



Australia's National
Science Agency

GISERA | Gas Industry Social and Environmental Research Alliance

Progress report

Baseline Groundwater and Seismicity of northern Perth Basin



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	Water Level Monitoring – Preprocessing	March 2024	Apr 2024	Complete
2	Water Level Monitoring – Data Analysis	May 2025	Dec 2024	
3	Water Level Monitoring – 4D Mapping of WL Changes	Jan 2025	Dec 2025	
4	Interim Report 1	Jul 2024	Sept 2024	Complete
5	Seismicity-Preprocessing	April 2024	Apr 2024	Complete
6	Seismicity – Event Detection	May 2024	Sept 2024	Complete
7	Seismicity-Initial Event Location	Oct 2024	Mar 2025	
8	Local Velocity Model Integration	April 2025	Jan 2026	
9	Final Estimation of the Locations of Seismic Events and Catalogue Building	Jul 2025	Jan 2026	
10	Interim Report 2	Feb 2025	Mar 2025	
11	Final Report	Dec 2025	Jan 2026	
12	Communicate project objectives, progress and findings to stakeholders	Mar 24	Jan 2026	

Project schedule report

TASK 1: Water Level Monitoring – Preprocessing

BACKGROUND

A number of steps need to be followed to make the data ready for the next stage of the data analysis.

TASK OBJECTIVES

Removing instrument gain, homogenising the records, removing problematic recordings, and quality control the data.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

A homogenised seismic data collection, ready to be used in the next steps of the 4D seismic imaging.

PROGRESS REPORT

This milestone is complete.

Raw data imported into CSIRO's internal network, data homogenisation, spectral analysis and filtering complete. The data is in general ready for the next step of 4D monitoring.

TASK 2: Water Level Monitoring – Data Analysis

BACKGROUND

For the proposed groundwater depth monitoring with seismic waves, a correlational data processing step is needed to be applied to the homogenised dataset. This step includes auto and cross-correlation of seismic data for short term time windows e.g., hourly for the whole recording duration.

TASK OBJECTIVES

Estimation of hourly seismic velocity changes via auto and cross-correlation of the passive seismic data

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

Temporal velocity change curves for several station pairs and stations. These outputs will be later used for modelling and estimation of water levels.

PROGRESS REPORT

This task will be completed December 2024.

TASK 3: Water Level Monitoring – 4D Mapping of WL Changes

BACKGROUND

Changes in the seismic velocities measured via auto and cross-correlation of passive seismic data ultimately corresponds to the subsurface physical changes. So far, several studies showed that the largest contribution comes from ground water level fluctuations.

TASK OBJECTIVES

In this step, the team invert the previously computed velocity change curves to map the changes in the subsurface and also perform the physics-based modelling to constrain the depth of the changes from these results. Comparison of results between two regions (black and white rectangles).

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

- 4D seismic velocity images across both networks.
- Water level depths estimated for several months.

PROGRESS REPORT

This task will be completed in December 2025

TASK 4: Interim Report 1

BACKGROUND

This part uses the continuous seismic data from GSWA's WA Array and analyses the ground water level depths and seismic activity in northern Perth Basin.

TASK OBJECTIVES

Provide a general outline of the velocity changes and detected seismic events from the GSWA WA Array.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

A detailed report showing the results of the velocity analyses and detected seismic events using the GSWA WA Array seismic data.

PROGRESS REPORT

This milestone is complete.

A detailed report has been prepared and will be placed on the GISERA website. Using passive seismic data, we found that the seismic velocity is inversely correlated with the groundwater level from November 2022 to December 2023, which highlights the promise of using existing seismometers in Western Australia for monitoring groundwater levels. We also conducted machine-learning based analysis for earthquake detection and phase picking, and found several clusters of earthquakes.

TASK 5: Seismicity - Preprocessing

BACKGROUND

Seismic raw datasets often contain the signature of the measurement setup and also potential data glitches. Before proceeding to actual data processing, these effects need to be removed from the data and a QC analysis needs to be performed.

TASK OBJECTIVES

Application of instrument removal, filtering, and format conversion of the raw records.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

A homogenised seismic data library to be used in the coming steps.

PROGRESS REPORT

This milestone is complete.

As is the case in milestone 1, raw data has been imported into CSIRO's internal network, data homogenisation, spectral analysis and filtering complete. The data is in general ready for the next step of 4D monitoring.

TASK 6: Seismicity – Event Detection

BACKGROUND

It is a well-known fact that, with the deployment of dense seismic arrays, the seismic activity of a region can be mapped with an unprecedented resolution. Several locations that were considered seismically quiet can be found to be active after the operation of dense arrays.

TASK OBJECTIVES

Application of state-of-the-art seismic detection methods to map the seismic activity of the region.

TASK OUTPUTS AND SPECIFIC DELIVERABLES:

Time of the detected events, histogram plots (e.g., Activity vs time).

PROGRESS REPORT

This milestone is complete.


Seismicity-event detection has finished. We analysed the recorded seismic data using machine learning and found several clusters of earthquakes, for example, in the Southwest Seismic Zone (SWSZ), located about 150 km to the east of Perth in southwestern Australia and Region in the east and southeast of Wagin.

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
10/08/2024	Deley due to access to full data set only provided on 22 June 2024, sufficient time is required to review and interpret data.	Milestone 4 extended from July 2024 to September 2024.	

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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.