GISERA
Gas Industry Social and Environmental Research Alliance

Project Order

Proforma 2018

1. Short Project Title

Potential health impacts from CSG

Long Project Title	Identification and screening for potential human health effects of coal seam gas (CSG) activity in the southern Surat Basin, Queensland.
GISERA Project Number	H.2
Proposed Start Date	15 May 2018
Proposed End Date	30 June 2020
Project Leader	Dr Cameron Huddlestone-Holmes

2. GISERA Region

- ☒ **Queensland**
- ☐ New South Wales
- ☐ Northern Territory
- ☐ South Australia
- ☐ Western Australia
- ☐ Victoria

3. GISERA Research Program

- ☐ Water Research
- ☐ GHG Research
- ☐ Social & Economic Research
- ☐ Biodiversity Research
- ☐ Agricultural Land Management Research
- ☒ **Health Research**

4. Research Leader, Title and Organisation

Cameron Huddlestone-Holmes, Senior Research Scientist, CSIRO Energy, 40%

5. Background

This project will be the first study of the potential human health impacts of CSG activities to implement the health study framework developed in GISERA project H.1 and will provide an exemplar for future studies. A single comprehensive project on all of the potential human health impacts of CSG activities in Australia, covering the diversity of locations and component activities of the CSG industry would be unmanageable. The health study framework was designed with this in mind, and allows for the research to be broken in to projects that cover the different stages of the framework and for prioritisation of the research to specific locations and CSG activities. This project's scope will focus on a single study site in Queensland with specific research objectives that address issues that are a priority to the local community and other stakeholders. The project management approach will have some agility to respond to community needs and the findings of the research as it progresses.

Potential human health risks from CSG activities are consistently raised as an issue of concern to the community (OCSE 2014). In response to these concerns, GISERA conducted the project *H.1, Human Health effects of Coal Seam Gas Activity Study Design (**health study design project**)* The health study design project involved collaboration between CSIRO, the Queensland Alliance for Environmental Health Sciences, Sustainable Minerals Institute and Centre for Coal Seam Gas at the University of Queensland, Summit Toxicology LLP and Hunter Research Foundation Centre at the University of Newcastle. The project had four main tasks:

- Update the previously conducted literature reviews from the NSW Chief Scientist to provide a current picture of the state of knowledge and identification of gaps in the knowledge base related to potential contaminants and human health risks associated with CSG activities.
- Establish a community stakeholder group to contribute to understanding of the local site and an expert consultation group to guide study design and implementation. The community consultation occurred in NSW.
- Build an initial conceptual site model of the community and the CSG activities in this community based on community stakeholder, governmental, expert consultation group, and industry input. This conceptual site model provides an initial picture of the potential contaminants and exposure pathways. Evaluation of alternative health risk assessment approaches were undertaken in parallel with and were informed by the conceptual site model.
- Design a study to address the general and local knowledge gaps based on the conceptual site model and the community stakeholder perspectives. The study design could apply to unconventional gas activities in any region.

The literature review conducted as part of the health study design project highlighted that there is currently insufficient evidence to conclude that health impacts associated with CSG activities exist. Most available scientific knowledge relative to unconventional gas development relates to shale gas regions in the United States. This knowledge does not translate well to the Australian context where environmental conditions, geological characteristics of the resource, gas extraction methods and regulatory frameworks differ.

Stakeholder workshops conducted in Queensland and New South Wales identified concerns related to direct chemical and physical hazards, concerns related to social stressors and mental health effects, and benefits related to improved health outcomes as the main factors warranting investigation in a future health study. An expert workshop held in May 2017, involving local and international experts from government, academia and industry along with community-based health professionals discussed stakeholders, information needed for a health study, and potential health of the approaches. The workshop identified the importance of community involvement in a future health study and that trust, transparency and independence are critical criteria for the success of a study. The workshop found that the Health Impact Assessment (HIA) framework would be an effective and useful framework to evaluate health impacts load to CSG activities.

The health study design project was completed in March 2018 and provides a framework, which uses the core tenets of the HIA, that can be applied to conducting studies of the potential human health impacts of CSG activities (Keywood et al 2018). The framework outlines how a health study should be conducted so that it has high research quality and maintains legitimacy with stakeholders, including the public, regulators and industry. Largescale CSG development has been underway for a number of years in the Surat basin, Queensland. This provides an opportunity to implement the health study framework in an area where there has been a large amount of CSG activity.

CSIRO's GISERA has been granted funding by the Queensland Government to conduct a health study using the framework developed in the health study design project. The project will follow GISERA governance protocols that requires research to be conducted independently of the source of funding. This requirement does not preclude researchers from engaging with the Queensland Government for the provision of technical expertise and data.

The results of this research will assist government in their regulation of the industry by providing an evidence base on potential health impacts of CSG activities. The project will determine whether there are hazards with viable causal pathways that may result in impacts on human health. The research outputs will enable a classification of the likely risk to human health. If any hazards with viable causal pathways to human health impacts are found, the research results will allow the development of risk mitigation actions to reduce the potential for any human health impacts.

6. Project Description

This project will implement the study framework developed in GISERA project H.1 - Potential human health effects of coal seam gas and described in Keywood et al (2018) and outlined in the attached fact sheet "*Human health and CSG development: a framework to investigate possible health effects.*" The overarching goal of the framework is a health study that has high research quality and legitimacy with stakeholders.

The health study framework involves a series of stages (Figure 1):

1. A ***scoping*** and ***planning*** stage that defines the overall project structure and strategies for involving stakeholders, communicating findings, and meeting all ethics requirements. The aim of this phase is to establish processes and governance that will support the legitimacy and quality of the research. The research objectives and project team are established in this stage.
2. The ***identification*** stage establishes potential sources of chemical and physical hazards (chemicals in air, water and soil, plus noise and light) and other stressors, such as social stressors, and the pathways via which the community may be exposed to the hazards. This is done by developing a site specific conceptual model of hazard and risk identification. At the end of this stage a decision is made about whether a chemical or physical hazard poses a health risk and whether further screening and assessment is required.
3. The ***screening*** stage involves the collection of all available data (physical, chemical, social and health) from research organisations, industry and government agencies, and establishes the quality of these data. Gaps in data are identified and new data may be collected if required to understand key exposure and health factors for the study location.
4. The ***further assessment stage*** involves in-depth exposure and risk assessments, as well as health outcome assessments. This phase addresses any gaps for relevant chemical and physical stressors, while a health needs assessment approach would be used to further investigate and mitigate social stressors.
5. The final ***options*** stage integrates findings, draws conclusions, and provides options for future management, including identifying needs for ongoing monitoring.

The study will be conducted in a region (or regions) in Queensland with a significant level of CSG activity, and will focus on the first three stages of the framework (up to stage 3, screening, stage gate 2 in Figure 1). Developing a project plan that goes on to the fourth stage (further assessment phase) is not practical without having first conducted the identification and screening stages to determine the number and types of issues that may need further assessment. However, some example issues will be selected for stage 4 further assessment as part of the project to enable the health study framework to be demonstrated in its entirety. This will provide experience that will assist the planning of future health studies.

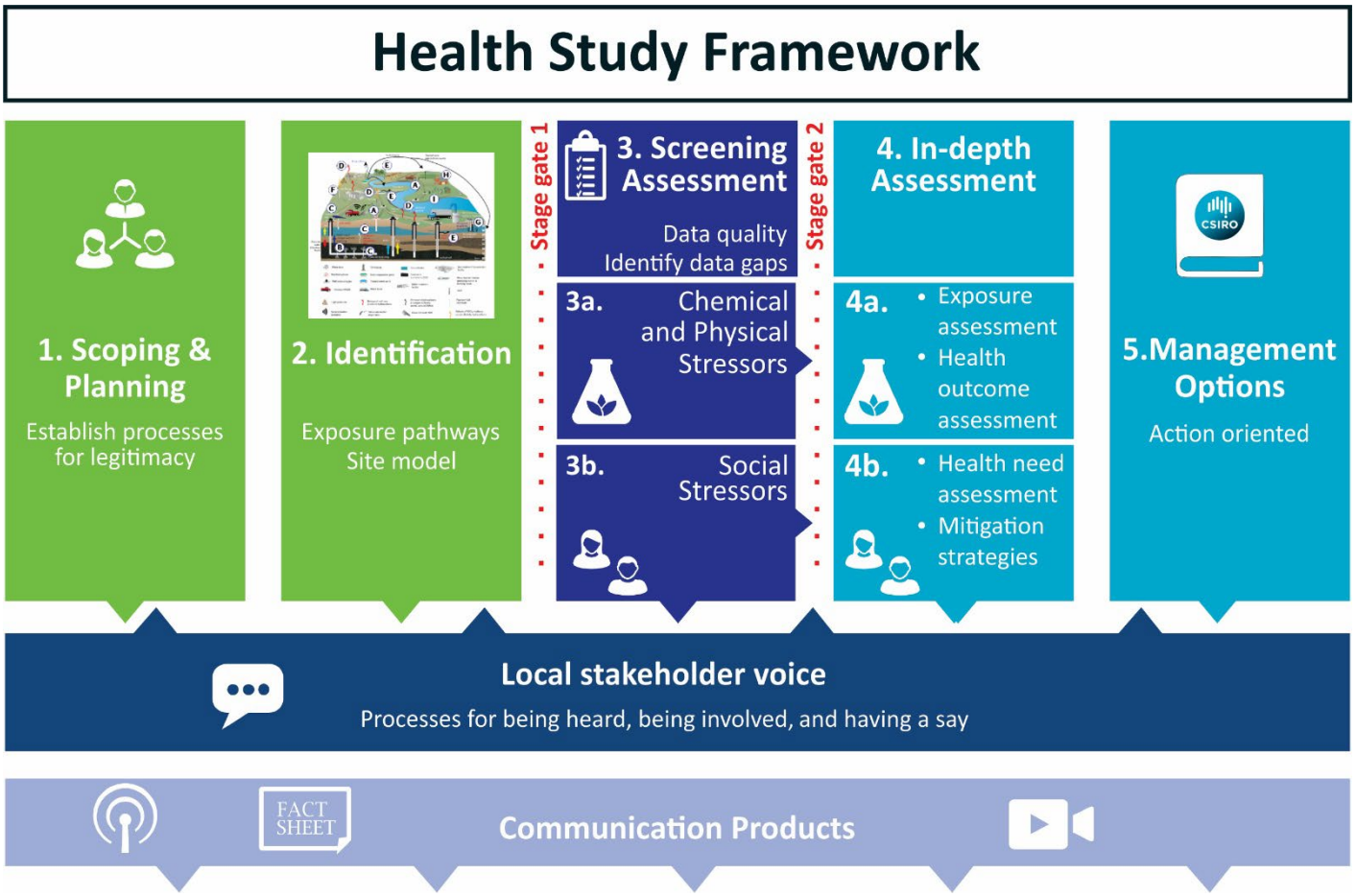

Figure 1: Overview of the health study framework.

Importance and necessity

Why is it important or necessary to do this project?

This project is important because of ongoing community concerns about the potential human health impacts of CSG activities. These concerns have been confirmed in the recently completed health study design project (Keywood et al 2018) used to design the framework to be applied in this proposal. The Queensland government has also acknowledged a need to address these issues, hence their support for a health study in Queensland.

An important outcome of the health study design project is the need for any health study to be seen to be legitimate by the community for it to be effective in addressing community concerns. The framework design includes governance and stakeholder engagement requirements that will build trust in the study's outcomes by addressing the community's needs for a transparency, independence, research quality and engagement.

How will you do it (method)?

This project will use the methodology outlined in the health study framework (Figure 1). The project needs some agility for two reasons. Firstly, stakeholder engagement is required to finalise site selection and to prioritise research objectives (potential issues that are important to the community). Secondly once the final site and research objectives are selected, there will be an initial period of discovery to determine the

nature and extent of CSG activities within the study site. This will dictate the amount of effort required to complete the identification stage, and the screening stage is dependent on the results of the identification stage.

To deal with this uncertainty, the project will be managed in stages, providing the project steering committee and the Queensland Regional Research Advisory Committee (Qld-RRAC) with control points at stage gates within the project. This is in addition to the normal management by exception approach used by GISERA that requires project leaders to seek approval for variations to the project from the GISERA Director or the Qld-RRAC depending on the materiality of the change. The project leader will submit a stage plan to the steering committee for their consideration at each stage gate. If the stage plan results in a substantial change to the project scope, deliverables, timeline or budget the steering committee will refer the stage plan to the Qld-RRAC. The stage gates are highlighted in the description of the tasks below.

The first stage of the project is establishing the governance for the project and confirming the scope, which involves two tasks.

Task 1

Establish project governance and ethics approval

The governance structure for this project, as recommended by the health study framework, addresses community stakeholders' views on ensuring a health study is independent and trustworthy. The governance structure is shown in Figure 2 and will need to be endorsed as part of the ethics approval for this project. Submission of the ethics approval will be a key component of this task.

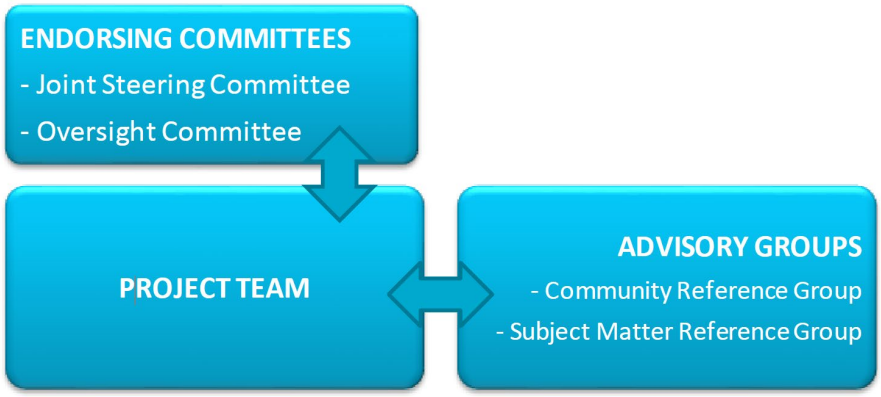

Figure 2: Project governance structure.

The **oversight committee** contributes to the legitimacy and quality of the research by safeguarding the integrity of the processes undertaken throughout the research. Adopting a neutral and balanced approach, it performs an oversight role to ensure independence of the project is maintained and to make sure the research is undertaken in a manner that meets ethical and regulatory guidelines. As the emphasis for the oversight committee is on governance, process and the overall integrity of the project members will consist of three individuals with backgrounds that are strong in these areas, such as judicial, corporate or human

research. The oversight committee will have a face to face meeting with the project team at its inauguration, and meet quarterly by teleconference for the remainder of the project.

The **joint steering committee** will be chaired by the Director of GISERA, with one representative from the Queensland government and two independent members from the Qld – RRAC. The steering committee's function is to provide endorsement of major project decisions, particularly at key stage gates. Their role is equivalent to that undertaken by the Director of GISERA for other projects, with major project changes or issues that the steering committee cannot resolve still being referred to the Qld – RRAC. A steering committee is necessary to remove any perceptions of a lack of independence, and to assist with the management by stages approach that the project will using. The joint steering committee will be accountable to the Qld – RRAC, which is structured to have a majority of members who are not affiliated with industry.

The **community reference group** will involve stakeholders who can be described as parties interested in and affected by potential health effects from CSG development at a local level. They include community members, local government, local and regional health service providers and other relevant stakeholders. Through the community reference group these stakeholders will bring valuable insights to the process, which are integral to the success of the research, including community values and perspectives and local knowledge. These aspects will contribute to scoping of the project through the formulating, identifying and prioritising of problems. Local knowledge will also assist data collection and help contextualise findings. A commitment to inclusion of community stakeholders and their involvement through the Community Reference Group also helps to build trust in the project's findings among all stakeholders and the wider public.

Technical reference groups will provide technical expertise and scientific knowledge. The involvement of experts from a range of fields will also contribute to the legitimacy and quality of the findings. Initially a single technical reference group will be established consisting of technical expertise in CSG activities and their management, exposure and risk assessment, and public health. As the project proceeds, multiple technical reference sub-groups may be formed on an ad hoc basis to provide advice on specific functional areas or subject matter. For example, a specific technical reference sub-group may exist in relation to water contaminants, or air monitoring, or public health expertise. In this way, industry and government experts can be incorporated into functionally based technical reference groups, with each group comprising a diversity of backgrounds and employer groups. This will help to balance the potential influence of industry or government which otherwise may operate as a distinct advisory entity. The technical reference groups will only be maintained while required, and may not persist throughout the life of the project to minimise administration.

The deliverables for Task 1 are ethics approval and terms of reference documents for organising committee, and reference groups. Members of these committees will be appointed/recruited once ethics approval by CSIRO ethics committee has been obtained. The steering committee will be appointed at project commencement.

A prioritisation or decision-making tool will also be developed as part of task 1 to use throughout the project. It is likely that the project will not be able to address all issues or hazards identified within the available resources. A transparent and consistent approach to prioritising research questions is required, and likely to be looked upon favourably by the CSIRO's ethics committee. The prioritisation/decision-making tool will have multiple criteria, and may include:

- Validity of concern or issue within the bounds of general knowledge (for example, carrying out a study of hydraulic fracturing health impacts in an area where hydraulic fracturing has not occurred would not be appropriate);
- Likelihood of being able to address an issue with available resources (this will mostly rely on the judgement of appropriate technical experts);
- Availability of data;
- Presence of confounding factors from other industrial processes (avoiding gas fired power stations, underground coal gasification, coal mining for example);
- How representative the concern or issue is of the industry more generally. Broadly representative issues have higher priority because resolving them will have greater impact compared with site specific issues. Issues or study locations covering multiple operators and activities that are ubiquitous to CSG activities will also be important for the same reason;
- Whether there is consensus amongst participants.

Once developed, the prioritisation/decision making tool will be presented to the community reference group and relevant technical reference groups for refinement, and then to the joint steering committee for their endorsement. This refinement and endorsement process will occur as part of Task 2.
Similarly, the communications plan will be further developed and then refined as part of Task 2.

Task 2

Site selection and defining specific research objectives

An important aspect of engaging with stakeholders in a transparent, participatory and independent process is to provide the community reference group to have input into the final scope of the project. The project needs to work within the resources available to it, and this will require a prioritization of the research objectives. A workshop will be held with the community reference group to provide an overview of the project and to get their input into the final site selection, communications plan, refinement of the prioritisation / decision making tool, and prioritisation of specific research objectives. The aim is to ensure that the research project addresses their highest priority concerns, within the context of the framework. The project team will present options to the community reference group for the site and research objectives based on their knowledge and potential health concerns raised in other GISERA and CSIRO research or identified by government agencies (Gasfields Commission, Queensland Health).

The project team will not be able to accurately determine the level of effort required to address all issues identified at the workshop while the workshop is in progress. Instead, a prioritised list will be prepared at the workshop and the project team will do some initial work, including consulting with the technical

reference group, to determine what can be achieved within the time and budget constraints of the project. The final scope will be presented back to the community reference group endorsement and the steering committee (who may refer it to the full Qld RRAC) for final approval.
A potential site for the study is an area bounded by the Warrego Highway to north, between Chinchilla and Miles, extending south towards Tara. This area contains a diverse range of CSG activities involving at least two operators, has a range of land uses with moderate population densities. The Queensland Government has also been conducting their "Project Stocktake" in this area, collating a range of data on a range of environmental parameters. This area has had limited hydraulic fracturing. Hydraulic fracturing has only been conducted on around 8% of CSG wells in Queensland, so it is arguably not a priority at this time. If the community reference group affirm that hydraulic fracturing is a priority, a second site may need to be included in the study.

Given the budget constraints of this project and the fact that this will be the first application of the health study framework, the project team believes that the priority research objectives should be on physical and chemical stressors. Resolving concerns around these stressors may also help to resolve associated social stressors. The site selection and research objectives must be endorsed by the community reference group.

The deliverables for this task are a report describing the final site selection and specific research objectives and the process that was used to select them, including the application of the prioritisation tool. This reporting is critical for maintaining transparency for the research process.

Stage Gate 0

This is the first stage gate of the project. The joint steering committee will be asked to review the deliverables of Tasks 1 and 2 and the project plan for the remainder of task 3, which will be updated to reflect the site selection and specific research objectives identified in tasks 2.

Task 3

Identification Stage

The identification stage will establish a comprehensive understanding of the study region. Critical information for the Identification stage for chemical and physical stressors includes:

- geographical location of CSG infrastructure and community resources/services (e.g. schools) and residential dwellings
- regional geology, pedology and hydrogeology, atmospheric composition and meteorology
- topography and environmental setting (e.g. natural barriers such as wooded areas)
- CSG industry practices, process/occupational health and safety controls in place and incidences of accidents and other non-compliance issues
- profile of the population (e.g. demographics, population density, age, occupation, landowners with CSG wells)
- health concerns of the local population

- baseline health indicators
- nature, source and exposure routes of chemical and physical stressors from CSG activities
- confounding factors in the region (e.g. alternative source of stressors resulting from, for example, non-CSG industries, the regional economy or drought; pre-existing stressors).

This site-specific information enables the identification of stressors relevant to the site and establishes which of these stressors are expected to have a complete human exposure pathway. If an exposure pathway is not complete, then there is no risk to human health (enHealth 2012).
To be complete, all of the following elements should be present (USEPA 1989):

- A source and release (emission)
- Movement or a transport medium away from the source (fate and transport)
- Contact with humans (exposure point)
- Exposure through ingestion, inhalation or dermal contact (chemical stressors), sight or hearing (physical stressors).

The key deliverable of this task (identification stage) is a conceptual site model (CSM) that attempts to encapsulate all the above information. Presentation of a CSM usually involves a graphical representation and/or a flow chart or table of complete exposure pathways, with accompanying explanatory text. Controls and other strategies already in place to mitigate and alleviate stressors will be accounted for in the CSM. The residual risk, after relevant controls and mitigations are considered, is risk of the exposure pathway that is assessed. While the term 'stressor' is generally associated with impacts that may adversely affect human health, the exposure pathways associated with health benefits for individuals and the community may also be included in the CSM. An interim project report will present and discuss the CSM.

Data on background environmental parameters (air and water quality for example) will be collated as part of the identification phase. Much of this data is available from other GISERA projects. In addition, a suite of non-target analysis on a range of samples from the study region may be conducted during the identification phase. Non-target analysis allows screening for all possible chemicals and the results can be compared to industry records and other, generally un-validated, sources of information regarding chemicals used in CSG activities in the study area. This type of analysis has not been done in Australia and would provide evidence that confirms (or otherwise) the chemicals that are actually used in industry.

A database will be developed with a standard format for all hazards and pathways developed to ensure a consistent approach is used by all researchers and that the information is communicated in a consistent manner. Options for producing an interactive web-based interface to this database will be considered.

Importantly, hazards for which there is no complete exposure pathway will also be documented along with the evidence that led to that conclusion. These results will be communicated to stakeholders, particularly in relation to issues identified as a priority.

The final activity for Task 3 will be developing a plan for the Screening Stage, based on the outcomes of the identification stage. A workshop will be held with the community reference group to communicate the outcomes of the identification stage and to present the plan for the screening stage. Describing the concept of 'viable pathways' will be an important aspect of this workshop. The community reference group will be asked to provide feedback on what communication materials would assist in explaining this concept to a broader audience.

Stage Gate 1

The joint steering committee will be asked to review the deliverables of Task 3 and the project plan for task 4. Screening in task 4 will only be conducted for hazards identified in the identification stage (task 3) as having viable pathways for impact on human health. Planning of the screening stage can only effectively be completed once the identification stage is complete. It is also possible that during the identification stage the project team may find that the scale of CSG activities and the number of hazards, or that the effort in determining whether viable pathways exist, is significantly greater or smaller than anticipated. The project leader will present these issues along with a proposal for managing them to the joint steering committee if and when they arise.

Task 4

Screening Stage

In this stage data relevant to the hazards with complete pathways identified in task 3 will be collated. Data may include emissions data, air quality data, water quality data, human health data, and toxicity of chemical stressors. These data may be sourced from industry or government repositories. This task will involve

- identifying sources of data;
- collating data;
- establish the quality of data sets;
- identification of gaps in data needed to understand key exposure and health factors for the study location;
- potentially collecting existing data (although this is not a priority).

A key component of the screening stage is assessing the quality of available data and thus determining if the data are suitable for use in the health study. Key to determining the quality of data is a technical understanding of the source and the data gathering processes. In addition, a systematic approach to assessing data quality is required and completeness and accuracy are the two of the most common attributes of data quality. Some important attributes of data quality to be considered for a health study are listed and described in Table 1. The health study framework does not set out how a study should conduct a data quality assessment and the exact approach will depend on the hazards identified in the screening stage.

The final report of the health study design project (Keywood et al 2018) documents potential data sources. These include other GISERA research projects, research outputs from other institutions, CSG companies own data, and regulatory authorities (state and commonwealth).

New data may be collected as part of the screening stage if the hazard identification stage identifies a hazard and potential exposure pathway but there are no data at all available. For example, if exposure to particles from diesel trucks is a potential hazard but there is no information on how may diesel trucks or particulate matter concentrations available then those data could be collected. The amount of new data that could be collected will be constrained by the available budget.

Attribute	Description	Example
Validity	Data element passes all edits for acceptability	Validity flags established and passed, e.g. sample volume greater than threshold value; span and calibration check within certain threshold values
Completeness	Missing data elements are minimal, i.e. below a threshold percentage	Hourly averages only calculated from minute data with > 80% coverage in the hour
Consistency	Data element is free from variation and contradiction based on the condition of another data element	PM2.5 should be less than or equal to PM10 Time stamps on different instruments should be consistent
Uniqueness	Data element is unique—there are no duplicate values	Sample identifiers only occur once (i.e. are not duplicated)
Representativeness	Degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition	Percentage of population or time period sampled above a threshold value that is statistically determined
Accuracy	Data elements represent true values	Methods can be traced back to a primary standard Standard methods are used
Precision	Data elements are reproducible	Duplicate measurements are carried out and agree to within 10%
Comparability	Data elements from one data set or method can be compared to another	Difference in concentration of a compound measured by two independent methods less than a threshold amount

Table 1: Some attributes to consider during assessment of data quality.

There will be two deliverables from task 4, the screening stage. The first will be a database of all available data collated for the hazards/stressors with viable pathways from the identification stage. The second is a report that provides an assessment of the available data and recommendations for data collection required to fill any gaps.

Task 5

Further assessment of selected hazards

This task will take some hazards through the full health study framework, including the further assessment stage (stage 4 of the health study framework in Figure 1). This task will run in parallel with tasks 3 and 4. The project team will identify two or three hazards at the start of the identification stage (task 3) for this process and develop a detailed plan for task 5. The joint steering committee will be asked to review and

approve this plan. This task will also likely require additional ethics approval as it will involve research on human subjects. Selection of the example hazards will follow the same prioritization outlined in task 2.

The methodology for this task will depend on the nature of the hazards selected for further assessment. For chemical or physical stressors, the methodology will follow the human health risk assessment methodology that involves an exposure assessment and a determination of whether the exposure exceed levels that are associated with negative health outcomes.

Task 6

Final reporting

The final task will compile final report that will summarise the whole project. The final report will reference the deliverables produced throughout the project, and will contain:

- an overview of the project and the methodology of each stage and task;
- the conceptual site model;
- hazards ruled out through the identification stage;
- hazards identified through the identification stage
- the data available to assess these hazards (from the screening stage);
- conclusions that can be drawn based on these data;
- recommendations for further assessment of hazards and exposure pathways that warrant investigation in follow up health studies;
- a summary of the end to end assessment of example hazards using the health study framework; and
- lessons learned to assist in the planning of future health studies.

What do you expect it will deliver?

This project will deliver

- An increased understanding of potential human health impacts that is underpinned by quality research, strong stakeholder engagement and clear communications. This will include:
    - Identification of hazards with no viable pathway for impacts on human health;
    - Identification of hazards with a viable pathway for impacts on human health and an assessment on the likely risk of those impacts based on existing datasets;
    - Identification of hazards with a viable pathway for impacts on human health for which there is insufficient existing data to assess the likely risks and recommendations on closing those gaps in data;
- Enduring dataset that can be used for future studies;

- An exemplar of how to conduct a human health impacts study for unconventional gas activities, with recommendations for future health studies.

How does the proposal relate to community or industry benefits?
This project will benefit the broader community, particularly those living in regions with CSG activities, by providing them with an evidence based independent assessment of the potential human health impacts of CSG activities. Any health impacts identified will be able to be addressed, reducing the impact on the community.

Industry and government will benefit by having an evidence base for the effectiveness of their operational and regulatory approaches in avoiding potential human health impacts from CSG activities and any requirement to improve. Industry and government may also benefit from an increased social licence to operate based on their willingness to participate in a transparent assessment of their activities and an assessment of the actual impacts of their activities.

7. Budget Summary

Expenditure	2017/18	2018/19	2019/20	Total
Labour	40,924	305,504	164,365	510,793
Operating	1,000	58,500	50,000	109,500
Subcontractors	10,000	130,000	90,000	230,000
Total Expenditure	**$51,924**	**$494,004**	**$304,365**	**$850,293**

Expenditure per Task	2017/18	2018/19	2019/20	Total
Task 1	28,282	27,545	0	55,827
Task 2	0	44,439	0	44,439
Task 3	23,642	290,619	0	314,261
Task 4	0	75,491	187,025	262,516
Task 5	0	55,910	46,382	102,292
Task 6	0	0	70,958	70,958
Total Expenditure	**$51,924**	**$494,004**	**$304,365**	**$850,293**

Source of Cash Contributions	2017/18	2018/19	2019/20	Total
QLD Government (58.80%)	$30,533.00	$290,490.45	$178,976.54	$500,000.00
Federal Government (21.56%)	$11,193.12	$106,491.18	$65,611.19	$183,295.49
GISERA Industry Partners (2%)	$1,037.96	$9,875.14	$6,084.26	$16,997.36
- APLNG (1%)	$518.98	$4,937.57	$3,042.13	$8,498.68
- QGC (1%)	$518.98	$4,937.57	$3,042.13	$8,498.68
Total Cash Contributions	**$42,764.09**	**$406,856.77**	**$250,670.34**	**$700,292.85**

In-Kind Contribution from Partners	2017/18	2018/19	2019/20	Total
CSIRO (17.64%)	$9,159.91	$87,147.25	$53,693.03	$150,000.19
Total In-Kind Contribution from Partners	**$9,159.91**	**$87,147.25**	**$53,693.03**	**$150,000.19**

	Total funding over all years	Percentage of Total Budget
QLD Government Investment	$500,000.00	58.80%
Federal Government Investment	$183, 295.49	21.56%
GISERA Investment	$16,997.36	2%
CSIRO Investment	$150,000.19	17.64%
Total Other Investment		
TOTAL	**$850,293.00**	**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	Governance and ethics	Government / GISERA	May 2018	Jul 2018	2018/19	$45,978.55
Task 2	2.1	Scoping	Government / GISERA	July 2018	Sept 2018	2018/19	$36,599.50
Task 3	3.1	Identification	Government / GISERA	June 2018	April 2019	2018/19	$258,822.25
Task 4	4.1	Screening	Government / GISERA	April 2019	Nov 2019	2019/20	$216,205.55
Task 5	5.1	Further Assessment	Government / GISERA	Nov 2018	Nov 2019	2019/20	$84,246.70
Task 6	6.1	Final Reporting	Government / GISERA	Dec 2019	Apr 2020	2019/20	$58,440.30

8. Other Researchers (include organisations)

Researcher	Time Commitment (project as a whole)	Principle area of expertise	Years of experience	Organisation
Cameron Huddlestone-Holmes	155	Project management, CSG development, risk assessment	19	CSIRO
Andrea Walton	47	Community wellbeing, resilience and social acceptance	8	CSIRO
Sharon Grant	80 days	Environmental monitoring, exposure and risk assessment	7	Queensland Alliance for Environmental Health Sciences (QAEHS)
Melita Keywood	30 days	Air quality, lead of health study design project	22	CSIRO
Anu Kumar	30 days	Water and Environmental Toxicology	23	CSIRO
SOF4/5	80 days	Environmental science	-	CSIRO

9. Subcontractors

Subcontractors (clause 9.5(a)(i))	**Subcontractor**	**Role**
	QAEHS (Sharon Grant)	Environmental monitoring, exposure and risk assessment

10. Project Objectives and Outputs

Objectives

1. To identify potential hazards to human health from CSG activities within at a defined study site in Queensland and to determine whether or not they have viable pathways to impact on human health.
2. To screen the available data that would allow for the presence of these pathways to be verified. The results will inform the scope of further health impact assessments.
3. To validate the health study framework method and provide recommendations for the conduct of future health studies on unconventional gas resource activities.

Outputs

1. A conceptual model for the study site in Queensland and the CSG activities within it, including the identification of hazards and a qualitative assessment of the risk of the hazard.
2. A database of all available data collated for the hazards/stressors with viable pathways from the identification stage and a report that provides an assessment of the available data and recommendations for data collection required to fill any gaps.
3. A report that summarises the overall project that includes an overview of the project and the methodology of each stage and task, a discussion of the conceptual site model and hazards, a discussion of the data available to assess these hazards (from the screening stage), conclusions that can be drawn based on these data, recommendations for further assessment of hazards and exposure pathways that warrant investigation in follow up health studies, and lessons learned to assist in the planning of future health studies.

11. GISERA Objectives Addressed

Carrying out of research and improving and extending knowledge of social and environmental impacts and opportunities of unconventional gas projects for the benefit of the Gas Industry, the relevant community and the broader public.

Informing government, regulators and policy-makers on key issues regarding policy and legislative framework for the Gas Industry.

12. Project Development

This project follows on from the health study design project that consulted widely with stakeholders from government, the CSG industry, the health sector and the broader community on the need for research on the potential health impacts of CSG activities. The health study design project provides an excellent base from which to develop a health study. The health study design project involved collaboration between CSIRO, the Queensland Alliance for Environmental Health Sciences, Sustainable Minerals Institute and Centre for Coal Seam Gas at the University of Queensland, Summit Toxicology LLP and the Hunter Research Foundation Centre at the University of Newcastle.

In preparing this project proposal, the project team have engaged with representatives from across the Queensland Government (including the Department of Natural Resources, Mining and Energy; Department of Health; Department of Environment and Science; Gasfields Compliance Unit; Gasfields Commission). We have also engaged with several CSG operators to discuss the project with them and to enquire about their willingness to provide information about their CSG activities. These initial engagements have been very positive and the industry has indicated a willingness to engage with the project, regardless of the outcomes.

13. Project Plan

13.1 Project Schedule

ID	Task Title	Task Leader	Scheduled Start	Scheduled Finish	Predecessor
Task 1	Governance and ethics	Cameron Huddlestone-Holmes	1 May 2018	27 July 2018	Project approval
Task 2	Scoping	Cameron Huddlestone-Holmes	30 July 2018	7 September 2018	Task 1
Task 3	Identification	Cameron Huddlestone-Holmes	3 June 2018	19 April 2019	Task 1 and Task 2
Task 4	Screening	Cameron Huddlestone-Holmes	22 April 2019	29 November 2019	Task 3
Task 5	Further assessment	Cameron Huddlestone-Holmes	4 November 2018	29 November 2019	Task 2
Task 6	Final reporting	Cameron Huddlestone-Holmes	2 December 2019	30 April 2020	Task 4

Task 1

TASK NAME: Governance and ethics

TASK LEADER: Cameron Huddlestone-Holmes

OVERALL TIMEFRAME: 3 months

BACKGROUND: The governance structure for this project, as recommended by the health study framework, addresses community stakeholders' views on ensuring a health study is independent and trustworthy. The governance structure is shown in Figure 2 and will be included as part of the ethics approval for this project. Submission of the ethics approval will be a key component of this task.

TASK OBJECTIVE: Obtaining ethics approval for the project. Establishment of the project governance structure, including oversight committee, joint steering committee, community reference group and technical reference group. Development of a communication plan and proposed prioritisation /decision making tool to take to the community reference group and relevant technical reference groups.

TASK OUTPUTS: Ethics approval, terms of reference for committees, and draft communication plan and prioritisation/decision making tool for discussion.

SPECIFIC DELIVERABLES: A brief report outlining the governance structure and draft prioritisation/decision making tool.

Task 2

TASK NAME: Scoping

TASK LEADER: Cameron Huddlestone-Holmes

OVERALL TIMEFRAME: 6 weeks

BACKGROUND: An important aspect of the approach engaging with stakeholders in a transparent, participatory and independent process is to provide the community reference group to have input into the final scope of the project. The project needs to work within the resources available to it, and this will require a prioritisation of the research objectives. A workshop will be held with the community reference group to provide an overview of the project and to get their input into the draft communication plan and prioritisation / decision making tool, final site selection and prioritisation of specific research objectives. The aim is to ensure that the research project addresses their highest priority concerns, within the context of the framework. The project team will present options to the community reference group for the site and research objectives based on their knowledge and potential health concerns raised in other GISERA and CSIRO research or identified by government agencies (Gasfields Commission, Queensland Health). The prioritisation/decision making tool developed in task 1 will be used to define priorities for the remainder of the project.

TASK OBJECTIVE: Delineate the study location and research objectives with endorsement from the community reference group. Refinement of communication plan and prioritisation / decision making tool from the community reference group and technical reference group(s). Development of detailed plan for the identification stage for approval by the joint steering committee.

TASK OUTPUTS: Defined study location and research objectives. Communication plan. Prioritisation / decision making tool. Detailed plan for the remainder of the identification stage (task 3).

SPECIFIC DELIVERABLES: A brief report describing the outcomes of the workshop, the site selected and specific research objectives identified and the reasons for their selection. Project plan for the identification stage.

Task 3
TASK NAME: Identification
TASK LEADER: Cameron Huddlestone-Holmes
OVERALL TIMEFRAME: 11 months
BACKGROUND: The identification stage will establish a comprehensive understanding of the study region. Critical information for the Identification stage for chemical and physical stressors includes locations of CSG infrastructure and community resources/services and residential dwellings; regional geology, pedology and hydrogeology, atmospheric composition and meteorology; topography and environmental setting; CSG industry practices, controls in place and incidences of accidents and other non-compliance issues; profile of the population; health concerns of the local population and baseline health indicators; nature, source and exposure routes of chemical and physical from CSG activities; and confounding factors in the region. This site-specific information enables the identification of stressors relevant to the site and establishes which of these stressors are expected to have a complete human exposure pathway.
This task will overlap with task 1 to provide initial information to develop options for site selection and specific research priorities to present at the workshop in task 2. The final component of task 3 is the development of a plan for the screening stage (task 4), based on the outcomes of the identification stage. A workshop will be held with the community reference group to communicate the outcomes of the identification stage and to present the plan for the screening stage.
TASK OBJECTIVE: To develop a conceptual site model for the study site, including the identification of hazards and the viability of their exposure pathways. Options for producing an interactive web-based interface to this database will be considered. Development of detailed plan for the screening stage for approval by the joint steering committee.
TASK OUTPUTS: CSM for the study site. Database of hazards and pathways. Detailed plan for the remainder of the screening stage (task 4).
SPECIFIC DELIVERABLES: A database that presents the CSM and all hazards and pathways in a standard format. A report discussing the CSM and any limitations will also be prepared. Project plan for the screening stage.

Task 4
TASK NAME: Screening
TASK LEADER: Cameron Huddlestone-Holmes
OVERALL TIMEFRAME: 7 months
BACKGROUND: In the screening stage data relevant to the hazards with complete pathways identified in task 3 will be collated. Data may include emissions data, air quality data, water quality data, human health data, and toxicity of chemical stressors. These data may be sourced from industry or government repositories. This task will involve identifying sources of data; collating data; establish the quality of data

sets; identification of gaps in data needed to understand key exposure and health factors for the study location; and potentially collecting existing data (although this is not a priority).
TASK OBJECTIVE: Conduct screening of available data for hazards identified in the identification stage (task 3).
TASK OUTPUTS: A database of all available data collated for the hazards/stressors with viable pathways from the identification stage. A report that provides an assessment of the available data and recommendations for data collection required to fill any gaps.
SPECIFIC DELIVERABLES: A database of all available data collated for the hazards/stressors with viable pathways from the identification stage. A report that provides an assessment of the available data and recommendations for data collection required to fill any gaps.

Task 5
TASK NAME: Further assessment
TASK LEADER: Cameron Huddlestone-Holmes
OVERALL TIMEFRAME: 13 months
BACKGROUND: As this is the first implementation of the health study framework developed, it is important to test the framework through to completion. While the majority of effort in this project will focus on the identification and screening stages of the framework, this task will take some hazards through the full health study framework, including the further assessment stage (stage 4 of the health study framework in Figure 1). This task will run in parallel with tasks 3 and 4. The project team will identify a two or three hazards at the start of the identification stage (task 3) for this process and develop a detailed plan for task 5. The joint steering committee will be asked to review and approve this plan. This task will also likely require additional ethics approval as it will involve research on human subjects. Selection of the example hazards will follow the same prioritization outlined in task 2.
TASK OBJECTIVE: To conduct further assessment on several hazards to allow for refinement of the health study framework.
TASK OUTPUTS: This will depend on the hazards identified for further assessment at the start of the task.
SPECIFIC DELIVERABLES: A plan for this task will be prepared and presented to the joint steering committee for approval within two months of the task commencing. A report of the further assessment task will be prepared at the completion of the task.

Task 6
TASK NAME: Final reporting
TASK LEADER: Cameron Huddlestone-Holmes
OVERALL TIMEFRAME: 4 months
BACKGROUND: This project will be the first comprehensive study of potential impacts on human health from CSG activities. It is important that there is a summary of the project overall prepared in a manner that is accessible to a wide audience. It will also be important to present the study's findings to the community reference group and other stakeholders. Identifying priorities for further research will also be important.
TASK OBJECTIVE: Development of a final report and other communications activities, including a workshop with the community reference group and a knowledge sharing session.

TASK OUTPUTS: Communications material to present the findings of the study to a wide audience.
SPECIFIC DELIVERABLES: A report that summarises the overall project that includes an overview of the project and the methodology of each stage and task, a discussion of the conceptual site model and hazards, a discussion of the data available to assess these hazards (from the screening stage), conclusions that can be drawn based on these data, recommendations for further assessment of hazards and exposure pathways that warrant investigation in follow up health studies, and lessons learned to assist in the planning of future health studies. A fact sheet on the project's results. A workshop with the community reference group. A knowledge transfer session with government and industry stakeholders.

14. Communications Plan

This project will place a strong emphasis on communications because of the high level of interest anticipated. Communication activities will address the needs of those stakeholders directly involved in the project such as the community reference and technical reference groups, relevant government departments, industry and the broader community.

The community reference group will be engaged through workshops and regular meetings and communications to gain their input into the project as well as presenting results back to them. The following workshops will be held as a minimum:

- A project scoping workshop as part of task 2.
- A project update workshop as part of task 3 to communicate the outcomes of the identification stage and to present the plan for the screening stage.
- A project update workshop as part of task 6 to communicate the outcomes of the screening stage and the project as a whole.

Workshops will be held with the technical reference group(s) as required to get their technical input in to the project. Planning for the technical reference groups and interaction with them will be conducted at each of the stage gates in the project.

Communication with relevant state and federal government departments will be maintained to ensure that they are aware of the outcomes of the research and possible policy implications. As part of the project scoping stage, the project team will develop a protocol for communicating any human health impacts that are identified through the project to relevant authorities and impacted individuals. This protocol will comply with clause 16.5 of the GISERA Alliance Agreement, which allows CSIRO to disclose project results for reasons of public health and safety.

For communication with the broader community, the project team will work with the GISERA communications staff to develop fact sheets, and potentially a website, about the project. The fact that GISERA is conducting a health study may raise concerns for some in the community who may interpret this project was initiated to address some known health impacts. This health study is unlikely to be able to

address all concerns about the health impacts of the industry, and will have to prioritise the available resources. An important component of communication about the project, particular to those not directly involved, will be around explaining the origin of the project, setting the right expectations for the health study as well as communicating aspects of risk. Communicating the fundamental principle of toxicology that the dose of a substance is important in determining whether that substance is harmful to humans will be important.

The deliverables outlined in section 13.1 (Project Schedule) include regular reporting of results of each task and the associated governance activities. These deliverables will allow all interested parties to track the progress of the project. Reporting on governance activities, including the decision making process at stage gates, is an important component of transparent governance of this project.

Communication of the final results of the project will be managed in accordance with GISERA's communication strategy. This may include presentations at community and industry meetings, conferences and publication of reports, scientific articles and factsheets.

15. Impact Evaluation (Social, Economic and Environmental Impacts)

The main area of impact for this project will be social in that it will address community concerns of the CSG industry in relation to human health and reduce any health impacts the industry may be having on the community. This may also lead to economic impacts by providing evidence for sustainable development of CSG resources, and environmental impact where changes to CSG activities have an environmental benefit as well as a health benefit compared with business as usual.

Measurable outcomes of this research that will lead to social impacts are likely to include:

- changes in community sentiment to the CSG industry;
- changes to the way government regulates CSG activities; and
- changes in the way the industry conducts CSG activities.

Changes to community sentiment may be measured through the longitudinal studies being conducted through GISERA in the Surat Basin.

If this project does find evidence of impacts on human health from CSG activities, then regulators and industry will have the information they need to address these impacts. Changes to government regulation and industry conduct may be measured by surveying government for changes in the regulatory framework (legislation and quasi-legislation) and surveying industry for changes in the way they operate.

16. 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 1.1)	**Party**		**Commercialisation Interest**	
	APLNG		N/A	
	QGC		N/A	
	CSIRO		N/A	

References

EnHealth (2012). Environmental Health Risk Assessment. Guidelines for assessing human helath risks from environmental hazards. http://www.eh.org.au/documents/item/916.

Keywood M, Grant S, Walton A, Aylward L, Rifkin W, Witt K, Kumar A and Williams M. (2018) Human Health Effects of Coal Seam Gas Activity – A Study Design Framework. Final report to the Gas Industry Social and Environmental Research Alliance (GISERA). January 2018. CSIRO, Canberra. https://gisera.csiro.au/wp-content/uploads/2018/03/Health-1-Final-Report.pdf.

OCSE (2014). Independent Review of Coal Seam Gas Activities in NSW Managing environmental and human health risks from CSG activities. Report from the NSW Government Office of the Cheif Scientist and Engineer. http://www.chiefscientist.nsw.gov.au/__data/assets/pdf_file/0006/56922/140930-Final-Managing-Environmental-and-Human-Health-Risks.pdf.

USEPA (1989) Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A). https://www.epa.gov/sites/production/files/2015-09/documents/rags_a.pdf.