Personnel and key Hunter Valley mine staff. Data from this site will now be compiled, analysed and formatted to support upcoming reporting and inform future work.

Activities have commenced at the new site, with all safety procedures reviewed and implemented. Planting has begun with two experiments established to address key knowledge gaps. These focus on the cost/benefit of plant size at establishment, and the influence of ecotone on survival, growth, and contribution to the vegetative water pump for the tailings dam dewatering.

At the workplace, plant production has continued, with an increasing focus on diversifying species availability in response to findings obtained from our previous site. Results demonstrated that, under suitable conditions Eucalyptus camaldulensis trees can develop a root system in a conventional geotropic manner, in-turn enabling access to moist parts of the crust. Resultantly, E. camaldulensis and other select eucalypt species have been incorporated into the Plant Growth Facility rotating seeding regime.

Fine Coal

C34002 Full Scale Beneficiation of Coal Fines by Novel Agglomeration

Organisation: University of Newcastle
Project Leader: Kevin Galvin
Value: $4,568,256
Report Expected: July 2026
Industry Monitors: Ben Gill
Chris Jackson
Jack Lauder
Jason Schumacher
Jenny Goh
Luke Dimech
Paul Sainsbury
PeiPei Wang
ACARP Contact: Patrick Tyrrell

The objective of this project is to investigate the scale-up of a novel fine coal agglomeration technology through a study at full-scale. The project involves the design, commissioning and operation of the novel agglomeration technology. The feed source is expected to be a fine coal tailings stream suitable for the thermal market. The study will quantify the scale-up at up to 500m^3/h in terms of yield, ash, moisture and economic benefits. The novel agglomeration technology offers the prospects of a low capital investment for processing the fine coal tailings stream normally sent to the thickener.

This project involved a substantial scale-up from a 25mm diameter pipe configuration to a 350mm diameter pipe system requiring the flow of the slurry and binder through a single hole in an orifice plate to produce agglomerates. The early results suggested that the system does not scale directly, and that the collision efficiency with the emulsion binder is impacted negatively. Additional funding was secured to develop further understanding of the scale-up of the technology. The current standard pipe configuration, with a diameter of 350mm, was replaced by a new design standard based on a 100mm diameter pipe configuration. The oil dose was significantly lower than that achieved in the larger scale study. The work strongly indicates the potential for separation at an even lower oil dose.

It was then agreed the work should be extended to a final phase by inserting a pipe-bundle arrangement within the main 350mm pipe configuration. This approach would then allow the single pipe performance to be scaled to a multi-pipe arrangement to support higher flow rates. The installation of the agglomeration facility was finally completed through the previous quarter. Changes to the piping led to higher pressure drops, which then reduced the feed supply rate to around 200m^3/h. These changes were introduced to reduce the risks associated with supporting the elevated pipe with scaffolding. Instead, the feed was piped to ground level and then elevated back to the supply tank. The agglomeration facility incorporating the new pipe bundle arrangement was commissioned following its installation, allowing the experimental campaign to be undertaken.

The goal was to establish a stable and scalable operating window for multi-pipe agglomeration. The work focused on changes in the orifice plate hole size, feed rate and pipe velocity, pressure drop across the orifice plates, and binder dosage. This work was successful in reproducing the single 100mm diameter pipe agglomeration from the previous phase of work and was also successful in supporting the agglomeration through two parallel pipes. Poor performance was then observed in moving to a third pipe, attributed to poor distribution of the emulsion binder. The emulsion binder was then introduced prior to the pump to improve its distribution. The agglomeration performance improved significantly and was found to be robust. Product ashes ranged between 9.9 and 11.7%, with combustible recoveries between 82.3 and 92.8%. Clear conclusions were formed on the essential requirements for achieving scalable and robust performance of the agglomeration. The project is currently under review.

C34040 Optimising the Diesel Droplet Size in Coal Preparation Plants

Organisation: University of Queensland
Project Leader: Yongjun Peng
Value: $231,157
Report Expected: June 2026
Industry Monitors: Chris Denyer
Han Hooi
Jason Schumacher
ACARP Contact: Ben Gill

The objectives of this project are to:

- Develop full-scale emulsification systems incorporating the online droplet size measurement;
- Determine the optimal diesel droplet sizes in representative coal preparation plants varying with coal type, water salinity and diesel dosing through statistically designed ON/OFF trials;
- Identify the most efficient and economic diesel dispersion system to achieve each optimal droplet size; and to
- Develop the most suitable diesel dispersion strategy for each representative plant through an assessment of flotation improvement, reduction of diesel consumption, hurdles to implementation (e.g. safety, ease of installation and conversion, ease of operation) and capital and operating costs.

During this reporting period, the project has progressed from site preparation to final compliance and readiness for plant trials. JA Martin has commenced the electrical compliance inspection and certification of the emulsification system at Plant 2. This work is currently underway and is expected to be completed by May or early June 2026. The compliance process is being conducted in accordance with plant safety and

operational standards to ensure the system can be deployed under full-scale operating conditions.

Following completion of compliance and final commissioning, the plant trial will commence. The trial will involve continuous operation of the emulsification system under plant conditions to evaluate diesel dispersion performance, system stability, and its impact on flotation performance. This stage will provide critical data for full-scale validation and support the assessment of technical and economic performance.

In parallel, the final project report is being drafted.

C34043 In Plant Demonstration of the Next Generation Flotation System

Organisation:	University of Queensland
Project Leader:	Liguang Wang
Value:	$258,347
Report Expected:	May 2026
Industry Monitors:	Elie Bassil
	Nic Roberts
ACARP Contact:	Ben Gill

The draft report is with the industry monitors for review.

C35035 3D Particle Surface Composition Analysis for Flotation Using Micro-CT

Organisation:	University of Newcastle
Project Leader:	Rohan Stanger
Value:	$81,730
Report Expected:	May 2026
Industry Monitors:	Luke Dimech
ACARP Contact:	Ben Gill

The draft report is with the industry monitors for review.

C36026 Side-by-Side Analysis of Coal by Automated Micro-CT and Commercial Laboratory Testing

Organisation:	University of Newcastle
Project Leader:	Rohan Stanger
Value:	$167,432
Report Expected:	June 2026
Industry Monitors:	Mel Robbins
	Michael Saxby
	Tom Wilson
ACARP Contact:	Ben Gill

This project aims to trial an automated sample carousel for a laboratory micro-CT instrument and compare data with standard testing for float/sink and petrographic analysis. The intention is to determine the speed and accuracy of micro-CT derived coal tests. If successful, it will provide a automated 3D analytical test method with faster turn-around times and potentially lower costs. This automation trial will develop the work-flows needed to test the automated scanning, image reconstruction, particle recognition and analysis.

In this quarter, we have conducted a range of scans of sized samples of Feed, Product, Middlings and Reject and processed the images for particle analysis. We have encountered some interference of dense minerals in the lower size fractions (-0.5mm) that we believe has impacted the results. This has resulted in the need to trial several options for reducing “beam hardening” interference.

C36029 Testing a Novel Flotation Concept for Coal

Organisation:	CSIRO
Project Leader:	Nerrida Scott
Value:	$88,204
Report Expected:	July 2026
Industry Monitors:	Frank Mercuri
	Jenny Goh
	Michael Saxby
ACARP Contact:	Ben Gill

This project has involved the testing of a new prototype flotation rig as a proof of concept. A two-stage flotation was also tested using a 300mm Jameson cell as the first stage with the novel flotation rig processing the J-cell rejects. A faulty dosing pump resulted in low first stage yields with product coal reporting to the first stage flotation tailings, however the prototype flotation rig was able to pick up a considerable amount of this lost tailings as a scavenger cell.

Denver Flotation tests were used to provide a direct comparison with the novel flotation device with CSIRO’s Coal Grain Analysis techniques used to assess the maceral components in the product and reject streams. We now have sufficient data from the test work and a draft report is expected to be delivered in the next month.

C37016 Industrial Particle Sampling Systems for the Particle Profiler in Fine and Ultra-Fine Circuits

Organisation:	University of Newcastle
Project Leader:	Rohan Stanger
Value:	$178,404
Report Expected:	August 2026
Industry Monitors:	Chris Denyer
	Jenny Goh
	Michael Saxby
ACARP Contact:	Ben Gill

This project is based on developing two sampling systems for the Particle Profiler analyser to suit two different coal circuits. The intention is to conduct industrial trials and a coal preparation plant.

This project is currently waiting for a new pump to be delivered. It was found in laboratory testing that the pressure drop across the optical cell caused the venturi sampling device to perform poorly. It will be replaced with a pump.

C38023 Handling Effectively with Swelling Clays to Reduce the Ash Content of Coal Flotation Concentrates

Organisation:	University of Queensland
Project Leader:	Ngoc Nguyen
Value:	$295,586
Report Expected:	March 2028
Industry Monitors:	Chris Denyer
	David Hensley
	Tom Loweke
ACARP Contact:	Ben Gill

This project aims to reduce ash content in coal flotation concentrates by targeting swelling clays using magnesium-based clay depressants. We investigate effective chemical reagents (known as clay suppressants) to reduce the ash content of fine coal flotation concentrate. Specific aims include:

- Characterise clay types and compositions in coal flotation feed;
- Identify and test clay suppressants to remove clay slime coatings and/or clay entrainment;
- Design and conduct experiments using mechanical cell, Microcel, and Jameson cell for evaluating and benchmarking the effectiveness of chemical reagents on ash removals.

The ultimate goal is to deliver higher-quality products and opportunities to increase overall plant recovery by avoiding high ash/clay entrainment.

During the quarter we had a project start meeting with the industry monitors. At the meeting, we reached an agreement on the project scope and timeline, identified the sites for samples collection. Recruitment of a postdoctoral research fellow to work on this project has been progressing well. We expect to have the research fellow starting their job by June to implement the research project. In the meantime, samples request has been submitted to sites. We expect to receive the samples in May for our experiments.

Gravity Separation

C34048 Using Clay Stabilised Medium for the Separation of Small Coal in a Dense Medium Cyclone

Organisation:	CSIRO
Project Leader:	Andrew Taylor
Value:	$204,432
Report Expected:	June 2026
Industry Monitors:	Chris Denyer
	Frank Mercuri
ACARP Contact:	Ben Gill

This project involved establishing a comparison between small coal run through a DMC, spiral and a hydro cyclone for the same coal type. Care was taken to ensure that the relative % non-magnetics in the sample was held consistent in the samples. The objective was to demonstrate to industry the option of processing small coal, (-2.0mm +0.1mm) in a Dense Medium Cyclone with good cut point control, magnetite recovery and comparative efficiency when compared to spirals and hydro cyclone.

All test runs have been completed. The spiral run was redone due to a data glitch which prevented mass balancing on the first run. The second run was okay, however, we did encounter some problems with sample processing and with the spiral runs due to beaching in the spiral and as a result are expecting the spiral to have a degree of positive bias in results. Manual removal of non-magnetics was also a more time-consuming process than expected. We have the pycnometer density results ready but are awaiting fine float-sink data analysis.

A report is being prepared and the draft will be completed once final analysis is received. Last sample results are expected to arrive back from the lab in April and from these results, comparative partition curves will be established. This is the final stage of confirmation for the report with the draft to be submitted at end of May.

C36024 DMC Efficiency Improvement Using an Applied Magnetic Field

Organisation:	University of Queensland
Project Leader:	Quentin Campbell
Value:	$344,872
Report Expected:	April 2027
Industry Monitors:	Frank Mercuri
	Harry Lee-Jones
	Jenny Park
	Tom Loweke
ACARP Contact:	Ben Gill

Prior research has demonstrated that the application of a magnetic field to a Dense Medium Cyclone (DMC) system can effectively reduce the density cut-point, enhance separation sharpness, and increase product yield—all key objectives for Australian coal producers. The current project is designed to evaluate the technical and economic advantages of incorporating a magnetic field into a pilot-scale DMC process utilising a magnetite medium, with direct application to Australian coal preparation plants. The expected benefits are:

- Lower density cut-points -
  - the project aims to achieve lower ash content in the final product while maintaining or improving the overall yield;
- Improved separation sharpness -
  - the integration of a magnetic field is expected to provide enhanced control over the separation process, leading to improved yield;
- Cost efficiency -
  - the potential utilisation of coarser magnetite is anticipated to result in reduced magnetite losses and a lower viscosity medium, thereby offsetting the stability challenges typically associated with coarser media.

During the quarter the following project objectives have been met:

- Determine and optimise the effect of an applied magnetic field on the performance of a dense medium cyclone running a magnetite medium, by changing its strength and position around the cyclone;
- Determine the lowest practically attainable cut point and its associated separation efficiency by changing the magnetic field strength around the cyclone; and
- Produce one or more accredited journal/conference articles – submitted, awaiting peer review.

Due to unplanned wear to the pump shaft and sleeve, the required repair work is expected to be lengthy and would result in a project overrun. Given that an extension project has already been approved and will continue this line of work, it was therefore decided, in consultation with industry monitors, to conclude the current project at this stage. This decision ensures that remaining ACARP-funded work is delivered efficiently through the approved extension project rather than duplicating effort.

The outstanding objectives will be integrated with those in the project extension:

- Determine whether a cheaper coarse magnetite can yield similar results – a shipment of coarse magnetite is on order; and
- Confirm what the effect of the addition of coal to the circuit will have on the medium-only results generated above, especially on the yield – a coal sample has been received from one of the participating operations.

The large redesigned Multotec DMC plant has arrived at the JKMRC and is being erected, and the old rig has been decommissioned.

To recap, the findings to date are:

- The application of a magnetic field seems to stabilise the operation of the DMC at all medium feed densities investing. The results for 1.2 RD are inconclusive due to the available tracer density range being above 1.3 RD;
- An optimal magnetic field strength was identified between 30-50 Gauss to achieve the best performance;
- Tracer tests to date confirm an improvement in Ep as the magnetic field strength increases, but there seems to be a slight increase in the cut point (contrary to what was expected) and will be investigated further in the extension project;
- No discernible magnetite degradation in terms of PSD could be determined for the duration of the experiments.

C36030 Measurement of DMC Wear using 3D Laser Technology

Organisation: CSIRO
Project Leader: Nerrida Scott
Value: $175,422
Report Expected: June 2026
Industry Monitors: Dan Perkins
Luke Winkelman
ACARP Contact: Ben Gill

This project aims to scan the internal dimensions of a dense medium cyclone over its wear life. In the previous project, numerous scanners were trialled, proving the concept. Technology has moved forward from the original work and new scanners have been sourced. The intention of this project is to measure the internal wear of DMCs in a real plant situation over the course of their entire service and to link this information to the DMC operational performance as measured by the plant. The combination of off-the-shelf laser technology with CSIRO software enhancements will be used to digitally map DMC internal wear in a plant situation. The researchers have engaged with a DMC supplier to support this work and a trip to their manufacturing facility occurred in early June 2025 and again in March 2026 to trial various evolutions of the scanner in a DMC. Modifications to the scanner have now been made and a preliminary scan of a DMC has been done prior to being installed on the mine site.

A record of the measured wear of the DMC over the life of a cyclone will be mapped and linked to the performance of that DMC over time. Use of this new instrument will remove the need to enter the confined space of the DMC to take measurements. The compact design is also considerably better than previous scanners and will enable scanning in tight spaces.

With this project there were some delays in getting the hardware working well for the purpose of the DMC scanning. This aspect has now improved to the point where we can scan the internals of the DMC from outside the spigot (eg. from inside the shroud). This greatly simplifies the delivery system and negates the need for a robotic self-driven device to support the scanning operation. We are now in the process of organising a visit to the mine site to progress this work and measure a DMC in service.

C37008 Banana Screen Capacity and Efficiency

Organisation: CTE Coal
Project Leader: Chris Thornton
Value: $299,160
Report Expected: September 2026
Industry Monitors: Dan Delahunty
Jenny Park
ACARP Contact: Ben Gill

This project extension will determine if the learnings from the pilot scale rig can be applied to an operating site. Three sites have been chosen in the Hunter Valley that are dual module plants with changes being made to one of the modules onsite so side by side sampling can occur to test the effect of the improvements.

Sampling has occurred at the first site with cross dams added to the screen and spray water optimisations occurring. The results align with learnings from the first stage of the project. Sampling has commenced on the second site and we are currently awaiting results. Once these have been compiled, testing will commence on the third site.

Currently all project sampling is to be completed by end of June with final analysis and a report produced at end of July.

Process Control

C34044 Real Time Monitoring and Control of Froth Flotation

Organisation: University of Queensland
Project Leader: Liguang Wang
Value: $262,437
Report Expected: June 2026
Industry Monitors: Chris Denyer
Chris Huth
Josh Kowalczuk
Rick Jeuken
ACARP Contact: Ben Gill

The objectives of this project are to:

- Further evaluate and demonstrate a simple, cheap and fast sensor for monitoring the efficiency of multiple flotation cells; and to
- Develop remote control strategies corresponding to the sub-optimal operation identified by the sensor.

The team has completed the initial draft of the project report, which is currently undergoing internal review. Submission to the industry monitors is expected within two to three weeks.

C34052 Simulation Enabled Digital Twin for the Control, Design and Optimisation of a Teeter Bed Separator

Organisation: University of Queensland
Project Leader: Kym Runge
Value: $232,531
Report Expected: May 2026
Industry Monitors: Chris Denyer
Chris Jackson
ACARP Contact: Ben Gill

The draft report is with the industry monitors for review.

General

C37017 Improved Measurement of Coal Bulk Density

Organisation: University of Newcastle
Project Leader: Aleksej Lavrinec
Value: $90,377
Report Expected: September 2026
Industry Monitors: Mel Robbins
Tom Buckby
Tom Wilson
ACARP Contact: Ben Gill

The aim of the project is to improve the accuracy of the test method used in determining the loosely poured bulk density of Australian full-size coal. The objectives are as follows:

- Quantify and compare loosely poured bulk density measurements for coal samples using multiple container sizes and methodologies;
- Establish a repeatable and standardised experimental procedure consistent with relevant Australian and international standards;
- Prepare coal samples in a representative manner to minimise segregation, degradation, and handling bias; and
- Generate reliable bulk density data to support downstream handling, processing, and modelling activities.

Work undertaken during the reporting period:

- One of the three received coal samples has been subsampled and its moisture adjusted to the desired moisture contents;
- The testing of the first moisture content has been completed with the second moisture underway; and
- Preparation and subsampling of the second coal sample has been started.

TECHNICAL MARKET SUPPORT

Reports Published This Quarter

C35041
Effect from the co-combustion of coal and biomass on production of fine particles (<PM10)
University of Newcastle
Liza Elliott
Link to download the final report:
https://www.acarp.com.au/abstracts.aspx?repId=C35041

C36034
Sugar-Coated Coal: Determining if Glucose Addition Can Improve Coke Quality of Coal-Biomass Blends
ALS Coal Technology
Callum Mainstone
Link to download the final report:
https://www.acarp.com.au/abstracts.aspx?repId=C36034

Maritime Regulation

C38032 Streamlining Moisture Management Procedure Submissions: An Industry Led Approach

Organisation:	Goodwin Port Solutions
Project Leader:	Ash Goodwin
Value:	$73,800
Report Expected:	August 2026
Industry Monitors:	Graeme Harris
	Jane Lawson
	Jeremy Byrnes
	Jonas Good
ACARP Contact:	Patrick Tyrrell

This project aims to streamline the preparation and submission process of Moisture Management Procedures (MMPs) for coal producers. Producers have identified challenges in developing MMPs to an acceptable standard largely due to the absence of a consistent, standardised industry framework. This project will develop a standardised MMP template and a practical guidance document offering best practice advice on preparation and submission.

Progress this quarter includes:
- Initial consultation with key industry representatives;
- Seeking expressions of interest for industry participants;
- Drafting of survey questions to be asked during 1 on 1 discussions with participating industry representatives.

In the coming quarter, we are seeking to:
- Organise and partake in several 1 on 1 discussions with industry representatives;
- Gather common feedback and incorporate it into a standardised MMP template; and to
- Prepare practical guidance document highlighting common issues (on a de-identified basis) and recommendations for a smoother preparation and submission process.

Metallurgical Coal

C35040 Changes in Combustibility of Coal when Co-Combusted with Hydrogen Rich Fuels in PCI

Organisation:	University of Newcastle
Project Leader:	Liza Elliott
Value:	$218,367
Report Expected:	June 2026
Industry Monitors:	Cameron Tasker
	Caroline Lang
	James Bottle
	Jeremy Byrnes
	Oliver Scholes
ACARP Contact:	Ashley Conroy

With the steel industry under pressure to reduce CO_2 emissions, there are several possible changes to the steelmaking process that could be adopted. The first and easiest step in improving sustainability is the introduction of a material with high hydrogen content via tuyere injection. This injectant could be coke oven gas, waste plastics, biomass materials or hydrogen and hydrogen containing gases. However, as most of these materials have lower coke replacement ratios, most steelmakers will be looking to introduce these fuels along with coal. It is unclear, however, what the impact of co-combustion has on the possible injection rate.

This project aims to determine the impact on coal reactivity of co-combustion of hydrogen rich fuels: biomass, plastics, coke ovens gas, ammonia, and hydrogen. Two techniques are being used: the combustibility of solid fuels is assessed using the Drop Tube Furnace technique developed in ACARP project C19049, that compares the combustion behaviour of coals in a set standard condition. And a TGA (Thermo-Gravimetric Analyser) is used to measure the reactivity of these materials individually and when co-combusted with coal, showing changes in behaviour expected due to reduction of oxygen concentrations caused by the consumption of the hydrogen rich fuel.

TGA tests are complete. Significant issues with the drop tube furnace occurred and rectification was difficult. A new furnace has been purchased to replace the existing Drop Tube Furnace. This has been installed and calibration to ensure consistency across the two furnaces is complete. All test work is complete and writing of the final draft report is underway.

C35042 Physical and Chemical Interactions Between Charcoal and Coal During Coking

Organisation: University of Queensland
Project Leader: Karen Steel
Value: $135,694
Report Expected: May 2026
Industry Monitors: Graeme Harris
ACARP Contact: Ashley Conroy

The draft report is with the industry monitors for review.

C35044 What We Now Know about Coking Coals and Coke

Organisation: CSIRO
Project Leader: Lauren Williamson
Value: $96,284
Report Expected: May 2026
Industry Monitors: Lauren North
ACARP Contact: Ashley Conroy

The draft report is with the industry monitors for review.

C36031 Structural Optimisation and Reactivity Evaluation of Ferro Coke Produced using Australian Coals

Organisation: University of Newcastle
Project Leader: Arash Tahmasebi
Value: $167,000
Report Expected: May 2026
Industry Monitors: Cameron Tasker
Graeme Harris
Stephen Brant
ACARP Contact: Ashley Conroy

The draft report is with the industry monitors for review.

C36032 Impact of Biomass on Coke Microstructure Evolution and Gas Diffusion During CO2 Gasification

Organisation: University of Newcastle
Project Leader: Arash Tahmasebi
Value: $169,000
Report Expected: July 2026
Industry Monitors: Graeme Harris
Sean Flanagan
Shaun Booth
ACARP Contact: Ashley Conroy

The project investigates the impact of biomass on coke reactivity and microstructure evolution during CO_2 gasification. Specific objectives are to:

- Study the impact of biomass species and pre-treatment method on the mechanism of reactivity of biochar;
- Compare gas diffusion in biocoke microstructure with the progression of gasification using a developed reaction-diffusion model;
- Investigate the changes in biocoke microstructural evolution and structural degradation during gasification;
- Develop new mechanistic understanding of biocoke gasification, i.e., volumetric vs. diffusion-controlled gasification;
- Determine the degree to which biomass pretreatment influences biocoke degradation; and to
- Investigate the Onset as a means of benchmarking biocoke reactivity with conventional coke.

Progress during this quarter:

- The project involves stepwise reaction and imaging of biocoke samples at 15% and 30% mass loss;
- Micro-CT imaging, image registration, and calculations of radial mass loss profiles have completed;
- Kinetic parameters (reaction rate constant and effective gas diffusivity) of the biocoke CO_2 gasification reaction were calculated using a revised reaction-diffusion model calculating a separate reaction rate constant for biochar;
- Biochar particles showed significantly higher reaction rates than the coke matrix, leading to localised reaction and coke degradation. Biochar addition was also found to increase the diffusivity of CO_2 into the coke microstructure;
- Project findings were presented at a workshop in April.

The next quarter will involve analysing the microtexture of unreacted and reacted biocoke samples.

C36035 Microstructure Characterisation and Simulation of Bio-additives in Coke

Organisation: University of Newcastle
Project Leader: Edward Bissaker
Value: $114,200
Report Expected: June 2026
Industry Monitors: Graeme Harris
Sean Flanagan
Shaun Booth
ACARP Contact: Ashley Conroy

The project objectives are:

- Develop a capability, based on statistical characterisation of coke microstructures, to relate the properties of bio-additives in coke to the mechanical properties of coke (i.e. coke strength);
- Use the capability to identify the specific properties of bio-additives that affect coke strength; and
- Investigate the range of possible microstructures that could be created using bio-additives to optimise the coke strength, for specified bio-additive demand (e.g. mass fraction added).

During the quarter the final results of the project were presented to industry monitors. The presentation included a summary of the methods and results, along with an assessment of the project outcomes. Links

between the findings of this project and related bio-char projects, C36037 (Exploring the Effects of Bio-char and Torrefied Biomass Addition on the Microtexture of Bio-coke), and C36032 (Impact of Biomass on Coke Microstructure Evolution and Gas Diffusion During CO_2 Gasification) were discussed and explored.

During the next quarter the finalisation of the draft project report will be completed and the report will be submitted for review.

C36036 Biochar-Coke Integration for Improved Coke Strength and Performance

Organisation:	University of New South Wales
Project Leader:	Pramod Koshy
Value:	$244,400
Report Expected:	November 2026
Industry Monitors:	Graeme Harris Sean Flanagan Shaun Booth
ACARP Contact:	Ashley Conroy

This project is focussed on analysing the impact of higher biochar addition levels and coal type on the quality of the resultant cokes for ironmaking. This project is part of a set of concurrent ACARP projects investigating different aspects related to the addition of biochar to coals. The aims of the project are as follows:

- Understand the impact of biomass addition (5-20 wt%, possibly 25-30 wt%) to coals (with varying vitrinite contents) on the resultant macrostructural, microstructural, and microtextural features of the cokes;
- Analyse the physical, microstructural, and interfacial features of the biochar-coal components in blended cokes through fractography and microtextural analysis after mechanical testing; and
- Develop associations between biomass addition levels with coal type and coke performance under potential blast furnace conditions using standard coke quality indicators.

High temperature strength testing revealed the following information.

Sample	High-Temperature Strength (MPa)
C1 Gasified – RT	15.8 ± 3.5
C1 Gasified – 1100°C	15.2 ± 6.1
C1 Gasified – 1400°C	13.3 ± 1.9
C2 Gasified – RT	9.5 ± 0.5
C2 Gasified – 1100°C	13.6 ± 4.8
C2 Gasified – 1400°C	16.4 ± 1.2

Based on the viability issues for blends at high biomass additions and the energy intensive process of particle comminution , the following blends were suggested by the industry monitors:

- Coal C1 + 10 wt% biomass (-0.125 mm);
- Coal C1 + 15 wt% biomass (-0.125 mm);
- Coal C2 + 10 wt% biomass (-0.125 mm);
- Coal C2 + 15 wt% biomass (-0.125 mm).

C36037 Exploring the Effects of Bio-char and Torrefied Biomass Addition on the Microtexture of Bio-coke

Organisation:	Royal Melbourne Institute of Technology
Project Leader:	Soonho Lee
Value:	$155,000
Report Expected:	October 2026
Industry Monitors:	Graeme Harris Sean Flanagan Shaun Booth
ACARP Contact:	Ashley Conroy

This project investigates microtextural interactions between biochar (900°C) or torrefied biomass (350°C) and coal macerals in bio-coke using anisotropy quotient (AQ) mapping and bireflectance analysis.

During this quarter, MATLAB workflows were applied to generate AQ maps for a reference coke (Rvmax 1.18%, vitrinite 60%) and bio-cokes containing 10 % bamboo and 10 % acacia char, focusing on biochar effects on Reactive Maceral Derived Components (RMDC) at particle interfaces.

Three interface types were evaluated: IMDC–RMDC and biochar–RMDC in bio-cokes, with IMDC–RMDC in the base coke as reference. Five regions per CSR lump were analysed across four lumps per sample. A boundary thickness of ~30 µm was selected, as microtexture stabilises beyond this range.

Compared with the base coke, bamboo char reduced RMDC interface development near both IMDC and biochar particles, with decreased ribbon structures and increased circular and incipient textures. Acacia char showed more localised effects, with RMDC–IMDC interfaces similar to the reference coke, while biochar–RMDC regions exhibited reduced ribbon and lenticular structures.

These microtextural changes were correlated with coke strength indices. Acacia coke showed significantly lower CRI (2.9%) and higher CRI (52%), attributed to its high CaO content (71.4%), contributing to an elevated modified basicity index (51.9) and enhanced CO_2 reactivity. As CSR and CRI are influenced by ash chemistry, I600 (cold strength index) was also evaluated.

I600 decreased from 88.3% to 84.4% (bamboo) and 82.0% (acacia). Previous ACARP studies indicate coarse mosaic structures reduce abrasion resistance, while suppression of ribbon and lenticular textures in bamboo coke may help limit I600 loss.

Bio-cokes with torrefied acacia and bamboo have been prepared for AQ mapping. Ongoing work will compare torrefied and charred biomass to assess their effects on microtexture and coke performance.

C36039 Alternative Thermal Processing of Coal Pilot Extruded Coke and Supercapacitor Demonstration

Organisation:	University of Newcastle
Project Leader:	Rohan Stanger
Value:	$157,178
Report Expected:	May 2026
Industry Monitors:	Graeme Harris
	Peter Austin
	Sean Flanagan
	Shaun Booth
ACARP Contact:	Ashley Conroy

The draft report is with the industry monitors for review.

C36041 Quantifying Biochar Interactions with Coal for Coke Making

Organisation:	CSIRO
Project Leader:	Lauren Williamson
Value:	$141,683
Report Expected:	June 2026
Industry Monitors:	Graeme Harris
	Sean Flanagan
	Shaun Booth
ACARP Contact:	Ashley Conroy

The objectives of this project are to:

- Prepare cokes for consistent analysis of different aspects of biomass addition (including coke standard coke quality determinations) for use across a suite of biomass related projects commencing in 2024 and retain material for future projects in the ACARP Coal Bank; and to
- Quantify the relationship between biomass char surface area, size distribution and their impact on coke properties.

A total of nine cokes for three projects (C30036, C36037 and C36041) are still to be prepared once sufficient torrefied/ charred biomass is available.

C37018 Mechanism of Biocoke Formation in Stamp Charged Cokemaking

Organisation:	University of Newcastle
Project Leader:	Arash Tahmasebi
Value:	$170,200
Report Expected:	January 2027
Industry Monitors:	Jane Lawson
	Stephen Brant
ACARP Contact:	Ashley Conroy

The objectives of this project are to:

- Evaluate the influence of torrefied biomass and biochar addition on plastic layer dilatation and permeability and the development of internal gas pressure under stamped charged coking conditions using test facilities at University of Newcastle;
- Prepare coke samples in the 8kg coke oven to investigate the impact of biomass addition on the quality (CRI/CSR) of top-charged and stamped cokes;
- Explore the carrying capacity of Australian premium and weakly coking coals in blends with biomass at elevated charge densities;
- Analyse the changes in the microstructure of stamped cokes in the presence of biomass-derived components using the micro-CT image analysis technique and draw correlations with biocoke quality indices;
- Investigate the influence of higher caking density on bonding quality at the biomass/RMDC interface; and
- Evaluate the impact of biomass addition and charge density on the development of anisotropy in coke microtexture and carbon matrix.

Progress during the quarter:

- The coal samples were selected in consultation with industry monitors and sourced through the ACARP coal bank;
- Two biochar sample were received in January and March;
- Preparation of biocokes for CSR/CRI testing and quenched plastic layer samples for micro-CT imaging were completed;
- Characterisation of coal-biomass blends were completed.

Micro-CT imaging at the Australian Synchrotron is currently underway.

Next quarter will involve IGP tests in the 4kg oven, dilation and permeability tests, and CT image analysis to explore impacts of stamping and biochar on coking performance and coke microstructure development.

C37019 Reactivity of Coke RMDC, IMDC and Biochar with H2O Under Hydrogen Reduction Blast Furnace Conditions

Organisation:	University of Newcastle
Project Leader:	Arash Tahmasebi
Value:	$169,900
Report Expected:	January 2027
Industry Monitors:	Lauren North
	Stephen Brant
ACARP Contact:	Ashley Conroy

The main objectives of this project are to:

- Examine the factors that influence the relative reactivity of the RMDC, IMDC and biochar components of coke and biocoke under gasification with CO_2 and with H_2O. This will include linking results to the degree of anisotropy within microtextural constituents and the Brunauer–Emmett–Teller (BET) specific surface area of these components;
- Measure the kinetics of the reaction of the individual coke and biocoke microtextural constituents with CO_2 and with H_2O at the CSR test temperature of 1100°C using thermogravimetric analysis (TGA). The additivity

of any effects, as well as the effects when the RMDC, IMDC and biochar are isolated from each other, will be examined;
- Compare lump reactivity with the intrinsic reactivity of the RMDC, IMDC and biochar in CO_2 and H_2O reaction environments;
- Examine the role of accessible porosity at the surface of individual IMDC and biochar components on coke and biocoke reactivity and identify differences as a function of the reactive gas atmosphere.

Progress in the quarter:
- Three coal samples varying in rank were selected in consultation with industry monitors; and
- Maceral separation and preparation of vitrinite and inertinite concentrates were completed at UQ. Required quantities of the maceral concentrates were produced. Maceral analysis was conducted to confirm purity.

Coking of vitrinite and inertinite concentrates in difference combinations for TGA gasification tests is underway.

Next quarter will involve TGA gasification tests in H_2O and CO_2 to determine reactivity of coke IMDC and RMDC components.

C37022 Fate of Bio-alkalis During the Carbonisation of Coal and Biomass Blends

Organisation:	University of Newcastle
Project Leader:	Salman Khoshk Rish
Value:	$95,740
Report Expected:	July 2026
Industry Monitors:	Graeme Harris
	Jonas Good
ACARP Contact:	Ashley Conroy

Partial substitution of coking coal with renewable biomass has been identified as a potential method to lower emissions in BF ironmaking. However, woody and grass biomass resources contain a high concentration of alkali and alkaline earth metals (AAEMs) which negatively impact the reactivity and structural strength of coke within the blast furnace. Since there are stringent limitations on AAEM content in biocoke intended for use in blast furnaces, it is essential to develop a comprehensive understanding of the true nature of biocoke's inorganic matter by characterising all aspects of biocoke minerals and understanding the retention of these harmful elements within the biocoke.

Project objectives include:
- Evaluate the volatility and retention behaviour of bio-AAEM species in coal blends during the cokemaking process up to 1000°C;
- Explore potential variations in behaviour of different AAEM species;
- Evaluate the impact of parent coal properties and biomass on the retention of AAEMs in bio-coke;
- Explore the potential role of volatile matter in coal on driving off the volatile AAEM during cokemaking at high temperature; and
- Investigate the potential interactions between bio-AAEM species and the mineral matter in coal.

During the quarter, we received one biomass sample from the ACARP coal bank and completed the interrupted coke-making tests (500-1000°C) on the samples received. The hardwood char sample is still pending delivery. We are currently conducting low-temperature ashing, after which the samples will undergo X-ray fluorescence analysis. In parallel, we are continuing coke-making runs in the 8kg coke-making furnace.

During quarters three and four, we will undertake the full suite of characterisation tests outlined in Task 1 of the proposal. Biocokes will be produced using the 8kg coking oven, and the resultant coke will be analysed via proximate analysis, X-ray fluorescence, X-ray diffraction, and the Integrated Mineral Analyser.

C37025 Mechanism of Reactivity and Microstructure Evolution of Stamp Charged Cokes During Reaction with CO2

Organisation:	University of Newcastle
Project Leader:	Arash Tahmasebi
Value:	$169,825
Report Expected:	April 2027
Industry Monitors:	Graeme Harris
	Lauren North
ACARP Contact:	Ashley Conroy

The objectives of this project are to:
- Investigate the gasification behaviour of stamp charged coke made from Australian coking coals;
- Investigate the impact of increased anisotropy of stamped cokes on its reaction rate with CO_2;
- Study the impact of lower density in stamped cokes on gas diffusivity into the microstructure;
- Evaluate the evolution of coke microstructure during gasification with CO_2, benchmarked against gravity charged coke;
- Analyse the susceptibility of IMDC/RMDC in top charged and stamp charged cokes to reaction with CO_2 by exploring changes with the progression of coke gasification;
- Investigate the mechanism of stamp charge coke gasification with CO_2, i.e., the balance between local carbon reactivity vs. gas diffusion;
- Determine carbon reactivity and gas diffusion in stamped cokes using a developed reaction-diffusion model; and to
- Quantify the impact of lower charge density on the reaction mechanism.

Progress during the quarter:
- Two sets of matched top-charged and stamped coke samples are used in the project;

- The second set of coke samples were sourced from the ACARP coal bank in April.

The next quarter will involve coring of the coke samples and initial micro-CT imaging prior to TGA gasification tests.

C37026 Coal and Biomass Properties Affecting Cokemaking for Coal-Biomass Blends

Organisation:	University of Queensland
Project Leader:	Karen Steel
Value:	$127,047
Report Expected:	January 2027
Industry Monitors:	Geoff O'Meley
	Stephen Brant
ACARP Contact:	Ashley Conroy

This project builds on project C35042 in which we identified key reasons why fluidity is reduced when charcoal is blended with coal for cokemaking; namely oxygen content and mesoporosity. We also found that the extent that mesopores form was different for different biomass materials and depended on the pyrolysis conditions; this project aims to elucidate the factors affecting mesopore formation by examining different biomass types and varying the pyrolysis conditions. In addition, project C35042 found that the extent that fluidity reduced also depended on the coal type such that for the same charcoal, fluidity was preserved for one coal but destroyed for another; this project also aims to identify the coal properties responsible for this. Finally, this project examines the effect of charcoal on coke reactivity (CSR), examining whether some combinations of coal and charcoal have higher or lower CSR and the extent that mesopores in charcoal influence CSR.

During this quarter we characterised produced chars, met with industry monitors to discuss results, and commenced blending produced chars with coals to study their impact on coal blend fluidity. Charring as received raw pieces (3cm) of acacia (hardwood) at 800°C produced a char having a surface area of approximately 160m^2/g, which is significantly higher than the surface area for the bana grass char produced from pellets of crushed grass, and above the preferred level of 5m^2/g. Interestingly, when the acacia was crushed the surface area was much lower at approximately 8m^2/g. Smaller fibres may be advantageous as they can shrink individually during pyrolysis. The density of the acacia char produced from raw pieces was 660kg/m^3, similar to the density of the bana grass pellet chars at 631kg/m^3. The mechanisms by which mesopores form and char densifies is being examined through comparisons of raw, crushed and crushed/pelletised samples. The commenced coal blend fluidity test work will involve bana grass char produced from crushed pellets and acacia char produced from raw pieces at 800°C to investigate the effects of mesoporosity.

Thermal Coal

C37023 Comparison of Ash Deposition of Coal and Biomass Blends in Laboratory, Pilot Scale and Industrial Scale

Organisation:	University of Newcastle
Project Leader:	Liza Elliott
Value:	$690,040
Report Expected:	September 2028
Industry Monitors:	Caroline Lang
	Chris Urzaa
	Jane Lawson
ACARP Contact:	Ashley Conroy

With increased public demand for regulation to limit the effects of climate change to 1.5°C, there is a strong demand to reduce net carbon emissions from the combustion of coal. One way this can be achieved is by replacing a proportion of coal with biomass. There are several issues associated with replacement of coal with biomass, but a strong theme of biomass use is the tendency for deposition. Due to the variety of compositions, it is difficult to predict deposition behaviour. Additionally, much of the work that is usually completed on deposition studies is completed at laboratory scale. It is unclear how these relate to industrial scale, and how the experimental setup impacts results.

This project will seek to examine the impact of biochar/biomass addition on ash deposition during the combustion of Australian thermal coals. The changes in deposition for Australian coal-biomass blends will be assessed at small scale and pilot scale and will be compared to Industrial scale performance to show the impact of scale on test results.

The project is the basis of PhD studies for Tom Finn. Tom has enrolled and has started readings for a literature review.

Both coal samples and one biomass sample have been received. The woody biomass provided by the industrial partner was insufficient. Multiple attempts to obtain the remainder of the sample have had no success due to an embargo placed on the stockpile by the industrial partner, resulting in a significant delay. Milling of the biomass sample has been more difficult than expected and alternate methods are being pursued. Initial test feeds of the biomass into the extruder for production of torrefied sample have occurred.

C38033 Combustion Performance of Higher Swelling Coals under HELE (High Efficiency, Low Emissions) – Supercritical Conditions

Organisation:	ALS Coal
Project Leader:	Tom Finn
Value:	$167,353
Report Expected:	April 2028
Industry Monitors:	Cameron Tasker Fiona McKenzie Graeme Harris Greg Wickman Jane Lawson
ACARP Contact:	Ashley Conroy

Thermal coals may exhibit swelling behaviour, commonly quantified by CSN. Concerns exist from consumers as to the impacts of swelling on performance. However, there remains a question as to what extent this concern is based on operational risk, and mere perception. This project aims to generate real operational performance data and quantify the limits and effects of swelling on thermal coal performance.

A planning meeting was held in March and the scope revised to maximise the opportunity for any effects from swelling to be observed. Three higher swelling coals are to be sourced:

- Hunter valley (CSN 2-3);
- Hunter valley (CSN 4-7);
- Bowen basin (CSN 4-7).

The test program will examine milling behaviour, carbon burnout efficiency, gaseous and particulate emissions, ash deposition under pilot-scale supercritical High-Efficiency, Low-Emissions (HELE) conditions. A post mill inspection will be conducted to observe any signs of caking which would suggest that mill performance might be impacted by swelling; while a post burn inspection of the burner will be conducted to observe any buildup caused by swelling. Where such evidence is found this will be collected and further analysed. To maximise the opportunity for any effects from swelling to be observed: a higher firing rate will be used to increase the heat radiating back to the burner, an extended burn time will allow more time for deposits to develop.

The findings from these three coals will help direct a fourth trial. This may investigate if limits can be overcome by: blending; or a change in milled product size; or, if limits are not found for this swelling range, if there are limits for the highest swelling coals. No experimental work was conducted during this period. Monitors have been invited to propose coals for this test program which is proposed to commence in October.

General

C25053 Coal Sample Bank

Organisation:	CSIRO
Project Leader:	Aedita Crouch
Value:	$668,939
Report Expected:	February 2028
Industry Monitors:	Technical Market Support Committee
ACARP Contact:	Ashley Conroy

The objective of this project is to operate the ACARP Sample Bank to make coal, coke and biomass samples available to researchers and to enhance the systematic provision of the samples for research projects funded by ACARP.

To date, 89 coal samples have been delivered, stored at -18°C and their details recorded in a database, there are also 39 cokes, seven biomasses and one fly ash stored. Of the coal samples stored coal quality data has been provided by coal producers for 79 of the samples.

In the quarter, nine coal samples were provided to projects. In calendar 2026 to date 22 samples (coal/coke/biomass) have been provided to projects.

C26003 Management of SA and ISO Coal Technical Committees Work Programs

Organisation:	Carbon Connections Consulting
Project Leader:	Barry Isherwood
Value:	$497,750
Report Expected:	December 2026
Industry Monitors:	Graeme Harris
ACARP Contact:	Anne Mabardi

This project is a continuation of ACARP support for the management and input into Australian and ISO Coal Sampling, Coal Preparation and Analysis Standards.

The quarter has been relatively quiet, with SA Committee MN/1/1 convening a thrice yearly hybrid meeting in Newcastle. Work centred on reviewing an old Australian Standard AS1038.16, Reporting of results and possible eventual input into ISO. This is a very valuable compendium and there is no equivalent Standard within ISO. Other general housekeeping was carried out for both SA and ISO tasks.

Advice was provided to John Kelly as he carries out initial planning for the next ISO TC27 meeting scheduled to be held in Astana, Kazakhstan in 2027.

C26037 Australian Participation in Development of ISO Methods for Sampling, Analysis and Coal Preparation and National Technical Committee Support

Organisation: Standards Australia
Project Leader: Ben Russell
Value: $497,750
Report Expected: December 2026
Industry Monitors: Graeme Harris
ACARP Contact: Anne Mabardi

SA support for Australian Mirror Committee—Schedule of meetings.

MN-001 (Coal and Coke)—Mirror Committee for ISO/TC27
Chairman: Barry Isherwood
Last meeting: 14 August 2025
Next meeting: 23 July 2026

MN-001-01 (Coal analysis) —Mirror Committee for ISO/TC27/SC3 and SC5
Chairman: Barry Isherwood
Last meeting: 26 March 2026
Next meeting: 23 July 2026
Meeting objective: Review ISO/TC27/SC5 and SC3 documents including systematic reviews and finalise Australian mirror Committee position on ISO ballot (and comments).

MN-001-02 (Coal Preparation) —Mirror Committee for ISO/TC27/SC1 and SC4
Chairman: Darren Mathewson
Last meeting: 14 April 2026
Next meeting: 14 July 2026
Meeting objective: Review of ISO/TC27/SC1 and SC4 documents including systematic reviews and finalise Australian Mirror Committee position on ISO ballot (and comments). Review update on national Standards and projects.

C33065 Digital Petrographic Atlas of Australian Coals - Maintaining the Knowledge

Organisation: University of Queensland
Project Leader: Joan Esterle
Value: $197,537
Report Expected: June 2026
Industry Monitors: Graeme Harris
Sean Flanagan
ACARP Contact: Ashley Conroy

This project will create a Digital Petrographic Atlas of Australian Coals, their maceral and mineral composition at different ranks, linked into our current understanding of basin scale variation in rank, type and grade, highlighting case studies that assist with conceptual mine scale models for understanding and predicting coal quality variation. In addition to the atlas, a library of scanned petrographic images of product coals from different basins and formations, illustrating the variation in rank, grade and type will be developed. This can be used for reference, training and round robins.

Editing and formatting of the final report is underway, including putting the samples into a broader geological context. The team also submitted a short paper that will be presented at the International Mining Congress to be held in Brisbane in 2026 entitled “Preserving Geological Collections for Teaching and Skills Development – A Digital Petrographic Atlas of Australian Coals”.

MINE SITE GREENHOUSE GAS MITIGATION

C28078 Technical Development Unit (TDU) for Catalytic Conversion of VAM

Organisation:	University of Newcastle
Project Leader:	Michael Stockenhuber
Value:	$1,040,592
Report Expected:	June 2026
Industry Monitors:	Jim Sandford Russell Thomas
ACARP Contact:	Patrick Tyrrell

Major industries, particularly those in mineral resources and energy, are facing increased pressure to reduce sources of greenhouse gas emissions. In mining, methane present in the exhaust emitted, referred to as Ventilation Air Methane (VAM) is one of the major anthropogenic sources of greenhouse emissions, accounting for over 60% of those associated with the sector. The low methane concentrations and the high flowrates required to maintain levels below flammability limits results in a stream which is very difficult to process. Traditional mitigation technologies utilise thermal oxidation, which increase the risk of utilisation for processing fugitive emissions due to the elevated temperatures required to combust lean methane, over 1000^{o}C. The operating temperatures required are well above the flammability threshold and alternative technology capable of oxidising methane below this temperature is highly desirable. Catalytic oxidation technologies have emerged as a potential solution, exhibiting high levels of methane oxidation activity at significantly lower temperatures (<500^{o}C) while only producing carbon dioxide as a product. Due to the complete oxidation of methane at lower temperatures, it is proposed that catalytic technology offers additional safety compared to thermal systems, where the surface reactions of the former oxidise the methane rather than via free radical production which occurs in thermal processes.

Catalytic systems have been shown to be stable and active over a wide range of methane concentrations, from 0.1 to 10% methane in air. At the low temperatures required for oxidation, no indicators of ignition were observed, even at methane concentrations above the LEL. It was found that the presence of a catalyst significantly increased the temperature required for ignition to occur, well above the temperature required for complete catalytic oxidation. The response of the system to these excursions is currently being examined and the resulting report will be submitted to the industry monitors for comment.

C35049 Optimisation of Operational Parameters of Catalytic Reactor for the Oxidation of Ventilation Air Methane

Organisation:	University of Newcastle
Project Leader:	Michael Stockenhuber
Value:	$238,464
Report Expected:	May 2026
Industry Monitors:	Jim Sandford Russell Thomas
ACARP Contact:	Patrick Tyrrell

The draft report is with the industry monitors for review.

C36007 Assessment of Sensors and Airflow Modelling for their Suitability to Quantify Methane Emissions in Open Cut mines

Organisation:	University of New South Wales
Project Leader:	Simit Raval
Value:	$534,880
Report Expected:	June 2026
Industry Monitors:	Ben Klaassen Iain Hornshaw Jim Sandford John Grieves Sandy Tickell
ACARP Contact:	Patrick Tyrrell

The project aims to establish evidence-based guidelines for the coal industry, covering the selection of sensors, strategies for data capture, and the influence of airflow modelling, leading to the utilisation of machine-learning-based mathematical models to estimate total methane emissions.

Over the past month, the final results from the controlled release experiments, along with the broader experimental findings, were presented to the industry monitors in February. These results consolidated our understanding of sensor performance, methane variability and the influence of local meteorological conditions. Following the completion of all experimental activities, the project team has now transitioned to the final stage of the project. Current efforts are focused on compiling and writing the final outcomes, integrating all observational, experimental, and modelling analysis.

C36008 Low Cost Precious Metal Free Honeycomb Monolithic VAM Catalysts and their Catalytic Activity and Stability Under Water and Dust Bearing Conditions

Organisation: CSIRO
Project Leader: Yonggang Jin
Value: $352,820
Report Expected: April 2027
Industry Monitors: Jim Sandford
Paul Wild
Russell Thomas
Victoria Longley
ACARP Contact: Patrick Tyrrell

The objective of this project is to develop low-cost honeycomb monolithic catalysts (HMCs) based on the high-performance precious-metal-free catalyst material newly developed by CSIRO in project C29069 and evaluate HMCs' catalytic activity and stability with a simulated VAM stream containing water vapour and simulated ventilation air dust. Success of the proposed project is a stepping-stone to progressing the development of low-cost high-performance VAM catalysts for the structured catalytic VAM mitigator.

Washcoating parameters for the HMCs were systematically investigated and tested at the CSIRO laboratory. More than 100 samples were prepared to optimise catalytic activity and mechanical strength. The resulting laboratory-scale HMCs demonstrated high catalytic activity, achieving T90 (the temperature for reaching 90% of methane conversion) at 460˚ C under dry VAM and 500˚ C under saturated vapour. Their catalytic performance is comparable to that of non-precious metal catalyst powders, confirming the successful development of washcoating approaches for non-precious metal HMCs. To deliver a tangible project outcome, the team is targeting production of a large-size HMC by subcontracting a commercial catalyst supplier to optimise and scale up HMC fabrication; this activity is additional to the original project scope without additional funds from ACARP.

Dust sampling from ventilation air shafts was conducted at two Queensland mines in April. The dust samples will be characterised in detail to support the application of RTO and RCO. Stone dust materials from both mines were also obtained to investigate interactions between stone dust and ceramic media through detailed thermal reaction studies.

C37014 Effect of Reactor Size and Operating Parameters on Intrinsic Safety of Catalytic Oxidation Systems for Mitigation of VAM Emissions

Organisation: University of Technology Sydney
Project Leader: Michael Stockenhuber
Value: $952,512
Report Expected: August 2026
Industry Monitors: Helen McCarthy
Jim Sandford
Russell Thomas
ACARP Contact: Patrick Tyrrell

Underground mines utilise high ventilation flows to ensure conditions within the mine remain safe, particularly ensuring the gases within the environment remain below the flammability limit when small pockets of methane are released during operation. This results in large volumes of highly diluted methane which presents a considerable environmental issue as a greenhouse gas that is difficult to process. Growing concerns around these emissions have led to the development of catalytic oxidation technology, which offers several advantages over current thermal combustion options, including smaller footprint, lower operating temperatures and lower energy requirements. Catalyst utilise structured monolith supports to ensure high surface interaction with the exhaust gas while minimising the pressure drop developed across the system. The current project examines the proposed safety properties of a catalytic system; operating at temperatures lower than the lower flammability limit of methane and producing only carbon dioxide through surface-initiated oxidation as opposed to the thermal combustion reaction which follows the cascade of radicals.

The proposed oxidation catalyst technology utilises active metal species on suitable substrates coated on structured supports. The catalytic process is offered as a safe alternative due to the nature of the surface reaction which is theorised not to proceed via free radical formation and as such is not susceptible to runaway combustion reactions. A large-scale reactor has been designed and is currently being constructed to allow for the examination of the effect of methane excursions on reactor properties while minimising the effect of unit cell size. These variations are currently being examined on a dedicated, smaller scale reactor. A draft review of current literature examining the differences between surface oxidation and radical combustion chemistry to provide industry with insights into safe oxidation processes.

C38010 Nitrogen and Other Uncertainties in the Gas Content of Coal

Organisation:	McMahon Coal Quality Resources
Project Leader:	Chris McMahon
Value:	$118,680
Report Expected:	February 2027
Industry Monitors:	De Nicholls Dennis Black Jim Sandford Murray Little
ACARP Contact:	Patrick Tyrrell

This project investigates how the origin of nitrogen, and sampling and testing methods affect the quantification and treatment of nitrogen measurements in coal-seam gas, which are critical for greenhouse gas reporting. The study will review literature, ACARP guidelines, and emissions calculation methods, and assess borehole classification and uncertainty modelling. It will also incorporate findings from industry workshops and feedback from the industry monitors to refine recommendations. The expected benefits arising from the examination of effects and review of calculation methodology will be better definition of methods of sampling, testing and evaluation for use, with consideration of nitrogen origins.

Bodies of work for five subject areas have been identified for separate review; each cascading in series, with mentor review , input and subsequent upgrades prior to advancing to subsequent stages as follows:

- Nitrogen and Air Contamination Evaluation;
- Method 2 vs 3 Definition;
- Gas Drillhole Data Definition;
- Uncertainty Calculations Review; and
- Carbonaceous Gas Bearing Strata Definition (Testing Materiality).

During the quarter, site visits to GeoGAS Wollongong and interview with Agi Burra (key author for multiple gas papers) have been undertaken, plus retrieval of Agi's key references and further unpublished notes were also completed.

The outcomes of this project will be a summary of current theories and practice on the effects of sampling and testing methods for the determination of nitrogen outcomes in gas testing in accord with the five listed objectives.

The expected benefits arising from the examination of effects and review of calculation methodology include better definition of methods of sampling, testing and evaluation for use; and more accurate representation of potential resource of greenhouse gasses.