



Australia's National  
Science Agency

**GISERA** | Gas Industry Social and Environmental Research Alliance

# Progress report

## Background Seismicity of Beetaloo Sub-basin and Seismic Hazard



# Progress against project milestones

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

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

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

- **Green:**

- Milestone fully met according to schedule.
- Project is expected to continue to deliver according to plan.
- Milestone payment is approved.

- **Amber:**

- Milestone largely met according to schedule.
- Project has experienced delays or difficulties that will be overcome by next milestone, enabling project to return to delivery according to plan by next milestone.
- Milestone payment is withheld.
- Milestone payment withheld for second of two successive amber lights; project review initiated and undertaken by GISERA Director.

- **Red:**

- Milestone not met according to schedule.
- Problems in meeting milestone are likely to impact subsequent project delivery, such that revisions to project timing, scope or budget must be considered.
- Milestone payment is withheld.
- Project review initiated by GISERA Director.

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

## Project schedule table

| TASK NUMBER | TASK DESCRIPTION                                | SCHEDULED START   | SCHEDULED FINISH | COMMENT                                       |
|-------------|---|-------------------|------------------|---|
| 1           | Identification of Potential Seismic Sources     | 01 July 2022      | 31 August 2022   | Completed                                     |
| 2           | Detection and Location of Background Seismicity | 01 September 2022 | 31 March 2024    |   |
| 3           | 1 <sup>st</sup> Interim Report                  | 01 September 2022 | 31 July 2023     | Completed                                     |
| 4           | Seismic Velocity Model Building                 | 01 July 2022      | 30 June 2023     | Completed                                     |
| 5           | 2 <sup>nd</sup> Interim Report                  | 01 May 2023       | 30 December 2023 | This task will be completed in February 2024. |
| 6           | 3D Seismic Wave Simulations                     | 01 August 2023    | 30 May 2024      |   |
| 7           | Final Report                                    | 01 March 2024     | 30 June 2024     |   |
| 8           | Communicate findings to stakeholders            |                   |                  |   |

## Project schedule report

### TASK 1: Identification of Potential Seismic Sources

#### BACKGROUND

The identification of existing seismic sources including man-made ones prior to the installation of the network is critical in discrimination in later stages.

#### TASK OBJECTIVES

Conduct desktop study to identify and map existing seismic sources from legacy data.

#### TASK OUTPUTS AND SPECIFIC DELIVERABLES

Time dependent 2D maps of seismic sources showing the variation historical seismicity. These maps will also indicate the information gap.

#### PROGRESS REPORT

This milestone is complete now.

-The shapefiles of the locations of the infrastructure road network, petroleum titles, mines (both historical and operating ones) have been obtained from the Northern Territory Geological Survey.

- Historical seismic event information and the current seismic monitoring station locations have been sourced from relevant earthquake catalogues.
- Reproducible python-based 2D mapping scripts have been developed to map this information.
- The mapped spatial information of road network, petroleum licenses and mine locations are assessed as potential source generators with respect to the station locations.

## **TASK 2: Detection and Location of Background Seismicity**

This task is due for completion in March 2024.

## **TASK 3: 1<sup>st</sup> Interim Report**

### **BACKGROUND**

The desktop study regarding the potential seismic sources aims to determine the location of existing sources and classify them. The workflow for detection and location of earthquakes will process the incoming data from Geoscience Australia's passive seismic network.

### **TASK OBJECTIVES**

Provide a general outline of the potential and historical seismic sources. Provide a preliminary assessment of the workflow's performance about the existing data.

### **TASK OUTPUTS AND SPECIFIC DELIVERABLES**

A detailed report showing the results of the desktop study of seismic sources through maps and digital datasets. Assessment workflow with respect to the already collected data.

### **PROGRESS REPORT**

The report has been finalised and will be publicly available early November 2023.

## **TASK 4: Seismic Velocity Model Building**

### **BACKGROUND**

Physics based ground motion modelling predicts time series for an expected earthquake (induced & natural) at any point, which is then used in the seismic hazard characterisation. The modelling requires high resolution 3D seismic velocity models as a primary input.

### **TASK OBJECTIVES**

Build a database of open-source seismic reflection/refraction interpretations and borehole data for extracting the general geometry of the geological layers. Conduct passive seismic imaging (P and S-wave velocities) with the current and legacy passive seismic datasets. Construct a hierarchical 3D seismic velocity model as in Guo et. al. (2022) by combining interpretations of reflection datasets, results from passive seismic imaging (new and Chen et al., 2022).

## **TASK OUTPUTS AND SPECIFIC DELIVERABLES**

A 3D seismic velocity model from surface to mid crust with P & S-wave velocities, attenuation, and realistic density values ready to be utilised in Physics Based Ground Motion Simulations (Task 6).

## **PROGRESS REPORT**

This task has been completed by incorporating the model of Chen et al. (2023) and 3D wave simulations have started.

## **TASK 5: 2<sup>nd</sup> Interim Report**

### **BACKGROUND**

The workflow for detection and location of earthquakes will process the incoming data from Geoscience Australia's passive seismic network. Meanwhile, the Seismic velocity model building activity will create a detailed 3D subsurface model that will be used in refining the earthquake locations, and physics based ground motion modelling.

### **TASK OBJECTIVES**

Provide an update of the detected baseline natural seismic activity in the Beetaloo Basin and completed 3D seismic velocity model.

## **TASK OUTPUTS AND SPECIFIC DELIVERABLES**

Examples of detected local seismic activity: location maps, magnitude information. 2D & 3D Visualisation of the seismic velocity model characterising the subsurface.

## **PROGRESS REPORT**




This task will be completed in February 2024.

## Variations to Project Order

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

The table below details variations to research Project Order.

Register of changes to Research Project Order

| DATE     | ISSUE  | ACTION   | AUTHORISATION   |
|----------|--|--|---|
| 27/10/22 | After completion of task 1, the current outputs are not large enough to form an interim report. The first-stage outputs of tasks 1, 2 and 4 will be documented and will then form a better picture of the projects progress. | Milestone 3 extended from October 2022 to February 2023.   |    |
| 26/06/22 | Due to the project leaders personal reasons, milestone 3 and 5 are delayed   | Milestone 3 extended from Feb 2023 to July 2023 and Milestone 5 extended from June 2023 to 16th August 2023. |   |
| 20/10/23 | The project team will need to process a new dataset from Geoscience Australia  | Milestone 5 extended from 15 August 2023 to 30 December 2023.  |  |

**As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.**

CSIRO. Unlocking a better future for everyone.

**Contact us**

1300 363 400  
+61 3 9545 2176  
[csiro.au/contact](http://csiro.au/contact)  
[csiro.au](http://csiro.au)

**For further information**

1300 363 400  
[gisera.csiro.au](http://gisera.csiro.au)

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