



Australia's National  
Science Agency

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

# Progress report

Examination of stygofauna ecosystems of the Beetaloo Sub-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	Knowledge discovery phase	01 Jul 22	30 Sept 22	Completed.
2	Planning and approvals for drilling of observation bores + drilling contractor procurement	1 Oct 22	30 Nov 23	RAC decision not to proceed with drilling of new bores. Milestone closed.
3	Field trip 1 – initial campaign	1 Oct 22	29 Feb 23	Completed.
4	Field trip 2 – wide-scale campaign	1 Apr 2023	29 Feb 24	Completed.
5	Construct observation bores for Stygofauna	1 Dec 23	30 June 24	RAC decision not to proceed with drilling of new bores. Milestone closed.
6	Field trip 3 – small, targeted campaign	1 May 24	31 Aug 24	Completed.
7	Analysis and reporting	01 Nov 22	30 Nov 24	Completed.
8	Communicate findings to stakeholders	Full duration of project		An addendum with bore logging results will be completed in July 2025.

## Project schedule report

### TASK 1: Knowledge discovery phase

#### BACKGROUND

While some work has now been carried out on Stygofauna in the Beetaloo Sub-basin, along with a significant amount of work into the ground water system, it will be important to ensure all the relevant information is captured prior to commencing work. It is important that this knowledge base, combined with the latest findings from current projects in the NT inform the proposed activities and that they will address the important issues associated with industry. The task involves a workshop with industry, stygofauna and groundwater experts to elicit what regulators and industry need to know to make decisions.

#### TASK OBJECTIVES

- 1) collate all relevant groundwater and stygofauna literature

- 2) carry out workshop that includes evaluation of the proposed scope of works, ensuring works address industry needs

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

A document addressing task objectives.

#### **PROGRESS REPORT**

A presentation on the project was given to a small group of stakeholders on 17 October 2023. This presentation set the scene for engaging with relevant stakeholders, and the opportunity to make further input to the direction of the project.

The knowledge gathering phase is complete. The project team has a very extensive dataset of the hydrochemistry and physical properties of bores relevant to this project. These data have been aggregated into a database (Excel spread sheet) and combined with all current knowledge on the distribution of stygofauna across the Beetaloo Sub-basin.

This database is the most comprehensive data set on the groundwater and subterranean biology of the Beetaloo biota and is now being used to inform future activities of the project.

#### **TASK 2: Planning and approvals for drilling of observation bores + drilling contractor procurement**

At the Northern Territory Research Advisory Committee meeting held on 30 November 2023, as part of a project decision point/stage gate, the RAC were presented with findings from the wide-scale field campaign (field trip 2), and two possible options for the completion of Implementation Phase (stage 2b). The RAC's preferred option will not involve the drilling of new observation bores so this milestone will no longer proceed.

#### **TASK 3: Field trip 1 (initial campaign)**

##### **BACKGROUND**

The previous stygofauna sampling program provided a snapshot of their presence in a small number of bores. However, whether the distribution is the result of specific environmental requirements, sampling artefacts, or some combination of the two is unclear. This task sets out a structured process to examine the knowledge gaps associated with stygofauna and their distribution.

The task involves an initial field campaign, carrying out a very detailed examination of up to 6 bores known to harbour stygofauna and those where stygofauna are known to be absent. Outputs will be used to inform a second field campaign (task 4). An internal workshop of technical experts will be engaged to provide commentary of the second field campaign (task 4).

##### **TASK OBJECTIVES**

- 1) Carry out an initial field campaign that targets bores known to harbour stygofauna as well as an equal number of bores where stygofauna have not previously been detected.

- 2) Sample for stygofauna, while simultaneously carrying out detailed analysis of the physical and chemical aspects of the subsurface and ground water.

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

- 1) Databases of stygofauna observations.
- 2) Database of relevant physical properties of the regions associated with the bores and groundwater chemistry.
- 3) Plan for second field campaign (task 4).

#### **PROGRESS REPORT**

Task 3 has been completed. Stygofauna could be retrieved from bores previously found to have stygofauna present (fig 1) and were not present in bores that did not possess stygofauna during previous sampling campaigns.

Water chemistry was determined for all bores sampled and sampling approaches, such as dissolved oxygen and salinity profiling throughout the bore were also trialled during the field trip. These data have also been used to update database details for Task 1.



**Fig 1. Shrimp collected as part of task 3**

Planning for field campaign 2 is well underway and will include intense water quality sampling, based on scoping methods from task 3, down hole photography, as two examples of additional approaches to be carried out in Task 4.

## TASK 4: Field trip 2 (wide-scale campaign)

### BACKGROUND

Field campaign 1 (Task 3) will provide detailed insight into properties of bores that support stygofauna. This field campaign seeks to broaden the number of sites (up to 20 bores, with a further 10 included as backups), thereby improving predictive capability to understand where stygofauna are found.

Connectivity of stygofaunal communities within the aquifers of the NT is unknown, yet key to understanding the ecology of stygofauna. This task will incorporate DNA-based biogeography analysis of *Parisia* sp. collected at different sites across the NT.

### TASK OBJECTIVES

- 1) Use outputs from field trip 1 (task 3) to inform this program.
- 2) Sample for stygofauna via a wide-scale sampling program.
- 3) Carry out analysis of data collected in the wide-scale field program.

### TASK OUTPUTS AND SPECIFIC DELIVERABLES:

- 1) Databases of stygofauna.
- 2) Database of relevant physical properties of the regions associated with the bores and groundwater chemistry.

### PROGRESS REPORT

Field trip 2 has been completed. Nineteen bores in the Beetaloo sub-basin were sampled between the 23rd and 30th of October 2022 for water quality and the presence of stygofauna. The complete sampling protocol carried out at each bore involved:

- Depth to water table, depth of bore, temperature and conductivity. A Solinst Sonic Water Level Meter was lowered down the bore and collected all data simultaneously.
- eDNA analysis. HydraSleeve discrete interval samplers (EON products incorporated) were used to collect samples from immediately below the surface and from the bottom of the bore, then combined to give a total volume 2 litres.
- Dissolved organic carbon (DOC), Total nitrogen (TN), Nitrogen oxides (NO<sub>x</sub>), ammonia (NH<sub>4</sub>) and Filterable reactive Phosphorous (FRP). Excess water from the discrete interval sampler was retained for water quality and nutrient analysis.
- Stygofauna. A 50µm-sized mesh, with either 100mm or 50mm diameter were lowered 3-4 times down each bore to collect animals. Collected samples were preserved in 70% ethanol.
- Down hole video camera: the camera was lowered down each bore to give real-time observations within the bores, including the presence of animals, the nature of casings and the presence of karstic features in open bores.
- Dissolved oxygen (DO). A DO logger was lowered into each bore, immediately below the surface and the bottom of the bore. The logger was allowed to stabilize for 5 minutes before lowering to the next depth.

The camera confirmed the presence of shrimp in six bores. In open bores, shrimp were not observed throughout the bore hole itself and were only observed when the borehole intersected Karstic features. When shrimp were observed in these features, they appeared more numerous than net sampling indicated. Although too small to accurately identify, camera footage indicated the presence of small juvenile crustaceans known as nauplii associated with these features.

When shrimp were observed in cased bores (either perforated or slotted), this was in association with the slots/perforations and not throughout the bore. It is probably that shrimp are moving into and out of the bore casing, but not resident in the casing.

In general, the numbers of shrimp caught by netting did not always reflect the numbers observed using video footage, demonstrating that net sampling alone will not give an accurate representation of abundance.

Analysis of the water quality and results from the eDNA analysis is ongoing and will be aggregated with the overall data set for the final report.

## **TASK 5: Construct observation bores for Stygofauna**

At the Northern Territory Research Advisory Committee meeting held on 30 November 2023, as part of a project decision point/stage gate, the RAC were presented with findings from the wide-scale field campaign (field trip 2), and two possible options for the completion of Implementation Phase (stage 2b). The RAC's preferred option will not involve the drilling of new observation bores so this milestone will no longer proceed.

## **TASK 6: Field trip 3 (small targeted campaign)**

### **BACKGROUND**

All stygofauna sampling carried out to date has been direct net capture or pumping water from bores. A key unknown is the extent to which bore samples represent ecosystems more broadly. This task involves carrying out a small, but targeted field campaign to measure ground water physical and chemical properties, and to collect samples for stygofauna analysis.

### **TASK OBJECTIVES**

To take samples from drilled observation bores.

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

Information collected on stygofauna distribution and sampling methods.

### **PROGRESS REPORT**

This milestone is complete.

Completed: Field trip 3. Sixteen bores in the Beetaloo sub-basin were sampled between the 28<sup>th</sup> April and 10<sup>th</sup> of May 2024 for water quality and the presence of stygofauna. The complete sampling protocol carried out at each bore involved:

- Depth to water table, depth of bore, temperature and conductivity. A Solinst Sonic Water Level Meter was lowered down the bore and collected all data simultaneously. For trip

three, all physico-chemical parameters (pH, EC, DO, ORP, turbidity and temperature) were also measured using a YSI EXO1 Multiparameter Sonde water quality meter.

Measurements were collected at one second intervals through the water column to develop bore profiles.

- eDNA analysis. HydraSleeve discreet interval samplers (EON products incorporated) were used to collect samples from immediately below the surface and from the bottom of the bore, then combined to give a total volume 2 litres.
- Dissolved organic carbon (DOC), Total nitrogen (TN), Nitrogen oxides (NO<sub>x</sub>), ammonia (NH<sub>4</sub>) and Filterable reactive Phosphorous (FRP). Excess water from the discreet interval sampler was retained for water quality and nutrient analysis.
- Stygofauna. A 50µm-sized mesh, with either 100mm or 50mm diameter were lowered 3-4 times down each bore to collect animals. Collected samples were preserved in 70% ethanol.
- Down hole video camera: the camera was lowered down each bore to give real-time observations within the bores, including the presence of animals, the nature of casings and the presence of karstic features in open bores.

Scheduled: Geophysical logging of cased bores to determine whether bores have intersected karstic features is scheduled for July 2025. The logging data will then be analysed by a geophysicist in CSIRO and released as part of task 8.

## **TASK 7: Project Reporting**

### **BACKGROUND**

Information from this project is to be made publicly available after completion of standard CSIRO publication and review processes.

### **TASK OBJECTIVES**

Prepare reports on all findings from the project.

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

- 1) Deliver summary following first field campaign.
- 2) Preparation of a final report outlining the scope, methodology, scenarios, assumptions, findings and any suggestions/options for future research.

### **PROGRESS REPORT**

This milestone is complete.

The final report has been peer reviewed, approved and released on the GISERA website – see [Examination of stygofauna ecosystems of the Beetaloo Sub-basin](#).

Note that a brief addendum will be prepared in July 2025, that summaries the results of the bore logging. This will be delivered as part of task 8.



## **TASK 8: Communicate project objectives, progress and findings to stakeholders**

### **BACKGROUND**

Communications of GISERA research are an important component of outreach and dissemination of findings to diverse audiences.

### **TASK OBJECTIVES**

Communicate project objectives, progress and findings to stakeholders through meetings, knowledge transfer session, factsheet and journal article, in collaboration with GISERA Communications officers.

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

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

- 1) Knowledge Transfer session with Government/Gas Industry
- 2) Presentation of findings to Community members/groups. This may include, but not necessarily be limited to, plain English documents (e.g., 'The Conversation' articles, fact sheets), material shared by CSIRO on relevant social media forums and a face-to-face forum.
- 3) Preparation of article for GISERA newsletter.
- 4) Peer reviewed scientific manuscript ready for submission to relevant journal

### **PROGRESS REPORT**

This milestone is progressing.



- The knowledge transfer session with government and industry stakeholders was conducted in December 2024.
- A digital story map has been developed and will be completed by end June 2025.
- An end of project fact sheet is being drafted.

## **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
22/06/23	The project team wish to proceed with the proposed wide-scale field campaign (task 4) and then conduct the stage gate/decision point presentation to the GISERA NT Research Advisory Committee in November 2023.	<ul style="list-style-type: none"> <li>• Milestone 2 delivery date extended from September 2023 to November 2023</li> <li>• Milestone 5 commencement date pushed back from July 2023 to December 2023 and delivery date extended from February 2024 to June 2024</li> <li>• State gate/decision point moved to November 2023.</li> </ul>	
30/11/23	The stage gate/decision point presentation resulted in a preferred option that excluded the drilling of new observation bores and extending the delivery date of the remaining milestones	<ul style="list-style-type: none"> <li>• Milestone 2 closed and all OPEX funds returned for future reallocation.</li> <li>• Milestone 5 closed and funds returned for future reallocation.</li> <li>• Milestone 6 commencement date pushed back from March 2024 to May 2024 and delivery date extended from May 2024 to August 2024.</li> <li>• Milestone 7 delivery date extended from July 2024 to November 2024</li> <li>• Milestone 8 delivery date extended from July 2024 to November 2024.</li> </ul>	

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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.