Australia's National
Science Agency

GISERA | Gas Industry Social and Environmental Research Alliance

Project Order

Short Project Title

Methane emissions from CSG water holding ponds in Queensland

Long Project Title	Comprehensive survey of methane emissions from Queensland coal seam gas water holding ponds in the Surat Basin
GISERA Project Number	G.11
Start Date	01/08/2023
End Date	30/10/2025
Project Leader	Nicholas Lupton

GISERA State/Territory

- [x] **Queensland**
- [ ] New South Wales
- [ ] Northern Territory
- [ ] South Australia
- [ ] Western Australia
- [ ] Victoria
- [ ] National scale project

Basin(s)

- [ ] Adavale
- [ ] Amadeus
- [ ] Beetaloo
- [ ] Canning
- [ ] Western Australia
- [ ] Carnarvon
- [ ] Clarence-Morton
- [ ] Cooper
- [ ] Eromanga
- [ ] Galilee
- [ ] Gippsland
- [ ] Gloucester
- [ ] Gunnedah
- [ ] Maryborough
- [ ] McArthur
- [ ] North Bowen
- [ ] Otway
- [ ] Perth
- [ ] South Nicholson
- [x] **Surat**
- [ ] Other (please specify)

GISERA Research Program

- [ ] Water Research
- [ ] Health Research
- [ ] Biodiversity Research
- [ ] Social & Economic Research
- [x] **Greenhouse Gas Research**
- [ ] Agriculture Research
- [ ] Land and Infrastructure Management Research
- [ ] Other (please specify)

1. Project Summary

The CSIRO GISERA phase 1 project 'Methane contributions from CSG water holding ponds' literature review showed that small anthropogenically-constructed ponds may be a potential source of significant greenhouse gas emissions (Gong et al., in progress). In Queensland, there are more than eighty operational ponds related to the coal seam gas (CSG) industry that are used to hold produced water flowing back from CSG wells and brine water generated from the produced water treatment process.

The potential contribution to Australia's greenhouse gas (GHG) emissions is not fully known because there are limited available emissions data from Australian CSG holding ponds and these emissions data are highly variable. Of the few observations available, measured methane emissions from a single CSG holding pond in NSW were 150 mg/m^2/d in winter and 260 mg/m^2/d in summer (Day et al., 2016). In Queensland, measured methane emissions from a CSG holding pond (a raw water pond) were reported at 221kg/h, which translates to 8840 mg/m^2/d (Kelly et al., 2022). This poses a high level of uncertainty on contributions of methane emissions from CSG holding ponds towards accounting for a regional methane budget in these natural gas producing regions.

This project aims to provide a comprehensive survey of Queensland CSG holding ponds in the Surat Basin to fully evaluate their methane emissions potential. The project will select multiple representative CSG holding ponds to accurately quantify methane emissions, in both summer and winter, using rigorous sampling methods to minimise known methane measurement limitations. This project will provide new data on methane emissions from CSG holding ponds, which will fill critical knowledge gaps, and enhance community's understanding of the potential climate impacts from coal seam gas production in Queensland.

This project is one of two follow-up (phase 2) projects to GISERA phase 1 project 'Methane contributions from holding ponds'. This project will focus on comprehensively surveying CSG-related holding ponds by direct measurement of methane emissions. The results from the first round of fieldwork from this project will be used to guide selection of holding ponds for examination in the related phase 2 project 'Key controls or contributors to methane emissions from CSG water holding ponds', which aims to fill knowledge gaps around microbial communities, microalgal growth, and different carbon pools associated with methane emissions from CSG holding ponds.

2. Project description

Introduction

The importance of small waterbodies as hotspots for GHG emissions is increasingly recognised (Grinham et al., 2018; Holgerson & Raymond, 2016). The previous review from natural and

anthropogenic freshwater waterbodies such as lakes, urban ponds, reservoirs, or dams indicated that climate/temperature strongly affects methane emissions, especially ebullitive methane emissions; small, shallow ponds are significant sources of methane emissions and nutrients such as phosphorous and organic carbon are important factors contributing to biogenic methane emissions. Nutrients support microbe growth which can then convert more carbon to methane by methanogens (methane generating microbes).

The CSG industry in Queensland uses ponds to hold water from various stages of water management during CSG production. These CSG holding ponds may be a potential source of methane emissions, however, estimating their contribution to Australia's GHG emissions is challenging for a number of reasons, including:

- Measurement of methane emissions from Queensland CSG-related holding ponds is very limited. To date, only two CSG-related holding ponds have had direct methane emission measurements carried out (Day et al., 2016; and Kelly et al., 2022).
- The exact number of holding ponds is not publicly available. The previous literature review in GISERA phase 1 project 'Methane contributions from CSG water holding ponds' reported on over 100 holding ponds publicly listed by the Queensland CSG industry and noted that it was unknown whether any CSG ponds had been constructed in recent years.
- Holding pond dimensions are not all publicly available. Most Queensland CSG-related holding ponds are less than 10 ha in area.
- The effect on methane emissions resulting from seasonal variations in temperature has not been fully assessed. Measurements of methane emissions from a CSG holding pond in NSW were reported at 150 mg/m^2/d in winter and 260 mg/m^2/d in summer (Day et al., 2016).
- The variation in methane emissions profiles resulting from differences in water held in CSG-related holding ponds is unknown. The CSG industry variously treats produced water and depending upon the treatment, the waters have different potentials of emissions.
- Water co-produced during CSG production will contain dissolved methane due to contact with gas in the reservoir. The potential impact of the exsolution of this dissolved gas on pond flux measurements will need to be considered.
- No information is available on methane emissions from brine ponds.

Prior Research

Limited data have been identified in the GISERA phase 1 project 'Methane contributions from CSG water holding ponds' literature review on methane emissions from CSG holding ponds. These data only include a few ground-based and air-based methane measurements.

- An elevated methane plume measured by CRDS (Cavity ringdown spectroscopy systems) was detected within 50 m of a CSG holding pond in the downwind direction in Queensland, having a

peak methane concentration of 2.107 which is 0.333 ppm higher than the background level (Iverach et al., 2015). Elevated methane concentrations were also detected 1 km away from another raw water pond related to CSG activity in Queensland in both 2018 and 2019 with excess methane concentrations over background being 0.2 ppm and 1.5 ppm, respectively (Lu et al., 2021). However, these elevated methane measurements cannot be converted to methane flux.

- The 2018 UNSW inventory estimated overall methane emissions from CSG produced water (28,823 ML) in south-east Surat Basin to be 8,900,000 kg/year, while air-based measurements suggested the CSG emissions from the 2018 UNSW inventory might be slightly overestimated based on this top-down approach (Neininger et al., 2021).
- Kelly et al. (2022) estimated methane emissions of 221 kg/h from a raw water pond related to CSG in Queensland, however, this may be an overestimation as it is also based on the 2018 UNSW inventory.
- Mean methane emissions from an NSW CSG holding pond varied from 150 mg/m^2/d in winter to 260 mg/m^2/d in summer (Day et al., 2016).

The limited number of ponds measured for methane emissions to date and the variation in the data reported, highlight the need for a comprehensive survey that directly measures the methane emissions from a large number of representative CSG-related holding ponds in the Queensland Surat Basin.

Need & Scope

The GISERA phase 1 project 'Methane contributions from CSG water holding ponds' literature review showed that there are limited available data and few measurements have been reported in regions where CSG operations occur. These limited data appear to be highly variable which are not sufficient for estimating overall contribution of methane emissions from CSG holding ponds. To allow accurate estimations of the GHG emissions from CSG-related holding ponds, a comprehensive survey measuring methane emissions from a representative sample of ponds is required. Surveys of the local community have indicated that emissions are an important issue. Quantification of methane emissions from CSG water holding ponds will provide improved data to address community questions and concerns, and will also assist industry and regulator efforts to better understand and mitigate potential emissions from these sources.

This study will:

- Liaise with the Queensland CSG industry operating in the Surat Basin to select up to twenty representative holding ponds for direct measurement of methane emissions.
- Accurately quantify methane emissions in winter and summer from CSG holding ponds across the Surat Basin.

Objective

This study aims to comprehensively survey methane emissions from CSG holding ponds by

- Selecting a range of representative holding ponds (up to 20) for the direct measurement of methane emissions. This will require consultation with the CSG industry to provide access to sites for representative sampling of holding ponds.

- Undertaking comprehensive survey of methane emissions from selected CSG holding ponds in winter and summer. All measures will use a floating chamber to determine flux.

This project will provide accurate methane emissions measurements from CSG holding ponds in Queensland to allow estimations of GHG emissions related to the CSG industry and to enhance community understanding of the risk of potential climate impacts from coal seam gas production in Queensland.

Methods

This project will undertake a comprehensive survey of methane emissions from CSG holding ponds in the Surat Basin. Direct measurement of methane flux will be carried out by continuous monitoring of methane from the holding ponds using a floating chamber deployed onto the surface of the pond. Methane concentrations will be analysed using a portable trace gas analyser designed for environmental and emissions monitoring, employing cavity ring-down spectroscopy. The survey will involve two field trips, one in winter and another in summer to assess the effect of season/temperature on methane emissions from CSG holding ponds.

Before the survey, extensive consultation with CSG companies operating in the Surat Basin will locate and identify representative holding ponds. Ideally, up to twenty holding ponds will be identified to give a representative sample of type of held water, pond size, water chemistry, CSG company, and spatial distribution (location). Consideration will also be given to the pond type and purpose within the water management system (e.g., in-field pond, water treatment pond). Accessibility of holding ponds will be critical and CSG company representatives will be contacted to assist with both the winter and summer field trips. Pond selection will also be undertaken in coordination with the other GISERA phase 2 project 'Key controls or contributors to methane emissions from CSG water holding ponds' to enable complementary field data to be collected. That project aims to address knowledge gaps on the key controls and contributors to methane emissions in CSG water ponds. The Technical Reference Group and any relevant experts will also be consulted regarding holding pond selection.

The project will undertake two workshops in Chinchilla (held in conjunction with the other phase 2 project workshops) to inform and engage local government and community stakeholders throughout the project. The first workshop will be conducted at the early stages of the project to communicate

knowledge gaps identified from the phase 1 project 'Methane contributions from CSG water holding ponds' and present objectives, methods, timing and expected outcome of this phase 2 project. The second workshop will be conducted at the end of the project to communicate project outcomes.

Field sampling will be undertaken in both winter and summer by two or three staff traveling to the Surat Basin. Each field trip will be two weeks in length to allow time for measurement of methane emissions and collection of samples for dissolved gas analysis and water chemistry. Each field trip will measure and sample from up to twenty holding ponds. The final number of ponds included in the survey will be subject to accessibility and general logistic considerations. Measurements will be taken using CRDS at all of the selected ponds. Additionally, forward looking infrared (FLIR) camera detection of methane will be undertaken at each holding pond to assess potential existence of hotspots of methane emissions.

Analysis of methane emission measurements will investigate the influence of factors such as type of held water, residence time, pond size, water chemistry, location (including proximity to the well field,), and seasonal variation on concentrations of methane measured. Water co-produced during CSG production will contain dissolved methane due to contact with gas in the reservoir. The potential impact of the exsolution of this dissolved gas on pond flux measurements will also be considered.

3. Project Inputs

Resources and collaborations

Researcher	Time Commitment (project as a whole)	Principle area of expertise	Years of experience	Organisation
Nicholas Lupton	82 days	Reservoir Engineering	+14 years	CSIRO
Se Gong	27 days	Geochemistry	+16 years	CSIRO
Deasy Heryanto	33 days	Chemical Engineering	+14 years	CSIRO
Michael Camilleri	5 days	Mechanical Engineering	+20 years	CSIRO
Adrian Element	2 days	Mechanical Engineering	+16 years	CSIRO
Stephen Sestak	5 days	Analytical chemistry and engineering	+20 years	CSIRO
Cameron Huddlestone-Holms	5 days	Project management, CSG development, risk assessment	+20 years	CSIRO
Mohinudeen Faiz	5 days	CSG Industry & Geology	+30 years	CSIRO

Subcontractors (clause 9.5(a)(i))	Time Commitment (project as a whole)	Principle area of expertise	Years of experience	Organisation
ALS	1-2 weeks turnaround on receipt of water samples for chemical analyses 3-4 weeks turnaround on receipt of samples for dissolved gas analyses.	Testing water chemistry & dissolved gas analysis	Many. Commercial laboratory.	ALS. NATA accredited laboratory.

Technical Reference Group

The project will establish a Technical Reference Group (TRG) that will include the project leader and a group of different stakeholders as appropriate which may include:

- Australia Pacific LNG representative
- Shell/QGC representative
- Origin Energy representative
- Arrow Energy representative
- UQ's Centre for Natural Gas representative
- Office of Groundwater Impact Assessment representative
- QLD Government representative

Budget Summary

Source of Cash Contributions	2022/23	2023/24	2024/25	2025/26	% of Contribution	Total
GISERA	$0	$110,830	$105,026	$44,472	80%	$260,329
- Federal Government	$0	$83,123	$78,770	$33,354	60%	$195,247
- APLNG	$0	$12,468	$11,815	$5,003	9%	$29,287
- Origin Energy	$0	$12,468	$11,815	$5,003	9%	$29,287
- QGC	$0	$2,771	$2,626	$1,112	2%	$6,508
Total Cash Contributions	**$0**	**$110,830**	**$105,026**	**$44,472**	**80%**	**$260,329**

Source of In-Kind Contribution	2022/23	2023/24	2024/25	2025/26	% of Contribution	Total
CSIRO	$0	$27,708	$26,257	$11,118	20%	$65,082
Total In-Kind Contribution	**$0**	**$27,708**	**$26,257**	**$11,118**	**20%**	**$65,082**

TOTAL PROJECT BUDGET	2022/23	2023/24	2024/25	2025/26	-	TOTAL
All contributions	$0	$138,538	$131,283	$55,590	-	$325,411
TOTAL PROJECT BUDGET	**$0**	**$138,538**	**$131,283**	**$55,590**	**-**	**$325,411**

4. Communications Plan

Stakeholder	**Objective**	**Channel** (e.g. meetings/media/factsheets)	**Timeframe** (Before, during at completion)
Regional community stakeholders including landholders, traditional owners and wider public	To communicate project objectives, and key messages and findings from the research	A fact sheet at commencement of the project that explains in plain English the objective of the project.	At project commencement
		Local government and community groups invited to a community workshop (face-to-face) to convey the knowledge gaps discovered in GISERA phase 1 project 'Methane contributions from CSG water holding ponds' and the commencement of the two subsequent phase 2 emissions projects.	At project commencement
		Project progress reported on GISERA website to ensure transparency for all stakeholders including regional communities.	Ongoing
		Local government and community groups invited to a community workshop (face-to-face) to communicate the project outcomes.	At project completion
		Public release of final reports. Plain English fact sheet summarising the outcomes of the research.	At project completion
Gas Industry & Government	To communicate the outcome of the project	Fact sheet that explains the objective of the project.	At project commencement
		Gas company representatives involved in identifying knowledge gaps from the previous related research project.	At project commencement
		Project progress reporting (on GISERA website).	Ongoing
		Final project report and fact sheet.	At project completion
		Presentation of findings at joint gas industry/government Knowledge Transfer Session	At project completion
Scientific Community	Provide scientific insight into quantity of methane emissions from CSG holding ponds in the Surat Basin	Peer-reviewed scientific publication (optional). Dataset(s) available through CSIRO's data repository.	After completion of project

In addition to project specific communications activities, CSIRO's GISERA has a broader communications strategy. This strategy incorporates activities such as webinars, roadshows, newsletters and development of other communication products.

5. Project Impact Pathway

Activities	Outputs	Short term Outcomes	Long term outcomes	Impact
Representative pond selection	• A list of up to twenty holding ponds will be compiled for the survey.	This project will provide direct measurement of methane emissions/flux from up to twenty CSG holding ponds in the Surat Basin. Additionally, water chemistry and methane emission visualisation will be assessed from the CSG holding ponds.	• Assist in informing governments, regulators as well as policy-makers on more accurate quantity of methane emissions from CSG holding ponds in Queensland which can be used for regional methane budget accounting. • Improve community's awareness about the potential of the CSG industry to contribute to emissions in the Surat Basin and the impact of methane emissions on the environment. • Improve industry's knowledge on quantity of methane emissions from CSG holding ponds and inform the need for mitigating the emissions from CSG holding ponds.	The impact of this research extends to communities, government and industry. All Australian communities that are located in coal seam gas regions as well as industry will benefit from the outcomes of this research, through increased understanding on methane emissions from holding ponds and the impacts on environment.
Logistics	• A series of documents describing the contacts, samplings, relevant permissions, sampling equipment and HSE considerations for this project by establishing the volume and type of available samples from up to twenty CSG holding ponds. • Identification of any permits or travel documents required to allow this travel to occur. • HSE documents to ensure safe work practices during this time.			
Field trips	Provision of water samples and methane flux measurements			
Project coordination	Coordination between project leaders of the two phase 2 projects out of GISERA phase 1 project 'Methane contributions from CSG water holding ponds'			
Information sharing with the community stakeholders	Two workshops will be organised: • The first at the beginning of the project to discuss knowledge gaps identified in the preceding GISERA phase 1 project 'Methane contributions from CSG water holding ponds' and present objectives of the two subsequent phase 2 emissions projects. • The second at project completion to present research outcomes.			
Communications	• GISERA Communication team will develop a plain English fact sheet at project commencement. • Completed fact sheet(s) with key findings for distribution via the GISERA website and at community engagement events. • Final report with detailed outcomes will be prepared. • Manuscripts will be prepared for submission to scientific journals (optional).			

6. Project Plan

Project Schedule

ID	Activities / Task Title	Task Leader	Scheduled Start	Scheduled Finish	Predecessor
Task 1	Representative pond selection for survey of methane emissions	Mr. Nicholas Lupton	1 August 2023	30 April 2024	N/A
Task 2	Sampling logistics and field campaign planning	Mr. Nicholas Lupton	1 April 2024	30 June 2024	N/A
Task 3	Field trips I and II – Methane emissions measurement and water sampling	Mr. Nicholas Lupton	1 June 2024 and 31 December 2024	1 July 2024 and 31 January 2025	Task 1,2
Task 4	Coordination between CSG holding pond projects	Mr. Nicholas Lupton	1 August 2023	30 October 2025	Task 1,2, 3
Task 5	Project reporting	Mr. Nicholas Lupton	1 August 2023	30 October 2025	Task 1,2, 3, 4
Task 6	Communicate findings to stakeholders	Mr. Nicholas Lupton	1 August 2023	30 October 2025	Task 1-5

Task description

Task 1: Representative pond selection for survey of methane emissions

OVERALL TIMEFRAME: August 2023 – April 2024

BACKGROUND: The GISERA phase 1 project 'Methane contributions from CSG water holding ponds' literature review showed that CSG holding ponds are a potentially significant source of methane emissions, however, there is a high level of uncertainty as to the quantity of methane emitted from these holding ponds in Queensland. Identifying representative CSG holding ponds from the Surat Basin for evaluating the methane emissions is critical. Selection of representative ponds will be based on a number of criteria including accessibility, type of held water, pond size, water chemistry, and location.

TASK OBJECTIVES: This task is to identify the representative CSG holding ponds from the Surat Basin for future evaluation of ebullitive methane emissions and dissolved methane concentrations in the field campaign. The project team will liaise with CSG companies operating in the Surat Basin to obtain information on the properties and accessibility of the CSG ponds. Dependent on accessibility, the pond selection will cover both produced water ponds and brine ponds, attempting to encompass the range of properties such as location, pond size and water chemistry represented in CSG ponds across the Surat Basin.

1. Liaise with representatives from CSG companies to assist with pond selection and further sampling campaign.
2. Select representative CSG holding ponds in the Surat Basin based on accessibility, type of held water, pond size, water chemistry, and location.
3. Identify the requirements for permission to access and sample the selected ponds.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Identify up to twenty CSG holding ponds in the Surat Basin for direct methane emission measurements and produce a document describing contacts, sampling site accessibility and relevant permission requirements.

Task 2: Sampling logistics and field campaign planning

OVERALL TIMEFRAME: April 2024 - June 2024

BACKGROUND: During this task, the project team will consult with representatives from CSG companies in Queensland to prepare for sampling water and measuring emissions from the selected CSG holding ponds in the Surat Basin (selected in Task 1), and develop safe, environmentally sensitive planning and logistics for the sampling campaign.

This task will also ensure that sampling methods will be able to be practicably carried out in the field for accurately measuring methane flux from holding ponds.

TASK OBJECTIVES:

1. Consult with CSG companies' representative for guidance of the sampling campaign.
2. Establish sampling requirement, e.g., locations, volume, number.
3. Prepare for remote sampling fieldwork including accommodation, vehicle hire and HSE considerations.
4. Establish logistics of transporting equipment and samples between CSIRO laboratory in Sydney and collection sites in Queensland.
5. Detail the analytical requirements from external laboratories.
6. Undertake necessary commissioning and calibration of measurement equipment for use in the field campaign.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: This task will yield a series of documents describing sampling equipment, sampling details, analysis plan, field trip details and HSE considerations.

Task 3: Field trips I and II – Methane emissions measurement and water sampling

OVERALL TIMEFRAME: June 2024 - July 2024, and December 2024 - January 2025

BACKGROUND: The GISERA phase 1 project 'Methane contributions from CSG water holding ponds' literature review showed that methane emissions are temperature dependent, especially ebullitive methane emissions. This task will investigate the emissions from the selected CSG holding ponds in both winter (June 2024 - July 2024) and summer (December 2024 - January 2025). This task will involve two or three staff travelling to Queensland with the purpose of measuring emissions from the selected CSG holding ponds in the Surat Basin. Additionally, water samples will be collected for chemical analyses and FLIR camera detection of methane will be undertaken at each holding pond to assess hotspots of methane emissions.

TASK OBJECTIVES:

1. Continuous monitoring of methane emissions flux from the holding pond using a floating chamber deployed onto the surface of the pond.
2. Collect water samples for dissolved gas analysis by a commercial laboratory.
3. Collect water samples for water chemistry analysis by a commercial laboratory.
4. Relevant environmental parameter measurements (e.g., water temperature and air temperature) during sampling.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: This task aims to investigate methane emissions from CSG holding ponds in winter and summer. The project team will measure methane emissions flux from all selected holding ponds using CRDS and collect water samples for measuring dissolved gas and water chemistry analyses. Additionally, environmental parameters will by recorded during sampling and FLIR camera detection of methane will be undertaken at each holding pond to assess potential existence of hotspots of methane emissions.

Task 4: Coordination between CSG holding pond projects

OVERALL TIMEFRAME: August 2023 – October 2025

BACKGROUND: The focus of this phase 2 project is on comprehensively surveying CSG holding ponds through direct measurement of methane emissions. The results from the first round of fieldwork (Task 3 Field trip I) from this project will be used to guide selection of holding ponds for examination in the other phase 2 project coming out of GISERA phase 1 project 'Methane contributions from CSG water holding ponds'. This other phase 2 project 'Key controls, and contributors, to emissions from CSG holding ponds' aims to fill knowledge gaps around microbial communities, microalgal growth, carbon particulates and organic carbon content associated with methane emissions from holding ponds. The project leaders of these two phase 2 projects will work closely and communicate with each other on pond selection, sampling plan and analyses.

TASK OBJECTIVES: To ensure coordination between the phase 2 projects coming out of GISERA phase 1 project.

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 around measured emissions from CSG holding ponds in the Surat Basin, and fill knowledge gaps associated with potential methane emissions from CSG holding ponds.

Task 5: Project reporting

OVERALL TIMEFRAME: August 2023 – October 2025

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. Provide 6 monthly progress updates to GISERA office.
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

Task 6: Communicate findings to stakeholders

OVERALL TIMEFRAME: August 2023 – October 2025

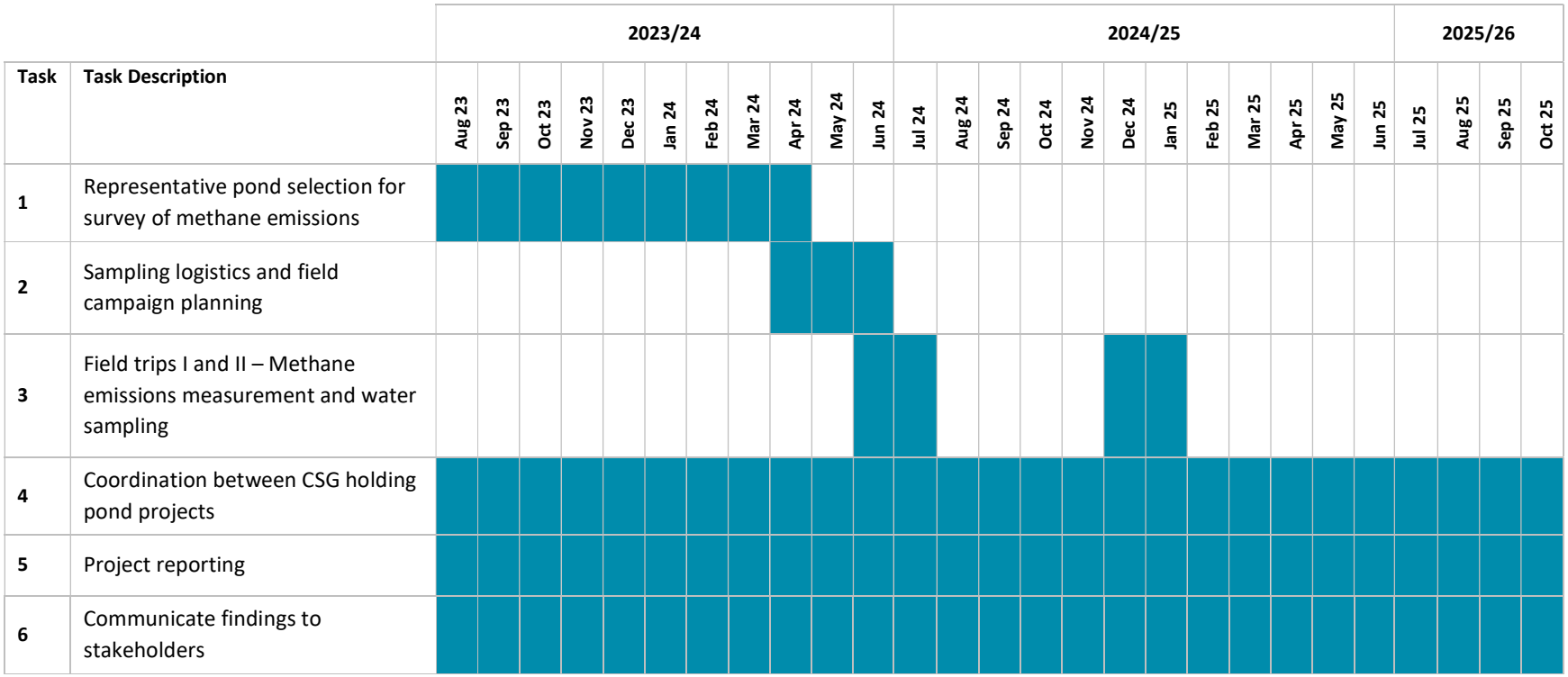
BACKGROUND: Communication of GISERA's research is an important component of all research projects. The dissemination of project objectives, key findings and deliverables to relevant and diverse audiences allows discourse and decision making within and across multiple stakeholder groups.

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:

1. Presentation and workshop (held in conjunction with the other phase 2 project workshops) with local government and community groups to convey the knowledge gaps discovered in GISERA phase 1 project 'Methane contributions from CSG water holding ponds' and the commencement of the two subsequent phase 2 emissions projects.
2. Knowledge Transfer Session with relevant government/ gas industry representatives.
3. Presentation of findings to community members/groups with a community workshop held in Chinchilla to communicate project outcomes (September-October 2025).
4. 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.
5. Project reporting.
6. Preparation of an article for the GISERA newsletter.
7. Peer-reviewed scientific manuscript ready for submission to relevant journal (optional).

Project Gantt Chart



7. Budget Summary

Expenditure	2022/23	2023/24	2024/25	2025/26	Total
Labour	$0	$100,038	$83,483	$51,540	$235,061
Operating	$0	$38,500	$30,200	$4,050	$72,750
Subcontractors	$0	$0	$17,600	$0	$17,600
Total Expenditure	**$0**	**$138,538**	**$131,283**	**$55,590**	**$325,411**

Expenditure per task	2022/23	2023/24	2024/25	2025/26	Total
Task 1	$0	$41,477	$0	$0	$41,477
Task 2	$0	$73,798	$0	$0	$73,798
Task 3	$0	$2,584	$119,886	$0	$122,470
Task 4	$0	$11,029	$5,698	$11,780	$28,507
Task 5	$0	$8,271	$4,274	$23,561	$36,106
Task 6	$0	$1,379	$1,425	$20,249	$23,053
Total Expenditure	**$0**	**$138,538**	**$131,283**	**$55,590**	**$325,411**

Source of Cash Contributions	2022/23	2023/24	2024/25	2025/26	Total
Federal Govt (60%)	$0	$83,123	$78,770	$33,354	$195,247
APLNG (9%)	$0	$12,468	$11,815	$5,003	$29,287
Origin Energy (9%)	$0	$12,468	$11,815	$5,003	$29,287
QGC (2%)	$0	$2,771	$2,626	$1,112	$6,508
Total Cash Contributions	**$0**	**$110,830**	**$105,026**	**$44,472**	**$260,329**

In-Kind Contributions	2022/23	2023/24	2024/25	2025/26	Total
CSIRO (20%)	$0	$27,708	$26,257	$11,118	$65,082
Total In-Kind Contributions	**$0**	**$27,708**	**$26,257**	**$11,118**	**$65,082**

	Total funding over all years	Percentage of Total Budget
Federal Government investment	$195,247	60%
APLNG investment	$29,287	9%
Origin Energy investment	$29,287	9%
QGC investment	$6,508	2%
CSIRO investment	$65,082	20%
Total Expenditure	**$325,411**	**100%**

Task	Milestone Number	Milestone Description	Funded by	Start Date (mm-yy)	Delivery Date (mm-yy)	Fiscal Year Completed	Payment $ (excluding CSIRO contribution)
Task 1	1.1	Representative pond selection for survey of methane emissions	GISERA	Aug-23	Apr-24	2023/24	$33,182
Task 2	2.1	Sampling logistics and field campaign planning	GISERA	Apr-24	Jun-24	2023/24	$59,038
Task 3	3.1	Field trips I and II – Methane emissions measurement and water sampling	GISERA	Jun-24 & Dec-24	Jul-24 & Jan-25	2024/25	$97,976
Task 4	4.1	Coordination between CSG holding pond projects	GISERA	Aug-23	Oct-25	2025/26	$22,806
Task 5	5.1	Project reporting	GISERA	Aug-23	Oct-25	2025/26	$28,885
Task 6	6.1	Communicate findings to stakeholders	GISERA	Aug-23	Oct-25	2025/26	$18,442

8. Intellectual Property and Confidentiality

Background IP (clause 11.1, 11.2)	**Party**	**Description of Background IP**	**Restrictions on use (if any)**	**Value**
				$
				$
Ownership of Non-Derivative IP (clause 12.3)	CSIRO			
Confidentiality of Project Results (clause 15.6)	Project Results are not confidential.			
Additional Commercialisation requirements (clause 13.1)	Not Applicable			
Distribution of Commercialisation Income (clause 13.4)	Not applicable			
Commercialisation Interest (clause 13.1)	**Party**	**Commercialisation Interest**		
	CSIRO	N/A		
	APLNG	N/A		
	QGC	N/A		
	Origin Energy	N/A		

9. References

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