

# Project Order

## Proforma 2016

### 1. Short Project Title

Human Health effects of Coal Seam Gas Activity Study Design

**Long Project Title** Human Health effects of Coal Seam Gas Activity: scrutinizing emission pathways for harmful exposure levels using novel risk assessment techniques

**GISERA Project Number** H.1

**Proposed Start Date** 1 February 2017

**Proposed End Date** 31 August 2017

**Project Leader** Melita Keywood

### 2. GISERA Region

Queensland  New South Wales  Northern Territory

### 3. GISERA Research Program

Water Research  GHG Research  Social & Economic Research

Biodiversity Research  Agricultural Land Management Research  Health

### 4. Research Leader, Title and Organisation

Melita Keywood, Principal Research Scientist, CSIRO Oceans and Atmosphere 30%

## 5. Background

The NSW Chief Scientist CSG Review included a report on managing environmental and human health risks from CSG activities (OCSE 2014). It identified potential risks to the environment (air, soil, water) by four major CSG activities

- drilling, well integrity and fracture stimulation;
- seam depressurisation;
- spills and leaks;
- produced water and solids.

Exposure pathways of risk to human health were identified as water, soil and air, and indirectly in food. The report suggested that exposure pathways can be understood through the modelling of water and air movement, or ecological webs, which requires knowledge of the local environment and potential contaminants.

While the report identified many risks and uncertainties around human health from emissions arising from CSG activities, the report concluded that the risks can be managed through regulation and monitoring. Subsequently, the report has been accused of leaving concerns about CSG and health unanswered.

Potential human health risks from CSG activities are consistently raised as an issue of concern to the community (OCS 2014). Directly measuring human health effects through epidemiological studies of such communities is difficult or perhaps impossible for several reasons. The CSG industry in NSW is relatively small. The small population exposed to activities means that epidemiological studies do not have sufficient statistical power to clearly distinguish disease states or health outcomes that may be caused or aggravated by exposures related to CSG activities from background occurrence of these conditions. Furthermore, some potential health effects of concern may not manifest over shorter time periods but rather emerge after longer periods (many years or decades) of exposure or latency. Thus, direct studies of health outcomes may not provide meaningful conclusions about the impacts of CSG activity on human health. Published peer-reviewed studies on this issue are limited (Vaneckova and Baylis 2014; Stearman et al., 2014; Navi et al., 2014; Werner et al., 2015). However, human health risk assessment techniques can provide qualitative, semi-quantitative, or quantitative estimates of potential human health risks. The level of quantitative evaluation depends on the type and degree of data that is available regarding the possible chemical exposures.

This work complements existing Surat Basin CSG site and community investigations:

- Air quality work and water quality research- data sets collected from these studies will underpin health investigations;
- Social survey- data sets and experience will be valuable for designing health survey questionnaires and community engagement.

## 6. Project Description

The research described here is **Phase 1** of a study to address the question: does CSG activity in the NSW region influence human health, and if so, how and to what degree?

**Phase 1** focuses on a review of the state of knowledge about health impacts of CSG activity and identification of gaps in the knowledge base and the design of a study to address these gaps. The study design produced in **Phase 1** will be used to develop proposals for the implementation of the study that would be carried out in **Phase 2**.

The study that would be carried out in **Phase 2** will be a follow up project to the work detailed here. **Phase 2** will generate information required to investigate the health impacts of CSG activities. **Phase 2** is not included in the work described in this document.

CSIRO will lead **Phase 1** and, working together with the Queensland Alliance for Environmental Health Sciences (QAEHS, UQ), will draw upon a pool of subject experts in environmental monitoring, exposure assessments, (eco)toxicology, epidemiology, human health risk assessments, risk communication and community engagement.

This project will begin to address the community interest in a more explicit evaluation of potential human health risks and impacts from CSG.

### **Importance and necessity**

This project is important because of community concern about the influence of CSG activity on health. Comprehensive CSG health studies have not been carried out in Australia, and the few studies reporting health impacts that have been undertaken (Werner et al., 2016), have been opportunistic and inconclusive and generally led to heightened community concern). This concern is a significant driver for opposition to CSG activity and thus a source of revenue loss for industry. In this project, we plan to involve community in the design of the study and to make all information open and transparent e.g. publish data sets, community presentations etc.

### **Methodology**

The methodology will involve two phases:

- **Phase 1**- This phase will consist of 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.
  - 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 will occur 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 will provide an initial picture of the potential contaminants and exposure pathways. Evaluation of alternative health risk assessment approaches will be undertaken in parallel with and be 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 NSW or Queensland.
- **Phase 2**- This phase would include the implementation of the study and is not part of the scope of this document.

## Phase 1

### Task 1

**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:**

The review will compile and critically assess literature, reports and other information sources since 2013 (or an earlier date as necessary) on the following:

1. Datasets (physical environment and human health) available for the study region;
2. Health studies carried out in other CSG regions;
3. Potential CSG-related emission sources in the study area, including fugitive emissions of CSG, CSG flaring and combustion, as well as other emission sources linked to CSG extraction processes but not directly linked to CSG such as diesel exhaust emissions;
4. Chemicals likely to be used during CSG extraction activities;
5. Behaviour of these chemicals in the environment i.e. how they are introduced, how they move through the environment, how they are removed, how populations are exposed (exposure routes);

6. Mechanisms of toxicity of the above chemicals to populations, communities, and ecosystems;
7. Exposure risks to pollutants from CSG extraction activities;
8. Life style factors such as cigarette smoking and diet that could contribute to adverse health outcomes;
9. Community perception to the risk and perceived risk.

The results of this review will be used to inform the conceptual site model (Task 3). Importantly the review will identify the scope of what should be included in Phase 2 by eliminating from the study design factors with no risk and highlighting knowledge gaps related to potential contaminants and human health risks.

## Task 2

### **Establish a community stakeholder group to contribute to understanding of the local site and an expert consultation group to guide study design and implementation:**

Questions regarding health concerns will be incorporated into surveys planned for distribution during November 2016 as part of the “Social baseline assessment of the Narrabri region of New South Wales in relation to CSG development”. Based on the outcome of these survey questions, a further engagement plan focused on a study of potential human health risks and impacts from CSG will be designed and implemented in March 2017. Parallel to this, a community stakeholder group will be established to contribute to the development of the conceptual site model (see Task 3).

An expert consultation group will be established early in Phase 1. It is envisaged that the group would include, but not be limited to, the following individuals and/or organisations:

1. Air quality science: CSIRO and QAEHS
2. Water quality science: CSIRO and QAEHS
3. Toxicology (human) and ecotoxicology (ecosystems): Lesa Aylward (UQ), Peter Sly (UQ, specialist in respiratory toxicology), Beate Escher (UFZ Leipzig/UQ, specialist in ecotoxicology)
4. Exposure and risk assessments: QAEHS, Leisa-Marie Toms (QUT)
5. Human health, mental health and epidemiology: Lesa Aylward (UQ), Peter Sly (UQ), Geoffrey Morgan and Bin Jalaludin (CRE Energy transitions, air pollution and health in Australia) Melissa Haswell (QUT), NSW Health (tbd)
6. Psychology, risk communication and community engagement: Andrea Walton (CSIRO), Kelly Fielding (UQ), GISERA
7. Statisticians (tbd)

The expert consultation group will meet face-to-face on at least one occasion as well as by video conferencing. A facilitator will be engaged to manage the face-to-face meeting. We will hold a 1-2 day meeting for community groups and work with a community survey consultant to undertake a community survey to determine issues of concern to the community regarding health. This could be carried out in NSW or Queensland. The recommendation of the expert consultation group and outcomes of the community survey will be summarized for inclusion in final report developed in Task 4.

### Task 3

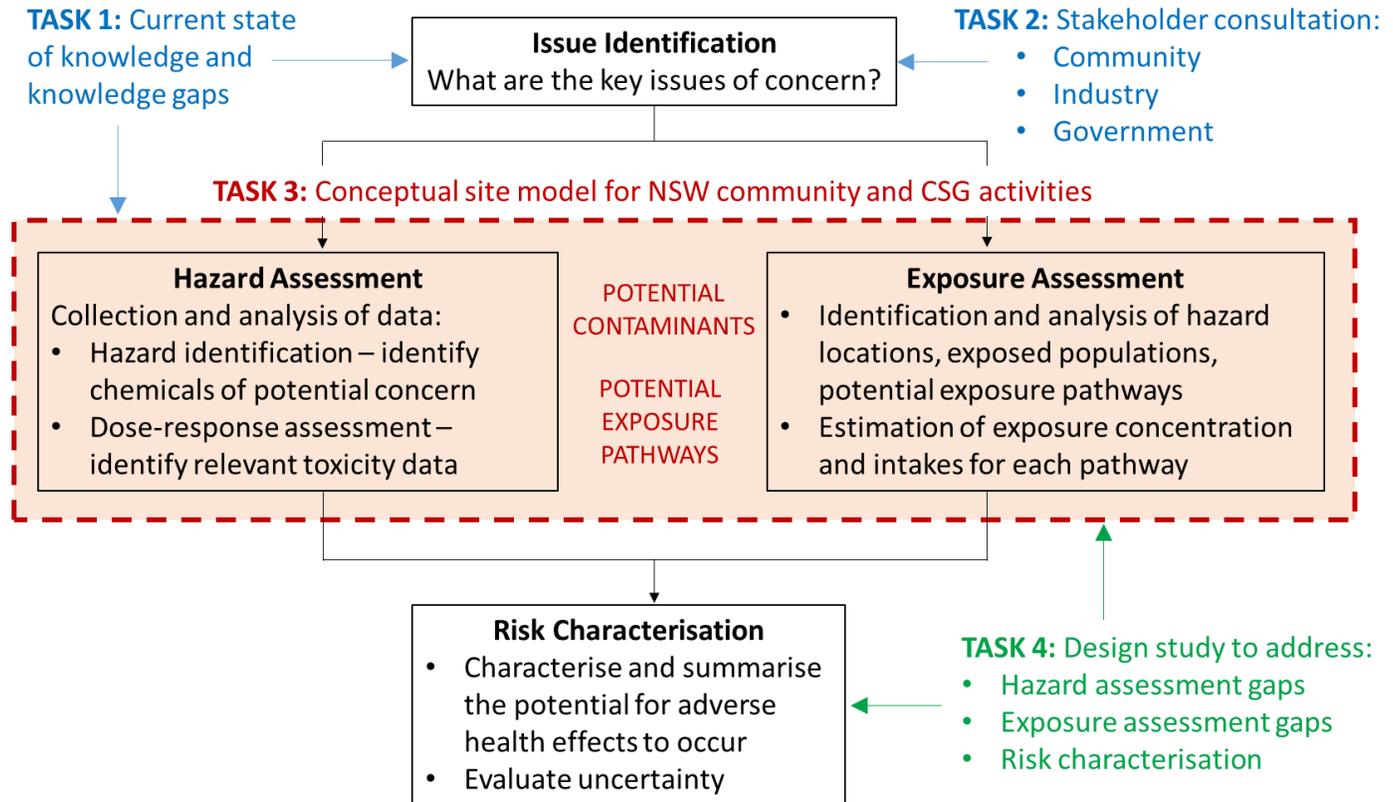
#### **Build an initial conceptual site model of the community and the CSG activities in this community based on community stakeholder, governmental, expert consultation group, and industry input:**

This conceptual site model will provide an initial picture of the potential contaminants and exposure pathways. Identification of exposure pathways will be informed by inspection of the CSG activities, discussion with industry and experts from the expert consultation group, consultation with government representatives, and consultation with the community stakeholder groups. In particular, the community stakeholder groups will be critical to identifying the possible exposure pathways that most concern residents and the basis of those concerns. Identification of potential contaminants will be particularly informed by the literature review and expert consultation group, as well as data or perspectives from the governmental and industry representatives.

Information on hazards of identified potential contaminants and the possible exposure pathways will be combined into a conceptual site model that allows a qualitative assessment of potential risks (Figure 1) and will guide the design of a more detailed study (see Task 4). Alternative risk assessment approaches, including consideration of the statistical representation of particular events/exposures occurring along the causal pathway will be evaluated by the expert consultation group and a recommended approach, appropriate to the study site(s) and the expected availability/quality of data, will be proposed. Additional relevant information including identification of lifestyle or social factors that may indicate vulnerable populations or modify response to possible chemical exposures will also be collected during this task.

We also expect that these consultations will identify aesthetic and environmental or ecological concerns as well -- these will be noted and incorporated as an arm of the conceptual model for further consideration in addressing community concerns and perception of acceptability of CSG activities, even when they do not directly relate to possible human health impacts.

The conceptual model will be developed for NSW but be applied in Queensland.



**Figure 1:** The environmental health risk assessment process (black boxes; adapted from enHealth , 2012) showing the information that Tasks 1-4 will deliver to enable the health risk assessment process (Phase 2)

#### Task 4

**Design a study to address the general and local knowledge gaps based on the conceptual site model and the community stakeholder perspectives:**

The outcomes of Tasks 1-3 will provide the basis for developing a study design to deliver an evaluation of potential human health risks and impacts of CSG activities. The intention is to provide an approach based on best practice that can be readily adapted to other CSG sites and communities at a regional or national level.

Based on the overall health risk assessment framework, the various parties (community stakeholders, expert consulting group, etc.) will identify the items of most concern for the specific site using information from the conceptual model and then design sampling methods and other data collection that will provide the necessary site-specific information to complete the assessment. This will be achieved through workshops and other consultation forums held throughout Phase 1. It is anticipated that an important component of the study design is the identification of potentially useful longitudinal monitoring components, both with respect to environmental media sampling and analysis and potentially with respect to markers of health outcomes. The result of Task 4 will be a report outlining the proposed best practice approach for the Phase 2 study design, as well as an implementation plan and associated costings.

Note that the report will include the details of how the quantitative health risk assessment will be carried out. However, a detailed health risk assessment itself will not be carried out as part of the work proposed here and will instead be carried out during Phase 2 which will be the subject of a future proposal.

The study design report will be peer reviewed.

### **Deliverables**

- A current picture of the state of knowledge and identification of gaps in the knowledge base related to potential contaminants and human health risks
- An initial conceptual model for the NSW community and CSG activities
- A fully costed, peer reviewed design for a health study that has industry and community endorsement

### **Community and industry benefits**

Community benefit- Community will receive information about chemicals emitted by CSG activities in the air, water and soil and a more explicit evaluation of potential human health risks and impacts from CSG

Industry benefit- Industry will demonstrate willingness to be transparent about environmental information (i.e. Social license to operate (Williams and Walton, 2013)).

## 7. Budget Summary

Expenditure	2016/17	2017/18	2018/19	Total
Labour	102,916	22,134	-	125,050
Operating	30,000	-	-	30,000
Subcontractors	91,508	25,966	-	117,474
<b>Total Expenditure</b>	<b>224,424</b>	<b>48,100</b>	<b>-</b>	<b>272,524</b>

Expenditure per Task	2016/17	2017/18	2018/19	Total
Task 1	28,193	-	-	28,193
Task 2	117,752	-	-	117,752
Task 3	41,279	-	-	41,279
Task 4	37,200	48,100	-	85,300
<b>Total Expenditure</b>	<b>224,424</b>	<b>48,100</b>	<b>-</b>	<b>272,524</b>

Source of Cash	2016/17	2017/18	2018/19	Total
<b>Contributions</b>				
GISERA Industry Partners (25%)	56,106	12,025	-	68,131
- Santos (12.5%)	28,053	6,012.50	-	34,065.50
- AGL (12.5%)	28,053	6,012.50	-	34,065.50
NSW Government (25%)	56,106	12,025	-	68,131
Federal Government (25%)	56,106	12,025	-	68,131
<b>Total Cash Contributions</b>	<b>168,318</b>	<b>36,075</b>	<b>-</b>	<b>204,393</b>



# GISERA

Gas Industry Social and  
Environmental Research Alliance

In-Kind Contribution from Partners	2016/17	2017/18	2018/19	Total
CSIRO (25%)	56,106	12,025	-	68,131
<b>Total In-Kind Contribution from Partners</b>	<b>56,106</b>	<b>12,025</b>	<b>-</b>	<b>68,131</b>

	Total funding over all years	Percentage of Total Budget
GISERA Investment	\$68,131	25%
NSW Government Investment	\$68,131	25%
Federal Government Investment	\$68,131	25%
CSIRO Investment	\$68,131	25%
Total Other Investment	-	
<b>TOTAL</b>	<b>\$272,524</b>	



Task	Milestone Number	Milestone Description	Funded by	Start Date	Delivery Date	Fiscal Year Completed	Payment \$ (excluding CSIRO contribution)
Task 1	1.1	Update the NSW Chief Scientist literature reviews to provide a current picture of the state of knowledge and identification of knowledge gaps regarding potential contaminants and human health risks. Includes project team labour and travel costs	GISERA	02-17	04-17	16/17	\$21,144
Task 2	2.1	Establish a community stakeholder group and an expert consultation group; includes project team labour and travel costs  Hold 3 day meeting of expert consultation group (or 2x 2 day meetings depending on schedules); includes engagement of a workshop facilitator, travel and accommodation costs for experts; project team labour  Hold a 1-2 day meeting of the community stakeholder group and undertake community survey, includes engagement of a community survey consultant; travel for project team and project team labour  Summarize recommendations from expert consultation group and the community survey; includes project team labour and travel costs	GISERA	02-17	06-17	16/17	\$18,000  \$34,318  \$18,000  \$18,000
Task 3	3.1	Build an initial conceptual site model of the community and the CSG activities in this community. Includes project team labour costs	GISERA	02-17	06-17	16/17	\$30,959

Task 4	4.1	Provide a study design to address the general and local knowledge gaps, an implementation plan and associated costings. Includes project team labour costs	GISERA	5-17	8-17	17/18	\$63,974
--------	-----	--	--------	------	------	-------	----------

## 8. Other Researchers (include organisations)

Researcher	Time Commitment (project as a whole)	Principle area of expertise	Years of experience	Organization
Andrea Walton	40 days	Community wellbeing, resilience and social acceptance	7	CSIRO
Anu Kumar	20 days	Water and Environmental Toxicology		CSIRO

## 9. Subcontractors

Subcontractors (clause 9.5(a)(i))	Subcontractor	Role
	Lesa Aylward, UQ	Human health risk assessments and toxicology
	Jochen Mueller, UQ	Environmental monitoring, exposure and risk assessment
	Sharon Grant, UQ	Environmental monitoring, exposure and risk assessment
	Leisa-Marie Toms, QUT	Epidemiology and exposure and risk assessment
	TBD	Workshop facilitator
	TBD	Community Survey Consultant

## 10. Project Objectives and Outputs

### Objectives

1. To provide the current state of knowledge regarding potential contaminants and health effects of CSG activities
2. To identify knowledge gaps regarding health effects of CSG activities
3. To design a study to address these knowledge gaps and answer the question “Does CSG activity in the NSW region influence human health, and if so, how and to what degree?”

## *Outputs*

1. Report summarising the current state of knowledge and knowledge gaps regarding potential contaminants and health effects of CSG activities.
2. Conceptual model for the NSW community and CSG activities, including the identification of hazards and a qualitative assessment of the risk of the hazard.
3. Peer reviewed report detailing the study design for a health study to investigate health effects of CSG Activity. Included in the report will be recommendations for the environmental and health data required to carry out the health study.

### 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

The NSW Chief Scientist identified that potential human health risks from CSG activities are consistently raised as an issue of concern to the community (OCS 2014), and while the NSW Chief Scientist identified many risks and uncertainties around human health from emissions arising from CSG activities, the NSW Chief Scientist has been accused of leaving concerns about CSG and health unanswered. Hence there is interest from NSW Government to address these concerns.

Concern over the potential health effects of CSG activities will be a national issue as CSG exploration occurs in other states around Australia. The value of this work is that the systematic review of information, identification of knowledge gaps and design of a study to address these health concerns could, with caveats, be tailored for any CSG exploration area. Thus effectively this study could develop a tool for the design of health studies to investigate the impact of CSG activities on health.

### Input for project development

- Discussion with Andrea Walton project leader of Social baseline assessment of the Narrabri region of New South Wales in relation to CSG Development- who shared insights regarding community consultation
- NSW Office of Chief Scientist- information in reports
- Discussions with GISERA management team who shared their insights from recent field trips to Narrabri and the discussions they have had with community, government, industry, local farmers, and indigenous stakeholders
- Discussion with Sarah Lawson project leader for Ambient Air Quality, Surat Basin, Queensland who shared insights from recent trips to Surat Basin around the communities concerns over health impacts.

## 13. Project Plan

The work will review the state of knowledge of the health impacts of CSG activities and will identify gaps in the knowledge base. Using this information and the expertise of an expert panel a study will be designed to address these gaps and answer the question “Does CSG activity in the NSW region influence human health, and if so, how and to what degree?”

### 13.1 Project Schedule

ID	Task Title	Task Leader	Scheduled Start	Scheduled Finish	Predecessor
<b>Task 1</b>	Update the NSW Chief Scientist literature reviews to provide a current picture of the state of knowledge and identification of knowledge gaps regarding potential contaminants and human health risks	Melita Keywood	1 February 2017	30 April 2017	None
<b>Task 2</b>	Establish a community stakeholder group and an expert consultation group  Hold 3 day meeting of Expert Working Group (or 2x 2 day meetings depending on schedules)  Hold a ½ day meeting for community groups and undertake community survey  Summarize recommendations from Expert Working Group	Andrea Walton (community)  Melita Keywood (expert group)	1 February 2017	30 June 2017	None
<b>Task 3</b>	Build an initial conceptual site model of the community and the CSG activities in this community	Melita Keywood	1 February 2017	30 June 2017	None
<b>Task 4</b>	Provide a study design to address the general and local knowledge gaps, an implementation plan and associated costings	Melita Keywood	1 May 2017	31 August 2017	1, 2 & 3

## Task 1

**TASK NAME:** Update CSG literature review

**TASK LEADER:** Melita Keywood

**OVERALL TIMEFRAME:** 3 months

**BACKGROUND:** The NSW Chief Scientist CSG Review included a report on managing environmental and human health risks from CSG activities. It identified potential risks to the environment (air, soil, water) by four major CSG activities:

- drilling, well integrity and fracture stimulation;
- seam depressurisation;
- spills and leaks;
- produced water and solids.

Exposure pathways of risk to human health were identified as water, soil and air, and indirectly in food. The report suggested that exposure pathways can be understood through the modelling of water and air movement, or ecological webs, which requires knowledge of the local environment and the potential contaminants.

While the report identified many risks and uncertainties around human health from emissions arising from CSG activities, the report concluded that the risks can be managed through regulation and monitoring. Subsequently, the report has been accused of leaving concerns about CSG and health unanswered. Potential human health risks from CSG activities are consistently raised as an issue of concern to the community (OCS 2014).

**TASK OBJECTIVE:** Update the NSW Chief Scientist literature reviews to provide a current picture of the state of knowledge and identification of knowledge gaps regarding potential contaminants and human health risks

**TASK OUTPUTS:** Report summarising the current state of knowledge and knowledge gaps

**SPECIFIC DELIVERABLES:** Report summarising the current state of knowledge and knowledge gaps.

## Task 2

**TASK NAME:** Establish a community stakeholder group and an expert consultation group

**TASK LEADER:** Andrea Walton (community) and Melita Keywood (expert group)

**OVERALL TIMEFRAME:** 5 months

**BACKGROUND:** Potential human health risks from CSG activities are consistently raised as an issue of concern to the community. It will be important for these concerns to be addressed by the study design hence consultation with the community is an important part of the project. Similarly an investigation of health effects will require capability from a range of disciplines, which lie outside of the core project team. Thus engaging a group of experts with diverse but relevant capabilities to provide input to the study design will ensure a robust design.

**TASK OBJECTIVE:** Establish a community stakeholder group to contribute to understanding of the local site and an expert consultation group to guide study design and implementation.

Hold a 3 day meeting of Expert Working Group (or 2x 2 day meetings depending on schedules).

Hold a 1-2 day meeting for community groups and undertake community survey.

Summarize recommendations from Expert Working Group and results of the community survey.

**TASK OUTPUTS:** Report summarising recommendations of the community survey.

**SPECIFIC DELIVERABLES:** Outcomes from the workshop will be incorporated into the Peer reviewed report detailing the study design.

### Task 3

#### **TASK NAME: Conceptual Model of potential contaminants and exposure pathways**

We also expect that these consultations will identify aesthetic and environmental or ecological concerns as well -- these will be noted and incorporated as an arm of the conceptual model for further consideration in addressing community concerns and perception of acceptability of CSG activities, even when they do not directly relate to possible human health impacts.

**TASK LEADER:** Melita Keywood

**OVERALL TIMEFRAME:** 5 months

**BACKGROUND:** This conceptual site model will provide an initial picture of the potential contaminants and exposure pathways. Identification of exposure pathways will be informed by inspection of the CSG activities, discussion with industry and expert consultation experts, consultation with government representatives, and consultation with the community stakeholder groups. In particular, the community stakeholder groups will be critical to identifying the possible exposure pathways that most concern residents and the basis of those concerns (for example, perceived odour). Identification of potential contaminants will be particularly informed by the literature review and expert consultation group, as well as data or perspectives from the governmental and industry representatives. Information on hazards of identified potential contaminants and the possible exposure pathways will be combined into a conceptual site model that allows a qualitative assessment of potential risks

and will guide the design of a more detailed study (see Task 4). Additional relevant information including identification of lifestyle or social factors that may indicate vulnerable populations or modify response to possible chemical exposures will also be collected during this task.

**TASK OBJECTIVE:** To build a conceptual model of potential contaminants and exposure pathways

**TASK OUTPUTS:** A conceptual model of potential contaminants and exposure pathways

**SPECIFIC DELIVERABLES:** The conceptual model will be incorporated into the Peer reviewed report detailing the study design.

#### Task 4

**TASK NAME:** Study design

**TASK LEADER:** Melita Keywood

**OVERALL TIMEFRAME:** 4 months

**BACKGROUND:** The outcomes of Tasks 1-3 will provide the basis for developing a study design to deliver an evaluation of potential human health risks and impacts of CSG activities. The intention is to provide an approach based on best practice that can be readily adapted to other CSG sites and communities at a regional or national level.

Based on the overall health risk assessment framework, the various parties (community stakeholders, expert consulting group, etc.) will identify the items of most concern for the specific site using information from the conceptual model and then design sampling methods and other data collection that will provide the necessary site-specific information to complete the assessment. This will be achieved through workshops and other consultation forums held throughout Phase 1. An important component of the study design will most likely be the identification of potentially useful longitudinal monitoring components, both with respect to environmental media sampling and analysis and potentially with respect to markers of health outcomes.

**TASK OBJECTIVE:** To produce a fully costed, peer reviewed design for a health study that has industry and community endorsement.

**TASK OUTPUTS:** Peer reviewed report detailing the study design.

## References

- EnHealth (2012). Environmental Health Risk Assessment. Guidelines for assessing human health risks from environmental hazards <http://www.eh.org.au/documents/item/916>.
- Navi, M., C. Skelly, et al. (2014). "Coal seam gas water : potential hazards and exposure pathways in Queensland" <http://eprints.qut.edu.au/72270>. International Journal of Environmental Health Research 25(2): 162-183.
- 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 Chief Scientist and Engineer. [http://www.chiefscientist.nsw.gov.au/\\_data/assets/pdf\\_file/0006/56922/140930-Final-Managing-Environmental-and-Human-Health-Risks.pdf](http://www.chiefscientist.nsw.gov.au/_data/assets/pdf_file/0006/56922/140930-Final-Managing-Environmental-and-Human-Health-Risks.pdf).
- Stearman, W., M. Taulis, et al. (2014). "Assessment of Geogenic Contaminants in Water Co-Produced with Coal Seam Gas Extraction in Queensland, Australia: Implications for Human Health Risk." Geosciences 4(3): 219.
- Vaneckova, P. and H. Bambrick (2014). Approaches to baseline studies of human health in relation to industries with potential environmental impact (Draft ed.). Report commissioned for the independent review of coal seam gas activities in NSW by the NSW Chief Scientist & Engineer: Centre for Health Research, University of Western Sydney. [http://www.chiefscientist.nsw.gov.au/\\_data/assets/pdf\\_file/0005/56894/140903\\_Human-CSG\\_completed\\_report.pdf](http://www.chiefscientist.nsw.gov.au/_data/assets/pdf_file/0005/56894/140903_Human-CSG_completed_report.pdf).
- Werner, A. K., S. Vink, et al. (2015). "Environmental health impacts of unconventional natural gas development: A review of the current strength of evidence." Science of the Total Environment 505: 1127-1141.
- Werner, A. K., K. Watt, et al. (2016). "All-age hospitalization rates in coal seam gas areas in Queensland, Australia, 1995-2011." Bmc Public Health 16.
- Williams, R. and A. Walton (2013). The Social Licence to Operate and Coal Seam Gas Development. A literature review report to the Gas Industry Social and Environmental Research Alliance (GISERA). March 2013. CSIRO, Canberra. <https://gisera.org.au/wp-content/uploads/2016/04/socioeco-proj-5-lit-review.pdf>.

Communication of the 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. In addition, communication with relevant state and federal government departments including Department of the Environment, NSW Health, NSW EPA and NSW Chief Scientist’s office will be maintained to ensure that they are aware of the outcomes of the research and possible policy implications.

The project will establish a Technical Reference Group (TRG) aimed at seeking peer-to-peer technical advice on contextual matters and to discuss research needs as well as outputs as the project progresses. The TRG will include the project leader and a group of different stakeholders as appropriate (noting NSW Chief Scientist Office have been approached and declined).

### 15. 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 confidential.			
Additional Commercialisation requirements (clause 13.1)	Not Applicable			
Distribution of Commercialisation Income (clause 13.4)	Not applicable			
Commercialisation Interest (clause 1.1)	<b>Party</b>		<b>Commercialisation Interest</b>	
	Santos		N/A	
	AGL		N/A	
	CSIRO		N/A	