Australia's National
Science Agency

GISERA | Gas Industry Social and Environmental Research Alliance

Progress report

Key controls or contributors to methane emissions from CSG water holding ponds

Progress against project milestones

Progress against milestones/tasks are approved by the GISERA Director, acting with authority in accordance with the GISERA Alliance Agreement.

Progress against project milestones/tasks is indicated by two methods: Traffic light reports and descriptive Project schedule reports.

1. Traffic light reports in the Project Schedule Table below show progress using a simple colour code:

- **Green**:
  - Milestone fully met according to schedule.
  - Project is expected to continue to deliver according to plan.
  - Milestone payment is approved.
- **Amber**:
  - Milestone largely met according to schedule.
  - Project has experienced delays or difficulties that will be overcome by next milestone, enabling project to return to delivery according to plan by next milestone.
  - Milestone payment is withheld.
  - Milestone payment withheld for second of two successive amber lights; project review initiated and undertaken by GISERA Director.
- **Red**:
  - Milestone not met according to schedule.
  - Problems in meeting milestone are likely to impact subsequent project delivery, such that revisions to project timing, scope or budget must be considered.
  - Milestone payment is withheld.
  - Project review initiated by GISERA Director.

2. Progress Schedule Reports outline task objectives and outputs and describe, in the 'progress report' section, the means and extent to which progress towards tasks has been made.

Project schedule table

TASK NUMBER	TASK DESCRIPTION	SCHEDULED START	SCHEDULED FINISH	COMMENT
1	Sampling logistics and field campaign planning	1 Sept 2023	31 Nov 2024	Complete
2	Field trips	1 Jun 2024	31 Mar 2025	Complete
3	Data and sample analyses	1 Jul 2024	31 Oct 2025	90% complete
4	Coordination between the two CSG holding pond projects	1 Sept 2023	31 Oct 2025	
5	Project reporting	1 Sept 2023	31 Oct 2025	
6	Communicate findings to stakeholders	1 Sept 2023	31 Oct 2025	

Project schedule report

TASK 1: Sampling logistics and field campaign planning

BACKGROUND

During this task, we will consult with representatives from CSG companies in Queensland to select two CSG holding ponds with one produced water pond and one brine pond. This task will prepare for sampling of water and sediment samples of the CSG holding ponds in the Surat basin, and develop the safe, environmentally sensitive planning and logistics for sampling campaign.

TASK OBJECTIVES

1. Establish contact with representatives from CSG companies to guide the pond selection and further sampling campaign.
2. Select two representative CSG water holding ponds in the Surat basin based on pond dimensions (e.g., area and depth) and existing water chemistry.
3. Identify the accessibility and the required permission for the selected ponds.
4. Establish sampling requirements, e.g., volume, size, sampling depth, number.
5. Prepare sampling equipment/reagents.
6. Prepare for remote sampling fieldwork including accommodation, vehicle hire and OH&S considerations.
7. Establish logistics of transporting equipment and samples between CSIRO laboratory in Sydney and collection sites in Queensland.
8. Detail the analytical requirements from external laboratories.

TASK OUTPUTS AND SPECIFIC DELIVERABLES

This task will yield a series of documents describing sampling equipment, sampling details, analysis plan, field trip details and OH&S considerations.

PROGRESS REPORT

This milestone is complete. The details are as below.

Task objective 1: Establish contact with representatives from CSG companies to guide the pond selection and further sampling campaign.

Contacts with two industry operators in the Western Downs Region were established before the GISERA workshop in Chinchilla in April 2024. Pond visits were arranged after the Chinchilla workshop with both industry operators. These visits guided pond selection and preparation of a sampling plan including safety considerations, sampling equipment and sampling logistics.

Task objective 2: Select two representative CSG water holding ponds in the Surat basin based on pond dimensions (e.g., area and depth) and existing water chemistry.

After the pond visits, it was noted that not all the CSG holding ponds are plastic-lined, some use clay linings. Hence, two representative CSG water holding ponds - a produced water pond and a brine pond, both with plastic linings - were selected for this study. Additionally, a produced water pond with a clay lining was included to ensure representation of different CSG pond types in the Western Downs Region.

Task objective 3: Identify the accessibility and the required permission for the selected ponds.

The pond visits were also used to access accessibility for sampling. The CSG holding ponds selected were all accessible by car via service roads.

Sampling plans were finalised in consultation with industry operators. Necessary safety training was completed and all required documents for the sampling were approved by the industry operators.

Task objective 4: Establish sampling requirements, e.g., volume, size, sampling depth, number.

Sampling requirements were established as follows. Three locations from each pond to be sampled. For each location, water from three depths (surface, middle and bottom depths) to be sampled for the water chemistry, microbial and algal community and organic compound analyses, and sediment to be collected from the bottom of the same location. If pond depth is shallow, only surface and bottom water depths to be sampled. Three replicates of water and five replicates of sediment to be collected for microbial analysis.

Task objective 5: Prepare sampling equipment/reagents.

Water and sediment sampling equipment have been prepared including a submersible pump for lateral sampling, a Van Dorn sampler for vertical water sampling and a sediment grabber for sediment sampling. A customised sediment sampling device was also made for collecting sediment from the plastic-lining ponds. A temperature logger was purchased for logging the water temperature during sampling. Microbial preservation solutions (DESS) and sample bottles for collection of water samples and sediments have been prepared.

Task objective 6: Prepare for remote sampling fieldwork including accommodation, vehicle hire and OH&S considerations.

Accommodation, vehicle hire and sampling logistics were organised in consultation with industry operators. Safety training requirements completed as required by industry operators.

Task objective 7: Establish logistics of transporting equipment and samples between CSIRO laboratory in Sydney and collection sites in Queensland.

Sampling equipment and containers were shipped to the CSIRO Pullenvale site and will be driven by field staff to Chinchilla by a hire car. Samples and equipment will be returned to CSIRO Lindfield via courier and water chemistry samples will be submitted to ALS Brisbane.

Task objective 8: Detail the analytical requirements from external laboratories.

- Water chemistry and sediment chemistry analyses to be done by ALS laboratory, with samples collected in containers provided by ALS.
- Microbial and algal sequencing will be done by Molecular Research DNA, using samples preserved in DESS bottles prepared in CSIRO Lindfield microbiology laboratory.
- Physical characterisations (particle size and surface area) of the sediment were analysed by Microanalysis Australia.

TASK 2: Field trips

BACKGROUND

This task will involve two staff travelling to Queensland with the purpose of collecting water samples for a variety of analyses to fill the knowledge gaps on understanding methane emissions from the CSG water holding ponds in the Surat basin. This project will carry out two field trips with one in summer and one in winter to cover the variation of microbial communities in different seasons.

TASK OBJECTIVES

1. Collect water samples from CSG water holding ponds identified in Task 1 for water chemistry analysis.
2. Collect water samples from CSG water holding ponds identified in Task 1 for microbial community and algal characterisation.
3. Collect water samples from CSG water holding ponds identified in Task 1 for evaluating water soluble organic compounds and solvent extractable organic compounds.
4. Collect sediment samples from CSG water holding ponds identified in Task 1 for microbial community, chemistry analyses, surface area and particle size distribution.

TASK OUTPUTS AND SPECIFIC DELIVERABLES

Collection of water and sediment samples from selected CSG water holding ponds.

PROGRESS REPORT

This milestone is complete. The winter field trip was in July and August 2024 and the summer field trip was in December 2024 and February 2025. The details of each objective are described as below.

Task objective 1: Collect water samples from CSG water holding ponds identified in Task 1 for water chemistry analysis.

43 water samples were collected from the three CSG holding ponds identified in Task 1 for water chemistry in ALS.

Task objective 2: Collect water samples from CSG water holding ponds identified in Task 1 for microbial community and algal characterisation.

129 water samples were collected from the three CSG holding ponds identified in Task 1 for characterisation of microbial and algal communities.

Task objective 3: Collect water samples from CSG water holding ponds identified in Task 1 for evaluating water soluble organic compounds and solvent extractable organic compounds.

42 water samples were collected from the three CSG holding ponds identified in Task 1 for evaluating water soluble organic compounds and solvent extractable organic compounds. It is noteworthy that the glass bottle for one of the water samples collected in summer was broken during transportation from QLD to Lindfield.

Task objective 4: Collect sediment samples from CSG water holding ponds identified in Task 1 for microbial community, chemistry analyses, surface area and particle size distribution.

11 sediment samples were collected from the three CSG holding ponds identified in Task 1 for microbial community, chemistry analysis, surface area and particle size distribution.

TASK 3: Sample and data analyses

BACKGROUND

Methanogen and methanotroph communities in CSG water holding ponds will provide critical information to fully understand the controls of methane emissions from CSG water holding ponds. The kinds of carbon in CSG water holding ponds will provide how accessible these different carbon pools and how these types of carbon are biodegraded or mobilised as emissions. CSG water holding ponds contain high content of inorganic carbon (bicarbonate) which could possibly be converted to organic carbon by algae. This task will analyse water and sediment samples either in-house or in different commercial laboratories.

TASK OBJECTIVES

1. Filter collected water samples, complete DNA extractions from all samples and process DNA for 16S NGS sequencing.
2. Perform water chemistry analyses of collected water samples through a NATA accredited laboratory.

3. Quantify hydrocarbons such as TRH, BTEX, VOCs, PAHs, volatile organic acids, phenols through a NATA accredited laboratory.
4. Determine detailed water-soluble organic compounds in the water and sediment samples through LCMS technique in a commercial laboratory.
5. Determine detailed solvent extractable organic compounds in the water and sediment samples using a GC-MS instrument in CSIRO laboratory.
6. Identify minerals in the sediment samples XRD technique.
7. Perform SEM (scanning electron microscopy) imaging on sediment samples which will provide the status of microbial colonisation in the sediment and also inform how coal particles bonded with other minerals which can determine the possibility of separation of coal from other minerals.
8. Characterise the surface area, particle size distribution of collected sediment samples by Brunauer-Emmett-Teller and laser diffraction and their coal fractions provided that coal fraction can be successfully separated.
9. Set up a growth experiment to assess whether inorganic carbon (bicarbonate) in CSG water holding ponds could be consumed by certain algae species.

TASK OUTPUTS AND SPECIFIC DELIVERABLES

This task aims to deliver insights of methanogen and methanotroph communities as well as algal species, information of different carbon pools in the ponds, accessibility of inorganic carbon by algae.

PROGRESS REPORT

This milestone is partially complete.

Task objective 1: Filter collected water samples, complete DNA extractions from all samples and process DNA for 16S NGS sequencing.

A total of 129 water samples collected for microbial analysis were filtered, from which DNA was extracted. DNA analysis using 16S next generation sequencing (NGS) has been completed.

Task objective 2: Perform water chemistry analyses of collected water samples through a NATA accredited laboratory.

Water chemistry analyses of 42 collected water samples have been completed by ALS Global, a NATA accredited laboratory.

Task objective 3: Quantify hydrocarbons such as TRH, BTEX, VOCs, PAHs, volatile organic acids, phenols through a NATA accredited laboratory.

Hydrocarbons such as TRH, BETX, VOCs, PAHs, volatile organic acids, phenols in the 42 collected water samples have been analysed and quantified by ALS Global.

Task objective 4: Determine detailed water-soluble organic compounds in the water and sediment samples through LCMS technique in a commercial laboratory.

Water-soluble organic compounds in 42 collected water and 11 sediment samples have been analysed and completed by ALS Global.

Task objective 5: Determine detailed solvent extractable organic compounds in the water and sediment samples using a GC-MS instrument in CSIRO laboratory.

All water (42) and sediment (10) samples were extracted using dichloromethane and the extractable organic matter (EOM) extracts were analysed on a GC-MS instrument in CSIRO Lindfield chemistry laboratory.

Task objective 6: Identify minerals in the sediment samples XRD technique.

Mineral composition analysis of the five sediment samples has been completed using XRD technique at the CSIRO Lindfield laboratory.

Task objective 7: Perform SEM (scanning electron microscopy) imaging on sediment samples which will provide the status of microbial colonisation in the sediment and also inform how coal particles bonded with other minerals which can determine the possibility of separation of coal from other minerals.

SEM Imaging was performed on the five sediment samples.

Task objective 8: Characterise the surface area, particle size distribution of collected sediment samples by Brunauer-Emmett-Teller and laser diffraction and their coal fractions provided that coal fraction can be successfully separated.

Particle size distribution and surface area of nine collected sediment samples have been characterized by laser diffraction and BJH methods, respectively. Coal fractions could not be separated for characterisation.

Task objective 9: Set up a growth experiment to assess whether inorganic carbon (bicarbonate) in CSG water holding ponds could be consumed by certain algae species.

Objective 9 is still progressing with expected delivery in October 2025.

TASK 4: Coordination between the two CSG holding pond projects

BACKGROUND

This project focuses on filling the knowledge gaps on emissions from CSG holding ponds. This project is closely linked with the other phase 2 pond emissions project 'Methane emissions from CSG water holding ponds in Queensland' which measures emissions from CSG holding ponds. The results from the first round of fieldwork (Task 3 Field trip I) in the emissions measurement project will be used to guide selection of holding ponds for examination in this project. The project leaders of these two projects should work closely and communicate with each other on pond selection, sampling plan and analyses.

TASK OBJECTIVES

To ensure the two phase 2 pond emissions projects link and communicate effectively.

TASK OUTPUTS AND SPECIFIC DELIVERABLES

The project leaders of the two phase 2 pond emissions projects work closely to communicate project findings with the aims to reduce the uncertainties on emissions from CSG holding ponds in Queensland and fill knowledge gaps to understand emissions lifecycle related to CSG holding ponds.

PROGRESS REPORT

This milestone will be delivered in October 2025.

TASK 5: Project reporting

BACKGROUND

Information from this project is to be made publicly available after completion of standard CSIRO publication and review processes.

TASK OBJECTIVES

To ensure that the information generated by this project is documented and published after thorough CSIRO internal review.

TASK OUTPUTS AND SPECIFIC DELIVERABLES

1. Ensure coordination between the two follow-up projects coming out of GISERA phase 1 project 'Methane contributions from CSG water holding ponds'.
2. Preparation of a final report outlining the scope, methodology and findings.
3. Following CSIRO Internal review, the report will be submitted to the GISERA Director for final approval; and
4. Provide 6 monthly progress updates to GISERA office.

PROGRESS REPORT

This milestone will be delivered in October 2025.

TASK 6: Communicate findings to stakeholders

BACKGROUND

Communication of GISERA's research is an important component of all research projects. The dissemination of project objectives, key findings and deliverables to relevant and diverse audiences allows discourse and decision making within and across multiple stakeholder groups.

TASK OBJECTIVES

Communicate findings to stakeholders through meetings, a Knowledge Transfer Session, fact sheets, project reports and journal article/s, in collaboration with the GISERA Communication team.

TASK OUTPUTS AND SPECIFIC DELIVERABLES

Communicate results to GISERA stakeholders according to standard GISERA project procedures, which will include but are not limited to:

1. Presentation/engagement with local government and community members/groups via two workshops held in Chinchilla (held in conjunction with the other phase 2 project workshops):
    a. one at the early stage to convey the knowledge gaps discovered in GISERA phase 1 project 'Methane contributions from CSG water holding ponds' and to present objectives of the two subsequent phase 2 emissions projects; and
    b. a second workshop at the completion of the project to present project outcomes.
2. Knowledge Transfer Session with relevant government/ gas industry representatives.
3. Two project fact sheets: one developed at the commencement of the project, and another that will include peer-reviewed results and implications at completion of the project. Both will be hosted on the GISERA website.
4. Preparation of an article for the GISERA newsletter.
5. Peer-reviewed scientific manuscript ready for submission to relevant journal (optional).

PROGRESS REPORT

This milestone will be delivered in October 2025.

Variations to Project Order

Changes to research Project Orders are approved by the GISERA Director, acting with authority, in accordance with the GISERA Alliance Agreement. Any variations above the GISERA Director's delegation require the approval of the relevant GISERA Research Advisory Committee.

The table below details variations to research Project Order.

Register of changes to Research Project Order

DATE	ISSUE	ACTION	AUTHORISATION
25/06/2024	To allow for measurements to be taken in three locations for each CSG water pond (two originally planned), an additional $25,000 funding is required for the increased number of samples to be commercially tested.	An additional $25,000 ($19,750 GISERA funding & $5,250 CSIRO in-kind) is allocated to overall project budget.	

DATE	ISSUE	ACTION	AUTHORISATION
17/06/2025	Milestones delayed due to staffing changes and subsequent recruitment of new employee.	Milestones 3, 4, 5 and 6 extended from July 2025 to October 2025.	

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GISERA is a collaboration between CSIRO, Commonwealth and state governments and industry established to undertake publicly-reported independent research. The purpose of GISERA is to provide quality assured scientific research and information to communities living in gas development regions focusing on social and environmental topics including: groundwater and surface water, greenhouse gas emissions, biodiversity, land management, the marine environment, and socio-economic impacts. The governance structure for GISERA is designed to provide for and protect research independence and transparency of research.