Australia's National
Science Agency

GISERA | Gas Industry Social and Environmental Research Alliance

Project Order

Short Project Title

Queensland CSG well integrity: cements, steels and microbial activity

Long Project Title	Queensland CSG well integrity: cements, steels and microbial activity
GISERA Project Number	Oth.3
Start Date	1 February 2023
End Date	31 December 2023
Project Leader	Mohinudeen Faiz

GISERA State/Territory

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

Basin(s)

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

GISERA Research Program

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

1. Project summary

Workshops and interviews with stakeholders organised by GISERA (Huddlestone-Holmes et al., 2018), Queensland Audit Office (2020) and University of Queensland - Centre for Coal Seam Gas (Gillespie et al., 2016) have revealed that community and landholders, in particular, have relatively low trust in the practices used by CSG industry. They find the information available regarding well completion and abandonment hard to access and difficult to understand due to highly technical nature of the data include in the reports. The failure of CSG well integrity is of significant concern to the community and landholders, as it could have a marked environmental impact, such as contamination of underground aquifers and gas leakage.

Gillespie et al. (2016) recognises that stakeholder trust is critical to the social licence to operate and building trust with landholders needs to be one of the main priorities for the CSG industry. To address community and landholders concerns about integrity of Queensland CSG wells, this project aims to bring together current and historic information on steels, cements and microbial processes that may impact this infrastructure and present these data in an open and readily comprehendible manner.

The growth in the coal seam gas (CSG) industry in Queensland over the past two decades has seen a significant increase in the number of petroleum exploration and production wells drilled and it is expected that the total number of CSG wells will reach 22,000 by 2050 (OGIA 2021b). The environmental integrity of these wells is heavily reliant on the performance of casing and cementing material used in completion and decommissioning. The construction of wells and their decommissioning are conducted in accordance with the 'Code of Practice for the construction and abandonment of coal seam gas and petroleum wells, and associated bores in Queensland' released by the Petroleum and Gas Inspectorate (https://www.resources.qld.gov.au/__data/assets/pdf_file/0006/1461093/code-of-practice-petroleum-wells-bores.pdf).

The Code of Practice was released to ensure integrity of a CSG well during its whole life cycle and is mandatory for the CSG operator. It addresses the use of the cement slurry and cement placement techniques to ensure isolation of the targeted coal seams from other formations to prevent fluid migration (i.e. prevent aquifer contamination), maintain aquifer pressure and quality, obtain and maintain well integrity and protect casing from corrosion. The Code states that cement constituents and casing properties must be appropriate for the downhole environment and a series of tests must be conducted on the cement slurry for both construction and decommissioning of the wells. CSG operators are required to maintain records of all the relevant data for the entire life cycle of the well. Guidelines for monitoring well integrity during its life cycle, well maintenance and operator

responsibilities are also included in the Code of Practice. Well integrity issues must be remediated, documented, and reported to the relevant authority if they are severe.

2. Project description

Introduction

South-east Queensland hosts the largest coal seam gas (CSG) producing fields in Australia where the key reservoirs comprise the Permian coals of the Bowen Basin and Jurassic coals of the Surat Basin. Additional contingent CSG resources have also been identified in the Galilee Basin in central Queensland. The significant growth of the CSG industry has been positively contributing to the overall economy of Queensland, however, the community sentiment on development of this valuable resource has not always been positive. Some of the main concerns include the possibility of contaminating groundwater resources, impact on human health, agriculture, the environment (e.g. the long-term management of safe disposal of salt and brine waste), uncontrolled or unintended release of gas and long-term integrity of the wells. CSG wells are typically designed with multiple barriers to maintain well integrity and to prevent the coal seam fluids from contaminating the groundwater resources or escaping to the surface (Figure 1). Cementing of a well including the casing is one of the crucial jobs performed during its completion to maintain integrity of the well.

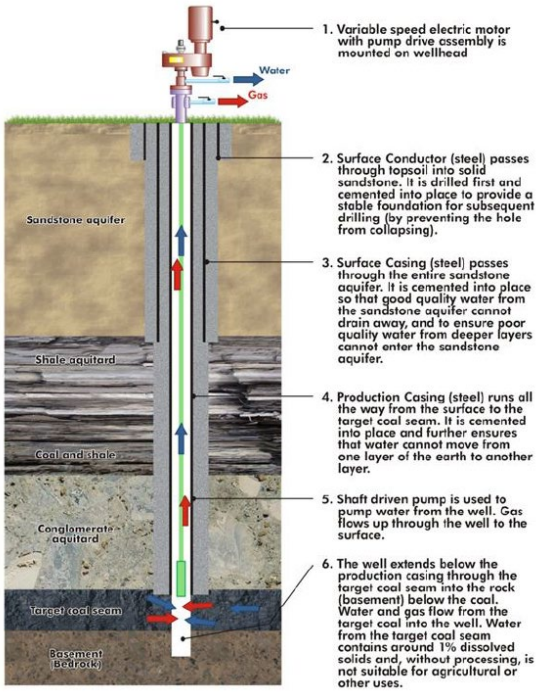

Figure 1 Schematic of a CSG well. The casings are held in place by cement (Commonwealth of Australia - Department of the Environment, 2014)

The Code of Practice of Queensland specifies that “all petroleum wells drilled should be constructed, maintained and abandoned to a minimum acceptable standard resulting in long-term well integrity, containment of petroleum and the protection of groundwater resources”. All appropriate documentation relating to the compliance with this Code must also be completed and submitted with well and bore reports. This includes information on material used in cementing, casing and abandonment of the wells. The API SPEC 10A also specifies requirements and recommendations for cements and materials for well cementing (American Petroleum Institute, 2022).

In Queensland, information on the cement composition is contained in well completion reports submitted by the operating companies, however, details or clarity of the included data are variable depending on the reporting practices of the company and vintage of the well. Information relating to the additives used in the cements is also not clearly specified in some of the reports. For example, some areas of the Permian Reids Dome coals contain > 30% CO_2, however, from information provided in the well completion reports it is not clear if the cementing and casing material used were specifically designed to tolerate these conditions (Figure 2). This project, therefore, aims to collate data pertaining to material used in casing and cements in the construction of CSG wells in Queensland. As most of the CSG wells in Queensland are drilled in the Surat and Bowen basins the information will be largely gathered from well completion reports for wells in these two basins.

AUSTRALIA PACIFIC LNG

Cementing Reports
REIDS 4

Production Casing Cement

Basin	Field Name	Tenure Reference		Lease	ATP	Well Type	Well Sub Type
BOWEN	SPRING GULLY	DURHAM WEST		PL 418	ATP 592	EXPLORATION	PILOT
Latitude (°)	**Longitude (°)**	**Lat/Long Datum**	**Ground Elevation (m)**	**Orig KB/RT (m)**	**Well Configuration Type**	**KB-Grd (m)**	**KB-CF (m)**
25° 55' 25.83" S	148° 54' 15.1" E	GDA 94	436.50	440.80	VERTICAL	4.30	

CEMENT DETAILS

Description	Cementing Start Date	Cementing End Date	Cemented String	Wellbore	Rig
Production Casing Cement	28/02/2015 08:53	28/02/2015 11:16	Production, 1,269.10mKB	Original Hole	ENSIGN, RIG 968
Cementing Company	**Cement Sup**	**Evaluation Method**	**Cement Isolation Comment**	**Cement Evaluation Results**	
Halliburton Energy Services	Phillip Lee	Pressure Test			

Comment

PJSM Rigged up cementing head. Pumped 2bbls freshwater and attempted to pressure test lines to 3000psi. Pressure test failed. Changed out Lo-Torq valve on floor and tightened unions on pump truck. Pumped another 2bbls freshwater and attempted to pressure test lines to 3000psi. Tested OK. Pump 20bbls brine spacer and Pumped 20bbl Flocheck spacer. Pumped 20 bbls gelled brine spacer. Drop bottom plug and load head with top plug. Batch mixed and pumped 24bbl 9.6ppg Tuned light cement and 39bbl 11.2 Tuned light tail cement. Dropped top plug head displaced with 2% KCl treated with Aldacide, OxyCon, and Baracor 100. 150.5bbl @ 4bbl/min 126.5bbl @ 4bbl/min- 10bbl @ 2bbl/min- 14bbl @ 1bbl/min (due to apparent losses). Had returns throughout the cement job, good returns until the final 15 bbls, slowed pumps to help. Full returns again just before bumping plug. Bumped the plug @ 11:06hrs with 2000psi pressure for 10min. Released pressure 1bbl return floats holding.

CEMENT STAGE # 1

Top Depth (mKB)	Bottom Depth (mKB)	Bottom Plug?	Top Plug?	Full Return?	Cement Volume Return (bbl)
747.00	1,273.66	Yes	Yes	No	
Initial Pump Rate (bbl/min)	**Final Pump Rate (bbl/min)**	**Avg Pump Rate (bbl/min)**		**Final Pump Pressure (psi)**	**Plug Bump Pressure (psi)**
4	1	2		375.0	2,000.0
Pipe Reciprocated?	**Reciprocation Stroke Length (m)**	**Reciprocation Rate (spm)**		**Pipe Rotated?**	**Pipe RPM (rpm)**
No				No	
Tagged Depth (mKB)	**Tag Method**	**Depth Plug Drilled Out To (mKB)**		**Drill Out Diameter (in)**	**Drill Out Date**
1,245.80					

CEMENT FLUIDS - Lead Cement

Fluid Type	Fluid Description	Amount (sacks)	Class	Volume Pumped (bbl)
Lead Cement		35	TLC R1	24.0
Estimated Top (mKB)	**Estimated Bottom Depth (mKB)**	**Percent Excess Pumped (%)**	**Yield (ft³/sack)**	**Mix H20 Ratio (gal/sack)**
747.00	947.00	20.0	3.83	14.50
Free Water (%)	**Density (lb/gal)**	**Plastic Viscosity (cP)**	**Thickening Time (hr)**	**1st Compressive Strength (psi)**
0.00	9.60		3.44	500.0

CEMENT FLUID ADDITIVIES

Add	Type	Amount	Amount Units	Conc	Conc Unit
Tuned Light Cement 9.6ppg	Cement	35.0	sacks		
NF-6	Defoamer	1.0	gal	0.25	10bblMF
Halad 344	Fluid Loss	26.0	lb	0.8	%BWOC
CFR-3	Friction Reducer	43.0	lb	1.3	%BWOC
Flocele	Lost Circulation Material	10.0	lb	0.3	%BWOC
Phenoseal	Lost Circulation Material	86.0	lb	2.6	%BWOC
HR-5	Retarder	8.0	lb	0.25	%BWOC

CEMENT FLUIDS - Tail Cement

Fluid Type	Fluid Description	Amount (sacks)	Class	Volume Pumped (bbl)
Tail Cement		79	TLC R2	39.0
Estimated Top (mKB)	**Estimated Bottom Depth (mKB)**	**Percent Excess Pumped (%)**	**Yield (ft³/sack)**	**Mix H20 Ratio (gal/sack)**
947.00	1,273.66	20.0	2.76	12.54
Free Water (%)	**Density (lb/gal)**	**Plastic Viscosity (cP)**	**Thickening Time (hr)**	**1st Compressive Strength (psi)**
	11.20		2.47	500.0

CEMENT FLUID ADDITIVIES

Add	Type	Amount	Amount Units	Conc	Conc Unit
Tuned Light Cement 11.0ppg	Cement	79.0	sacks		
NF-6	Defoamer	1.0	gal	0.25	10bblMF
Halad 344	Fluid Loss	21.0	lb	0.3	%BWOC
Halad 413	Fluid Loss	48.0	lb	0.7	%BWOC
Flocele	Lost Circulation Material	21.0	lb	0.3	%BWOC
Phenoseal	Lost Circulation Material	179.0	lb	2.6	%BWOC

Figure 1 Example of cement information for the production casing in Reds-4 well in the Bowen Basin, where CSG reservoir contains a high CO2 content. Source Reids 4 well completion report.

Prior Research

Casing and cementing are expected to fully support a gas well and form a barrier between producing zone and the surrounding geological formations throughout its life and after the abandonment. Cement quality and poor cementing practices are some of the common causes of well integrity failure (Davies et al., 2014; Liu, 2021). Cement must form a strong bond with both casing and rock formation and withstand downhole environment (high pressure/temperature and formation fluids composition) to prevent any leakages from the well. Cement de-bonding, fracturing and deterioration contribute to some of the potential escape pathways of fluids from wells (Figure 3; Liu, 2021). To lower the risk of fluids escaping from the well, significant research and development to optimise cement slurry composition and cementing techniques have been undertaken by the oil and gas operators (King and King, 2013) (Liska, et al., 2019). A comprehensive review of the well integrity related to cement failure and remedial measures is also presented in Yousuf et al. (2021).

The Queensland Petroleum and Gas Inspectorate (PGI) is responsible for monitoring well integrity management requirements and conducting audits of the well integrity management systems of operating companies (Scott, 2019). Although some data on the material usage and design of gas wells drilled in Queensland are included in the respective well completion reports, which can be downloaded from the data portal of the Geological Survey of Queensland, this information does not appear to be compiled in a readily accessible database. Detailed research and documentation on specifics of cementing and casing material including interactions with reservoir fluids in CSG reservoirs are also lacking in open-file literature. However, the Office of Groundwater Impact Assessment of Queensland has conducted several studies analysing coal seam gas wells constructed in the Surat and Bowen basins with respect to well integrity and these reports will provide background information for the proposed study (OGIA 2021b, Underground Water Impact Report for the Surat Cumulative Management Area; OGIA 2021a, Status of coal seam gas and conventional petroleum and gas development in the Surat Cumulative Management Area)

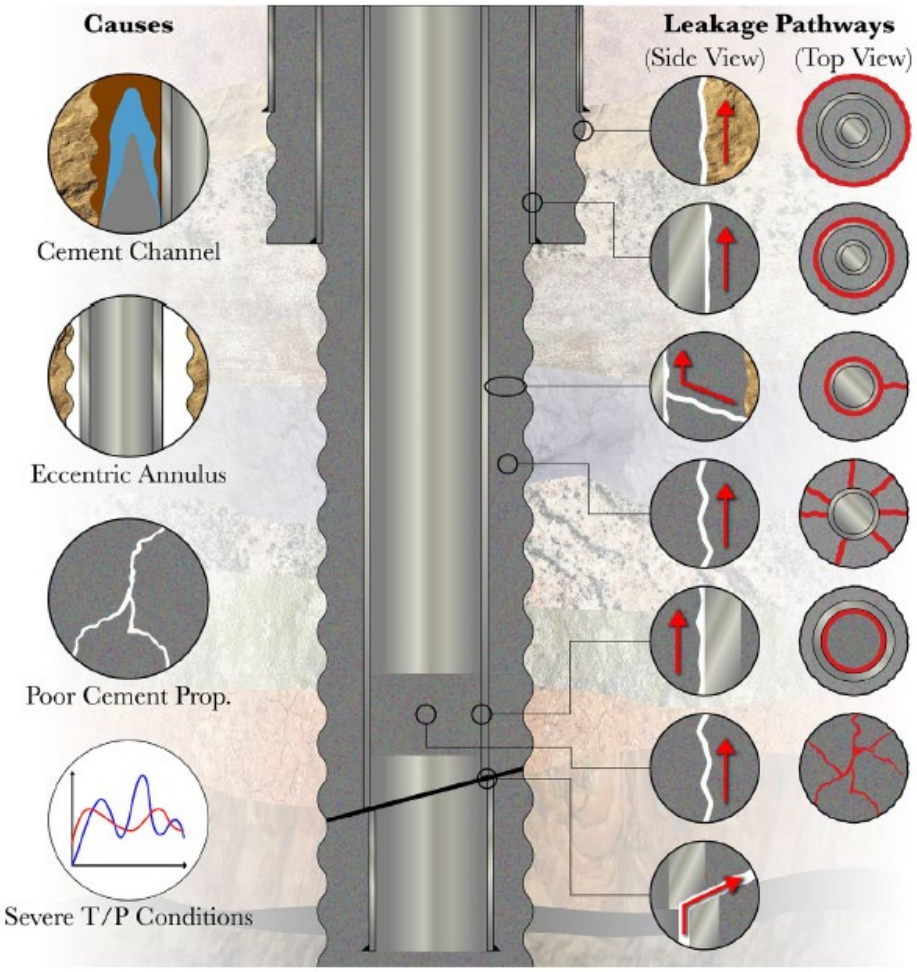

Figure 2 Schematic of potential leakage pathways in petroleum wells (Liu, 2021).

Need & Scope

With the rapid expansion of the number of closely spaced CSG wells across Queensland understanding the composition of materials used to case and cement wells becomes very important to help public understand the risks associated with leakage of reservoir fluids and aquifer contamination. Furthermore, the possible reaction of additives in the cements with reservoir fluids and the potential of microbes casing corrosion and cement degradation also needs to be broadly understood. Previous work conducted by the CSIRO have demonstrated a large diversity in microbial communities in CSG reservoirs with, potentially, differing capacities for degradation of chemicals prospectively used in the construction of wells. Currently, however, the capacity for microbes to act as mitigants of compounds used in the construction of gas wells worldwide is unknown.

Objectives

Identify trends in cement and casing materials used in CSG well construction over time in the Surat and Bowen basins, and its potential implications.

The project will achieve this objective through three broad components:

1) Acquire information on composition of casing material and cement slurries used in the construction and decommissioning of CSG wells in Queensland. There is a large number of well completion reports that are available. To progress this task, all reports will be downloaded and a process used to randomly, but representatively sample the data in these well completion reports. OGIA have advised that they adopted a similar process in assessing potential connectivity from conventional oil and gas wells in 2015. A random process for sampling the reports is important to ensure an unbiased selection of reports are examined and selected for the study. Further, the study will monitor the amount of additional information being gained from each well completion report examined to determine when sampling additional well completion reports does not yield any additional data on cement slurry or steel composition/selection. Regardless of this process, the study will include data from at least 100, and up to 200, well completion reports.

2) Understand, summarise and report the properties of materials used for cementing and casing the CSG wells. Analyse the cement and steel composition data with respect to evaluating the decision-making process that underpins their use, for example, the conditions under which specific additives or steels were used. Additionally, any changes in materials used by industry over differing time periods including the pros and cons of the use of these materials will be explored. Finally, the study will synthesize and summarise the findings in a report that is readily understandable by the community and other stakeholders.

3) Compile data on subsurface microbiology in Australia as it relates to those organisms with capacity to have deleterious impacts on well casings or cement.

Methods

This is primarily a desktop study aimed at capturing information on steels and cements from well completion reports and translating this information into more accessible forms.

Task 1: Project management, stakeholder engagement and communications
This task involves:

- Day to day management of the project and its deliverables.
- Liaise with the Office of Groundwater Impact Assessment, The University of Queensland, and other organisations and universities where relevant, to establish links and identify related research work and publicly available datasets in the area of well cementing.

- Initial engagement with industry operators, including government representatives and research organisations, to understand the current well cementing procedures and advancements of sustainable well integrity practices.
- Engagement with key parties (e.g., industry and industry subcontractors) to obtain data on materials or operational processes that result in particular material choices in casings or cements.
- Communicate with landholders and key non-industry stakeholders (e.g., Department of Resources, Mines Inspectorate, Gasfields Commission Queensland, OGIA and UQ Centre for Natural Gas) to learn their key concerns with respect to the impact of material used in CSG well construction.
- Communicate the outcomes of this project to its various stakeholders (i.e. community, regulators, government and industry).

Task 2: Data collection and collation

This task involves:

- Obtaining well completion reports
- Randomly subsampling these reports to obtain the following: date, cement slurry composition, steels used and other physico-chemical data (temperature, depth, water chemistry where available). This random sampling is used to ensure that an unbiased selection of reports is included in the study.
- This process will use an iterative approach to determine when sampling is no longer providing additional, meaningful data, regardless, at least 100 well completion reports will be examined to extract data on cements and steels.
- Collating retrieved data into tools for analyses in downstream tasks (2 & 3)

Task 3: Steels

This task involves:

- Summarising and analysing data on steels including changes through time (i.e., the Code of Practice changing)
- Linking operational needs from industry to particular steels.
- Understanding if there has been changes in industry practice related to steel choice.
- Summarising the pros and cons of particular steels.
- If enough variation in steels exist, this section will also include statistical analyses of these data to identify differences and similarities across the bores sampled in the study.

Task 4: Cements

This task involves:

- Summarising and analysing data on cements and cement additives including changes through time
- Linking operational needs from industry to particular cement slurry formulations.
- Understanding if there has been changes in industry practice related to cement composition choice.
- Statistical analyses of these data to identify differences and similarities across the bores sampled in the study.

Task 5: Microbes

This task involves:

- Summarising and analysing data on subsurface microbial communities associated with hydrocarbons in Australia.
- Summarising the ecological abundance and diversity of microbes capable of producing deleterious interactions with well infrastructure.
- Summarising the geochemical conditions that are required to underpin deleterious processes.
- Summarising the research on biofilms and their effects on steels and cements.

Task 6: Final report

This task involves:

- Integrating data from tasks 2, 3, 4 and 5 (along with feedback from Task 7) into a cohesive document. This will include:
    - Identifying trends and changes in industry practice over time through statistical analyses of the collated data set and interactions with industry.
    - Provide data that linking geological/hydrogeological conditions to industry selection of materials in their operations.
    - A statistical examination of the collated dataset to observe differences (if they occur) in practice across reservoirs in Queensland.
    - Information on subsurface microbiology in Queensland and its potential interactions with well and well infrastructure.
    - Creating plain-English summaries of the findings of these analyses for Task 7.

Task 7: Communications

Communications for this project will include:

- Two community meetings:
    - The first of these meetings will be conducted in April/May 2023 and will seek input through an in-person targeted community forum (to be held in Chinchilla or Roma) to discover and record community concerns regarding cements, steels and microbial aspects of well integrity. Data from this meeting will help frame the outcomes of the final report. This will be attended by the project lead and the subject matter experts in the areas of cements, steels and subsurface microbiology along with a social scientist.
    - The second of these meetings will, like the first, be a an in-person, targeted community forum (in Chinchilla or Roma) to present the main findings of the study with the aim of finding data related to concerns gained during Meeting 1. This will be attended by the project lead and the subject matter experts in the areas of cements, steels and subsurface microbiology along with a social scientist. This will be conducted in late 2023, and broad feedback from this session will be reported in Task 6 (final report).

- Production of an animation to summarise the main findings of this study.

3. Project Inputs

Resources and collaborations

Researcher	Time Commitment (project as a whole)	Principle area of expertise	Years of experience	Organisation
Mohinudeen Faiz	46 days	CSG Industry & Geology	>30 years	CSIRO
Mihaela Grigore	44 days	Material Science & Engineering	>25 years	CSIRO
David Midgley	5 days	Microbial ecology	>20 years	CSIRO
Nai Tran-Dinh	24 days	Microbiology	>20 years	CSIRO
Elaheh Arjomand	20 days	Mechanical engineering	>8 years	CSIRO
Jason Czapla	5 days	Drilling and Completions	>20 years	CSIRO
Emma Crooke	25 days	Chemical engineering	>15 years	CSIRO
Abbas Movassagh	29 days	Mechanical engineering	>15 years	CSIRO
Cameron Huddlestone-Holmes	5 days	Project management, CSG development, risk assessment	>20 years	CSIRO
CSIRO Environment - Social Scientist	30 days	Social science (gathering and analysing community perspectives)	>10 years	CSIRO

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:

- Well completion engineers from industry or well service companies
- Department of Resources, Petroleum and Gas Inspectorate representative
- Department of Environment and Science (DES) representative
- Gas Fields Commission Queensland representative

Budget Summary

Source of Cash Contributions	2022/23	2023/24	2024/25	2025/26	% of Contribution	Total
GISERA	$148,726	$151,829	$0	$0	80%	**$300,555**
- Federal Government	$102,249	$104,382	$0	$0	55%	$206,632
- APLNG	$37,182	$37,957	$0	$0	20%	$75,139
- QGC	$9,295	$9,489	$0	$0	5%	$18,785
Total Cash Contributions	**$148,726**	**$151,829**	**$0**	**$0**	**80%**	**$300,555**

Source of In-Kind Contribution	2022/23	2023/24	2024/25	2025/26	% of Contribution	Total
CSIRO	$37,182	$37,957	$0	$0	20%	$75,139
Total In-Kind Contribution	**$37,182**	**$37,957**	**$0**	**$0**	**20%**	**$75,139**

TOTAL PROJECT BUDGET	2022/23	2023/24	2024/25	2025/26	-	TOTAL
All contributions	**$185,908**	**$189,786**	**$0**	**$0**	-	**$375,694**
TOTAL PROJECT BUDGET	**$185,908**	**$189,786**	**$0**	**$0**	-	**$375,694**

4. Communications Plan

Stakeholder	**Objective**	**Channel** (e.g. meetings/media/factsheets)	**Timeframe** (Before, during at completion)
Regional community stakeholders / wider public including landholders and traditional owners	To communicate project objectives and key messages from the research	A fact sheet at commencement of the project which explains in plain English the objective of the project. Workshop in Roma or Chinchilla with regional community stakeholders, landowners and key non-industry stakeholders (e.g., Department of Resources, Mines Inspectorate, Gasfields Commission Queensland, OGIA and UQ Centre for Natural Gas) to explain the project objectives and to receive their feedback on their key concerns with respect to the impact of material used in CSG well construction. An animation that communicates the main findings of the study to be developed. Project progress reported on GISERA website to ensure transparency for all stakeholders including regional communities.	At commencement of project April/May 2023 December 2023 Ongoing
Gas Industry	Industry adopts methods for improving the accessibility of information on steels and cement slurries. Also, to provide context on the presence of sulfur-active microbes in the subsurface and the types and activities of acid-producing microbes.	Presentation of findings at joint Gas Industry/Government Knowledge Transfer Session	At project completion
Government	Advice provided to senior bureaucrats / ministers / policy makers	Presentation of findings at joint Gas Industry/Government Knowledge Transfer Session	At project completion

Stakeholder	**Objective**	**Channel** (e.g. meetings/media/factsheets)	**Timeframe** (Before, during at completion)
Regional community/wider public, government, scientific community and industry	To report on key findings	Public release of final report Plain English factsheet summarising the outcomes of the research. A second Workshop in Roma or Chinchilla with regional community stakeholders, landowners and key non-industry stakeholders (e.g., Department of Resources, Mines Inspectorate, Gasfields Commission Queensland, OGIA and UQ Centre for Natural Gas) to explain key findings of the study, framed by the key concerns collected during workshop 1. A range of approaches will be explored to present findings to the community, with close alignment with GISERA communication's activities. Preparation of article for GISERA newsletter and other media outlets as advised by GISERA's communication team	At project completion Nearing project end At project completion
Scientific Community	Provide scientific insight into the kinds of steels and cements (and cement additives) that are used by the CSG industry in Queensland and to provide information on situations were there may be microbial interactions with well infrastructure.	Peer-reviewed scientific publication. Dataset(s) available through CSIRO's data access portal.	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 communications products.

5. Project Impact Pathway

Activities	Outputs	Short term Outcomes	Long term outcomes	Impact
Tasks 1 through 6	Communications of the main findings of the study on the steels, cements (and cement additives) used in Queensland, along with operational drivers of material selection.	Improved community understanding of steels, cements, microbial interactions with well-infrastructure.	The project will highlight information industry has already made available in WCRs, but is largely inaccessible to non-technical audiences. This may inform regulators and policy makers about the value of making these data more accessible. This project will improve community's understanding of risk associated with well infrastructure. The project will improve community's understanding of microbes in the subsurface and how they may interact with well infrastructure if geochemical conditions are permissive.	This project primarily aims to create impact through: • Making data on the types of steels (and operational conditions where certain steels are selected) employed by industry more accessible for the community. • Making data on the types/composition of cement slurries (and operational conditions where certain cement slurries are selected) employed by industry more accessible for the community • Improving industry and community understanding of the interactions between geochemical conditions in the subsurface and microbes that live in these habitats, and further how these geochemical conditions and microbes may interact with well infrastructure.
	Information on potential microbial interactions with well-infrastructure and the geochemical underpinnings of these interactions.	Improved industry understanding of the geochemical underpinnings of microbial interactions with well infrastructure.		

6. Project Plan

Project Schedule

Task ID	Activities	Activity Leader	Scheduled Start	Scheduled Finish	Predecessor
Task 1	Project management, stakeholder engagement and communication management	Mohinudeen FAIZ	Duration of project		
Task 2	Data collection and collation	Emma CROOKE	1 February 2023	30 April 2023	
Task 3	Steels	Abbas MOVASSAGH	1 April 2023	30 June 2023	Task 2
Task 4	Cements	Mihaela GRIGORE	1 April 2023	31 July 2023	Task 2
Task 5	Microbial aspects of well integrity	Nai TRAN-DINH	1 February 2023	30 April 2023	-
Task 6	Final report compilation	Mohinudeen FAIZ	1 July 2023	31 December 2023	Tasks 2, 3, 4 & 5
Task 7	Communications	Mohinudeen FAIZ	1 April 2023	31 December 2023	Tasks 1, 2, 3, 4 & 5

Task description

Task 1: Stakeholder Engagement, Project Management and Communication Management

OVERALL TIMEFRAME: 1 February 2023 – 31 December 2023 (Full duration of project)

BACKGROUND: This project will require engagement with industry and industry subcontractors to obtain information around materials (cements and steel) and operational choices. Furthermore, communication with the UQ Centre for Natural Gas and various government regulatory agencies, at the inception of the project, are key component of this task. This task also includes time for the project leader to manage the project and undertake administrative actions associated with project progress. Further, communications of GISERA research are an important component of outreach and dissemination of findings to diverse audiences, time to facilitate these activities are also included here

TASK OBJECTIVES: Engage with industry, industry partners, universities and government agencies to obtain information for the project, manage project staff and deliverables, communicate project objectives, progress and findings to stakeholders through meetings, knowledge transfer session, factsheet and journal article, in collaboration with GISERA Communications officers.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: Communicate project objectives, progress and results to GISERA stakeholders according to standard GISERA project procedures which may include, but not limited to:

1) Obtain Ethics Committee approval for conducting workshops with community stakeholders
2) Complete milestone reports, undertake project team meetings
3) Engage with industry and industry subcontractors and record these interactions via the GISERA communications register.
4) Undertake Knowledge Transfer session(s) with Government/Gas Industry
5) Presentation of findings to Community members/groups
6) Preparation of article for GISERA newsletter and other media outlets e.g. The Conversation
7) Revision of project factsheet to include final results (a factsheet is developed at project commencement, and another will be done at completion)
8) Peer reviewed scientific manuscript ready for submission to relevant journal
9) Work with GISERA communications to organise Task 7.

Task 2: Data collection and collation

OVERALL TIMEFRAME: 1 February 2023 – 30 April 2023 (3 months)

BACKGROUND: Data on cements, their additives and steels used in well completions are held within well completion reports that are available online, from industry or from regulators.

TASK OBJECTIVES: This task will randomly subsample well completion reports from Queensland to obtain data on cement, cement additives and steels used in well construction. These data are required for Tasks 3 and 4.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

1) Data collated for cement and cement additives from a representative number of well-completion reports.

2) Data collated for steels from a representative number of well-completion reports.

3) These data are available on request.

Task 3: Steels

OVERALL TIMEFRAME: 1 April 2023 – 30 June 2023 (3 months)

BACKGROUND: The use of steel in well infrastructure is a key part of well integrity. Data on the types of steel used are not readily available in a non-technical form that is accessible for the community. Further, differences between types of steel and reasons for their selection are not commonly understood.

TASK OBJECTIVES: Analyse the types of steel, historic changes (if present) and reasoning for use of particular steels in well applications. Discuss the pros and cons of this steel and its various resistances and vulnerabilities.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

1) A summary of steels used by industry through time (through analyses of the data provided from Task 2).

2) A description and discussion of the types of steels used by industry, including information on their various resistances and vulnerabilities.

3) A commentary on industry choices and decision making when it comes to use of steels in well completions.

Task 4: Cements

OVERALL TIMEFRAME: 1 April 2023 – 30 July 2023 (4 months)

BACKGROUND: The use of cements in well infrastructure are a key part of well integrity. Data on the types of cements used, their additives and the purpose(s) of these additives are not commonly available for the community in a non-technical form that is accessible. Further, operational decisions by industry and industry subcontractors are not well understood outside industry.

TASK OBJECTIVES: Analyse data from the well completion report survey (Task 2). Collate information on changes in industry practice over time (if present), use of particular additives or cement types.

TASK OUTPUTS AND SPECIFIC DELIVERABLES: 1) A summary of cements and cement additives used by industry through time (through analyses of the data provided from Task 2).

2) A description and discussion of the types of cements (and additives) used by industry, including information on its various resistances and vulnerabilities.

3) A commentary on industry choices and decision making when it comes to particular formulations of cement in well completions.

Task 5: Microbial aspects of well integrity

OVERALL TIMEFRAME: 1 February 2023 – 30 April 2023 (3 months)

BACKGROUND: There are community concerns about well integrity being affected by microbial activity. In particular, the distribution, and function of bacteria that produce corrosive compounds (H2S or acids) are poorly understood in subsurface environments.

TASK OBJECTIVES: Review available literature on subsurface microbiology in association with hydrocarbons in onshore settings in Australia.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

A literature review of subsurface microbiology in Australia as it relates to microbes that may have deleterious effects on well integrity. This report will include all available published data on subsurface microbiology in Australia in association with hydrocarbon resources, specifically: the type of organisms in these environments, their function, constraints and ecology.

Task 6: Final report compilation

OVERALL TIMEFRAME: 1 July 2023 – 31 December 2023 (6 months)

BACKGROUND: Requires data from Tasks 1-5

TASK OBJECTIVES: Integrate data and analyses from Tasks 1-5 into a comprehensive report. Liaise with GISERA communications to explore opportunities (in Task 1) to communicate study highlights to various stakeholders.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

1) Preparation of a final report outlining the scope, methodology, scenarios, assumptions, data analyses, findings and any suggestions/options for future research; incorporate broad feedback from the community forum.

2) Following CSIRO ePublish review, the report will be submitted to the GISERA Director for final approval.

3) Liaise with GISERA Communications Team to complete (Task 7).

Task 7: Communications

OVERALL TIMEFRAME: 1 April 2023 – 31 December 2023 (9 months)

BACKGROUND: Requires data from Tasks 1-5

TASK OBJECTIVES: Organise two targeted community forums to communicate project objectives and understand stakeholder concerns, present results of the analyses, organise an animation to summarise the main findings of the study.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

1) With the GISERA Communications Team, organise and delivery of two targeted community forums to be held in Chinchilla or Roma with community members to be presented by the Project Leader with subject matter experts (cement and steel physico-chemistry and microbiology).

2) Liaise with GISERA Communications Team to organise an animation to communicate the main results of the study.

Project Gantt Chart

		2022/23						2023/24					
Task	**Task Description**	**Feb-23**	**Mar-23**	**Mar 23**	**Apr 23**	**May 23**	**Jun 23**	**Jul 23**	**Aug 23**	**Sep 23**	**Oct 23**	**Nov 23**	**Dec 23**
1	Project management, stakeholder engagement and communication management	■	■	■	■	■	■	■	■	■	■	■	■
2	Data collection and collation	■	■	■						■	■	■	■
3	Steels			■	■	■							
4	Cements			■	■	■	■						
5	Microbial aspects of well integrity	■	■	■	■								
6	Final report compilation						■	■	■	■	■	■	■
7	Communications				■	■							■

7. Budget Summary

Expenditure	2022/23	2023/24	2024/25	2025/26	Total
Labour	$178,908	$159,786	$0	$0	$338,694
Operating	$7,000	$15,000	$0	$0	$22,000
Subcontractors	$0	$15,000	$0	$0	$15,000
Total Expenditure	**$185,908**	**$189,786**	**$0**	**$0**	**$375,694**

Expenditure per task	2022/23	2023/24	2024/25	2025/26	Total
Task 1	$28,440	$23,012	$0	$0	$28,796
Task 2	$43,553	$0	$0	$0	$43,553
Task 3	$33,893	$0	$0	$0	$33,893
Task 4	$50,002	$24,539	$0	$0	$74,168
Task 5	$30,020	$0	$0	$0	$30,020
Task 6	$0	$67,884	$0	$0	$66,857
Task 7	$0	$74,351	$0	$0	$48,896
Total Expenditure	**$185,908**	**$189,786**	**$0**	**$0**	**$375,694**

Source of Cash Contributions	2022/23	2023/24	2024/25	2025/26	Total
Federal Govt (55%)	$102,249	$104,382	$0	$0	$206,632
APLNG (20%)	$37,182	$37,957	$0	$0	$75,139
QGC (5%)	$9,295	$9,489	$0	$0	$18,785
Total Cash Contributions	**$148,726**	**$151,829**	**$0**	**$0**	**$300,555**

In-Kind Contributions	2022/23	2023/24	2024/25	2025/26	Total
CSIRO (20%)	$37,182	$37,957	$0	$0	$75,139
Total In-Kind Contributions	**$37,182**	**$37,957**	**$0**	**$0**	**$75,139**

	Total funding over all years	Percentage of Total Budget
Federal Government investment	$206,632	55%
APLNG investment	$75,139	20%
QGC investment	$18,785	5%
CSIRO investment	$75,139	20%
Total Expenditure	**$375,694**	**100%**

Task	Milestone Number	Milestone Description	Funded by	Start Date	Delivery Date	Fiscal Year Completed	Payment $ (excluding CSIRO contribution)
Task 1	1.1	Project management, stakeholder engagement and communications	GISERA	Feb-23	Dec-23	2023/24	$41,162
Task 2	2.1	Data collection and collation	GISERA	Feb-23	Apr-23	2022/23	$34,842
Task 3	3.1	Steels	GISERA	Apr-23	Jun-23	2022/23	$27,114
Task 4	4.1	Cements	GISERA	Apr-23	Jul-23	2023/24	$59,633
Task 5	5.1	Microbial aspects of well integrity	GISERA	Feb-23	Apr-23	2022/23	$24,016
Task 6	6.1	Final report compilation	GISERA	Jul-23	Dec-23	2023/24	$54,307
Task 7	7.1	Communications	GISERA	Apr-23	Dec-23	2023/24	$59,481

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	

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