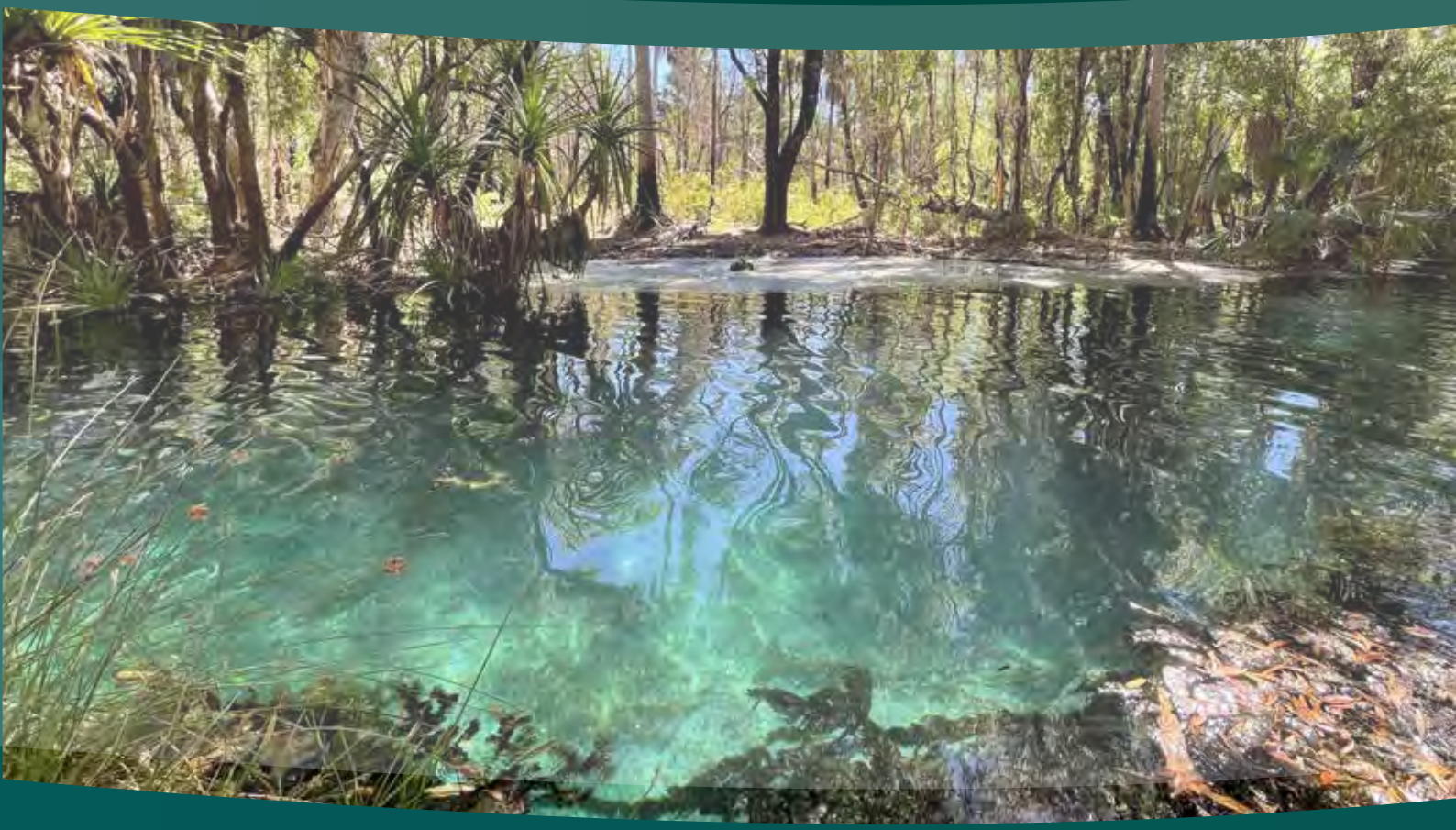
BEETALOO SREBA SCOPE OF WORKS

WATER QUALITY AND QUANTITY



Water Quality and Quantity studies for the Beetaloo Sub-basin Strategic Regional Environmental and Baseline Assessment

hydraulicfracturing.nt.gov.au

NORTHERN TERRITORY GOVERNMENT

Acronyms	Full form
AAPA	Aboriginal Areas Protection Authority
BRRG	Beetaloo Regional Reference Group
CLA	Cambrian Limestone Aquifer
DEPWS	Department of Environment Parks and Water Security
EC	Electrical conductivity
FEFLOW	Finite Element Subsurface Flow (software for simulating groundwater flow)
Final Report	The Final Report of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory
GBA	Geological and Bioregional Assessment Program (Commonwealth)
GDE	Groundwater dependent ecosystem
GIS	Geographic information system
GISERA	Gas Industry Social and Environmental Research Alliance
GW-SW	Groundwater – surface water
IEP	Independent Expert Panel
MIKESHE	an integrated hydrological modelling system
MIKE11	a hydrodynamic simulation model
NATA	National Association of Testing Authorities (Australia)
NLC	Northern Land Council
NT	Northern Territory
QA/QC	quality assurance and quality control
SREBA	Strategic Regional Environment and Baseline Assessment

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Cover Image: Bitter Springs, *Maddison Clonan*

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INTRODUCTION

In April 2018, the Northern Territory Government accepted all 135 recommendations of the Final Report of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory.

The Final Report and details about the Inquiry are available at: frackinginquiry.nt.gov.au/inquiry-reports/final-report

A number of the recommendations relate to undertaking a Strategic Regional Environmental and Baseline Assessment (SREBA). A SREBA is a set of studies to address knowledge gaps and establish appropriate baselines against which the potential impacts of proposed onshore gas activities may be assessed. SREBA baseline studies cover six broad domains: water quality and quantity; aquatic ecosystems; terrestrial ecosystems; greenhouse gases; environmental health; and social, cultural and economic studies.

The Northern Territory Government has subsequently developed a SREBA Framework, which describes the objectives and content of a SREBA, including governance and implementation arrangements, and has detailed guidance notes describing how baseline studies should be undertaken in each domain.

The Framework is available at: hydraulicfracturing.nt.gov.au/resources/sreba

The Northern Territory Government has also determined that a SREBA is required in the Beetaloo sub-Basin, which is the most prospective onshore gas basin in the Northern Territory. The Framework was written to be generally applicable to a SREBA undertaken in any region of the NT, and recognises that a more detailed, region-specific Scope of Works is required for each baseline study before it commences.

OBJECTIVES

The objective of a SREBA is to provide pre-development baseline data to inform resource management, regional and project level assessment, effective regulation and monitoring associated with the development of an onshore gas industry. The SREBA will provide baseline information to enable the assessment of regional and cumulative effects of onshore gas development across the region.

The objective of this Scope of Works is to define the requirements for individual projects that need to be undertaken to meet the requirements of the Final Report and the SREBA Framework.

Requirements of the final report

In relation to water quality and quantity, the Final Report states the SREBA should address the following objectives:

- Establish a baseline for groundwater and surface water hydrology over a period that is representative of the climatic cycles of the area and of the geological and geomorphological variation across the region.
- Characterise the hydrostratigraphy of the region sufficient to identify and characterise the aquifer systems and any interconnectivity that could be affected by the extraction of water for any onshore shale gas development.
- Quantify recharge rates (and where possible, recharge zones) and to establish the sustainable yield for potentially affected aquifer systems.
- Develop suitably calibrated groundwater-surface water flow models to quantify the connectivity between groundwater and surface water systems to predict the likely impacts of hydrological perturbation as the result of any potential onshore shale gas development and production.
- Establish a baseline for water quality, including measuring vertical profiles of water quality parameters through potentially affected aquifers and surface waters, noting that this will need to be done at a number of locations across a region to inform the lateral variations in quality. In semi-arid and arid regions, particular attention should be paid to the water quality of perennial to near-perennial water bodies that are likely to provide dry season refugia for aquatic biota and drinking water sources for wildlife.
- Define, using baseline water quality data, a staged operational regime (that is, response trigger levels) for remedial action in the event of upward trending key water quality indicators, such as dissolved methane and/or electrical conductivity.

Baseline information requirements

The Final Report also provides guidance around issues that must be addressed in designing a SREBA. For water, the key points are:

- The data collected for the regional assessment must be sufficient to inform the water supply, surface and groundwater interactions, and water quality components of the baseline assessment.
- The key groundwater parameters are recharge rate, recharge mechanism, sustainable yield and flow velocity.
- The regional assessment should identify locations where groundwater aquifers intersect with surface waters, and the extent and importance of any ecosystems dependent on, or influenced by, groundwater. In particular, the locations of groundwater-fed springs and dry season aquatic refugia must be identified and characterised, and the sensitivity of these assets to the extraction of groundwater should be assessed.
- For all relevant water resources and water dependent assets, a description of baseline conditions, and conceptual and numerical computer models of potential impacts of any onshore shale gas industry need to be developed. Numerical modelling should be undertaken to inform an understanding of potential impacts to a particular water resource. Such models should be constructed in accordance with the conceptual model, be calibrated and verified with appropriate baseline data, and should explore the probability of a range of possible outcomes based on uncertainty analysis.
- Adequate sampling of groundwater quality should take into account the following issues:
  - Aquifer systems can be vertically stratified, with overlying younger water flowing across the top of the aquifer profile and much older water residing below it. Therefore, measurements of groundwater age that do not specifically address this issue can yield estimates of recharge (and therefore sustainable yield) that are incorrect.
  - The concentrations of dissolved oxygen through the aquifer needs to be determined to inform the potential for degradation of fugitive methane in groundwater by aerobic or anaerobic microbial pathways, and the potential for the occurrence of stygofauna.
  - The baseline concentrations of major ions must be established through the aquifer profile to provide a reference condition against which leakage of flow back water from a well, or from a surface spill contaminating the groundwater, can be assessed.
- Addressing these issues will require the targeted installation of multilevel piezometer arrays screened across a number of discrete vertical intervals to permit sampling through time and conducted reliably and reproducibly at each horizon. In this context, the Panel has recommended that multilevel bores be used for performance monitoring of installed shale gas extraction wells (see Recommendation 7.11).

Independent Expert Panel

DEPWS appointed an Independent Expert Panel (IEP) to provide technical oversight of the development of the projects required to meet the objectives of the Water Quality and Quantity domain. The IEP included:

- Dr Craig Simmons – Director of the National Centre for Groundwater Research and Training at Flinders University
- Dr Peter Cook – Professor of Hydrogeology at Flinders University
- Dr Rick Evans – Principal Hydrogeologist at Jacobs

The plans for each individual project described in this Scope of Works were developed in consultation with the IEP and DEPWS.

Other relevant research programs

Geological and Bioregional Assessment Program

A range of studies have recently been undertaken in the Beetaloo sub-Basin as part of the Commonwealth Geological and Bioregional Assessment (GBA) Program .

Stage 1 of the program involved a rapid regional prioritisation which highlighted that the Beetaloo GBA region is one of the most prospective areas for shale gas (Hall *et al*., 2018).

Stage 2 is a synthesis of the existing knowledge about the geology and prospective shale gas resources, water resources, protective matters and risks to water and the environment from unconventional gas development (Huddlestone-Holmes, 2020). This study provides a comprehensive overview of the current hydrogeological conceptual understanding. Knowledge gaps are identified, and further work is recommended to address these data gaps as part of Stage 3 and additional future investigations.

Stage 3 involves an impact analysis and management assessments and will be completed in 2021.

Knowledge gaps identified in Stage 2 are consistent with the knowledge gaps identified by DEPWS and the IEP. The Scope of Works described below may be refined further as additional data and understanding becomes available from GBA studies that are still underway.

Gas Industry Social and Environmental Research Alliance

CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA) is a collaboration between CSIRO, Commonwealth and state governments and industry established to undertake publicly-reported independent research. GISERA is currently undertaking a number of research projects, some of which will provide valuable information to the Water Baseline Assessment in the Beetaloo Sub-basin. For example, recently GISERA has focussed studies in the NT on collecting baseline data on methane emission, groundwater chemistry, and stygofauna and microbial assemblages in groundwater-dependent ecosystems.

More information on their research is available at:
gisera.csiro.au/

[1] bioregionalassessments.gov.au/assessments/geological-and-bioregional-assessment-program/beetaloo-gba-region

BOUNDARIES

The Beetaloo Sub-basin is located in the northern half of the Northern Territory and extends from Mataranka in the north to Elliot in the south (see Figure 1).

The Beetaloo Sub-basin comprises a sequence of sandstones and mudstones known as the Roper Group and the deeper formations in this sequence are being explored for shale gas development. The Beetaloo Sub-basin is overlain by three geological basins which contain the Cambrian Limestone Aquifers (CLA):

- The Georgina Basin overlies the majority of the Beetaloo Sub-basin and the CLA comprises the Anthony Lagoon Beds and the Gum Ridge Formations. These aquifers form the major groundwater resources across the region and are connected to aquifers in the Daly Basin to the north.
- The Daly Basin is located to the north of the Georgina Basin and overlying the northern part of the Beetaloo Sub-basin. The Daly Basin is a deep multi-layered sedimentary basin in which the major aquifers are the Oolloo Dolostone and the Tindall Limestone. The key discharge features for these aquifers are the Roper River in the southern part of the Daly Basin and the Daly River in the northern half.
- The Wiso Basin overlies the western part of the Beetaloo Sub-basin and CLA equivalent is the Montejinni Limestone. Groundwater in the Montejinni Limestone flows into the Tindall Limestone in the Daly Basin and discharges to the Flora River.

Deeper aquifers are also present in the underlying basalt and Lower Proterozoic sandstone, however there is limited information available to characterise these aquifers.

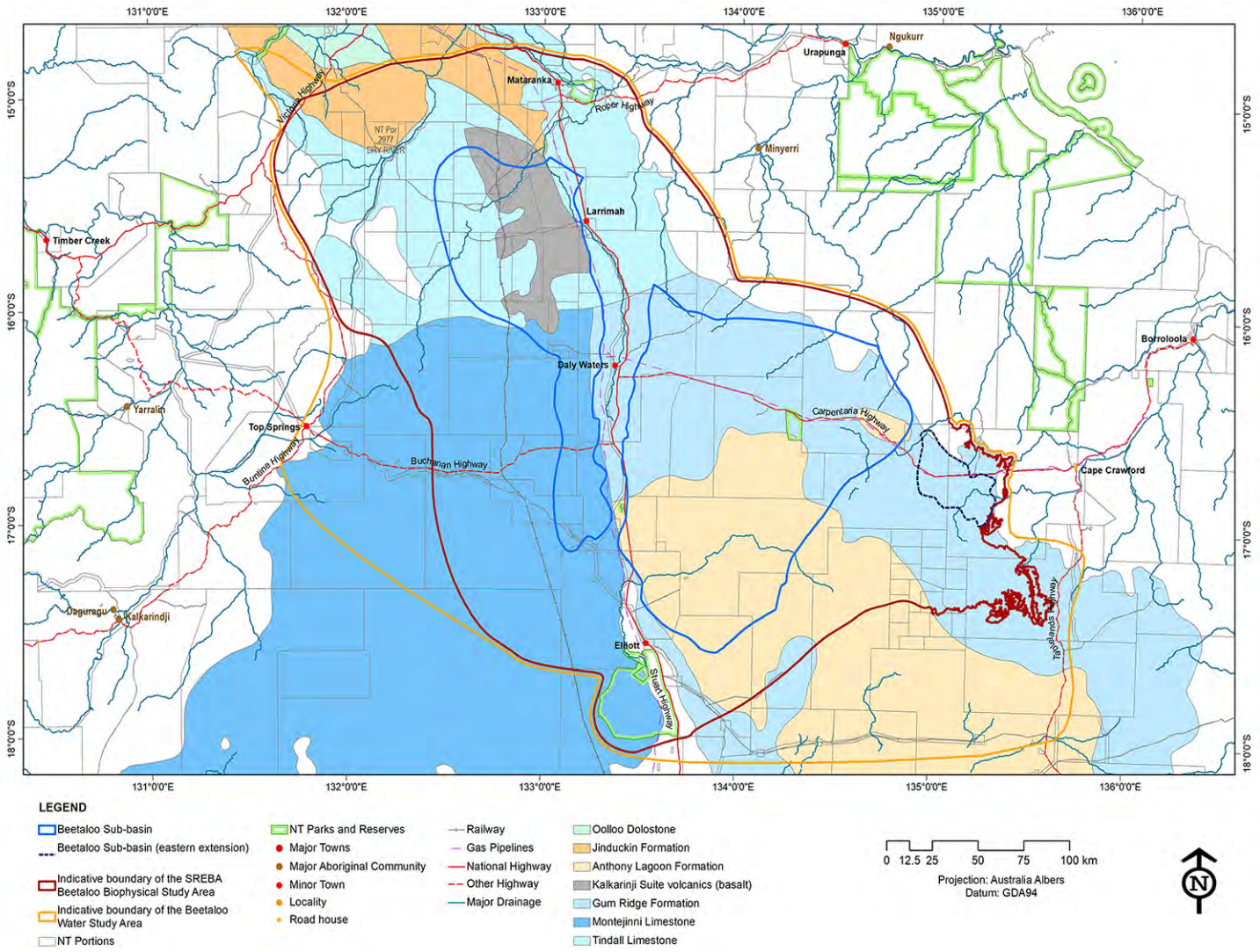

Figure 1: Beetaloo Sub-basin (Huddlestone-Holmes *et al*, 2020)

PROPOSED PROJECTS

Given the existing information available, the IEP and DEPWS recommended eight projects to address the current knowledge gaps within the region and meet the requirements described in the SREBA Framework:

1. Identification of knowledge gaps in the hydrogeological conceptual model of the regional aquifers overlying the Beetaloo Sub-basin.
2. Establishment of baseline of groundwater chemistry and groundwater levels.
3. Characterisation of intra-aquifer connectivity and aquifer parameters.
4. Characterisation of groundwater and surface water interactions and recharge and discharge processes for regional aquifers overlying the Beetaloo Sub-basin.
5. Update and re-calibrate the groundwater surface water model.
6. Surface water flow characterisation for catchments overlying the Beetaloo Sub-basin.
7. Cultural practices of water in the Beetaloo Sub-basin.
8. SREBA Water Baseline Report for groundwater flow, water quality and quantity.

Project plans for each of these projects is described in the following sections including the aim of the project, specific project objectives, scope of work, deliverables, suggested project timeline and potential risks.

TIMELINE

The timeframe for the individual projects is shown in Table 1, recognising that some relevant work has already been undertaken by DEPWS and GBA. The Water Baseline Report will be completed by December 2022, although update and calibration of the GW-SW model will continue into 2023 as it requires input from the results of all other projects.

	2020		2021				2022				2023	
	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr	Jul	Oct	Jan	Apr
Project 1	Identify data gaps											
Project 2	Baseline groundwater quality and levels											
Project 3		Intra-aquifer connectivity and aquifer parameters										
Project 4					Recharge and discharge processes and GW-SW interactions							
Project 5									Update and recalibrate GW-SW model			
Project 6				Surface water flow characterisation								
Project 7					Cultural water practices							
Project 8								Water baseline report				

PROJECT 1

Identification of knowledge gaps in the hydrogeological conceptual model of the regional aquifers overlying the Beetaloo Sub-basin

Aim

This project aims to collate and review the existing knowledge and data on the Beetaloo Sub-basin in relation to the hydrogeological conceptual understanding, interaction between groundwater and surface water systems (rivers, springs, wetlands) and groundwater quality. The aquifers to be considered should include the Cambrian Limestone Aquifers (CLA) and the underlying basalt and Lower Proterozoic sandstone. Information gaps should also be identified, and further work recommended and prioritised to address the identified knowledge gaps.

Objectives

The objectives of this project are to:

1. Review the following reports in relation to hydrogeological conceptual model of the Beetaloo Sub-basin, overlying aquifers and surface water catchments:
    a. Beetaloo Geological and Environmental Bioregional Assessment (Stage 2).
    b. Knapton (2020) Beetaloo Sub-basin Numerical Groundwater Model.
    c. Tickell & Bruwer (2019) Georgina Basin Groundwater Assessment – Daly Water to Tennant Creek.
    d. Bruwer & Tickell (2015) Daly Basin Groundwater Resource Assessment – North Mataranka to Daly Waters.
    e. Fulton & Knapton (2015) Beetaloo Basin Hydrogeological Assessment.
    f. Knapton (2009) Gulf Water Study – An integrated surface-groundwater model of the Roper River Catchment, Northern Territory.
    g. Tickell (2003) Water Resource Mapping Barkly Tablelands.
    h. Paul (2000) Helen Springs Groundwater Investigation.
    i. Yin Foo and Matthews, 2001 (Report17/2000D).
    j. Sturt Plateau Geophysics report by Knapton (32/2000D).
    k. Hydrogeological Mapping by Tickell (Daly Basin Aquifers).
2. Collate a spatial database with existing information on available hydrogeological layers and existing bores including:
    a. Bore location and use
    b. Hydrostratigraphic units
    c. Bore logs
    d. Gamma logs
    e. Bore construction details
    f. Water levels
    g. Groundwater chemistry
3. Identify knowledge gaps in the hydrogeological conceptual understanding to inform a suitable baseline for shale gas development.
4. Recommend additional monitoring assets or studies needed to address knowledge gaps.

Scope of work

The following activities will be undertaken to describe and document the hydrogeological conceptual model of the Beetaloo Sub-basin:

- Literature review focussed on information presented in the Beetaloo GBA Stage 2 report.
- Collate a spatial database with data on all existing bores in the region including available information on location, depth, bore logs, gamma logs, well construction, bore use, groundwater levels, yield and water quality. Existing hydrogeological spatial layers should also be included, for example formation extents and thicknesses, potentiometric surfaces etc.
- Critically evaluate current evidence to understand if major aquifers (i.e. Anthony Lagoon and Gum Ridge aquifers) behave as a single aquifer or if there are several isolated aquifers within these regional formations.
- Characterise the underlying basalt and Lower Proterozoic sandstone aquifer based on existing information.
- Identify knowledge gaps to determine a pre-development groundwater baseline assessment including but not limited to:
  - Suitable groundwater level and chemistry data to establish a baseline for CLA and underlying aquifers.
  - Characterisation of intra-aquifer connectivity and aquifer parameters.
  - Recharge and discharge processes for regional aquifers including groundwater surface water interactions.
- Recommend and prioritise further studies required to address the identified data gaps:
  - Provide a high level overview of studies to be completed in next 2-3 years to establish a baseline assessment.
  - Outline recommended studies to be completed 3-5 years.

Deliverables

- Concise report describing the identified knowledge gaps and recommendations and prioritisation for further studies.

Project timeframe

Milestone to be achieved	Anticipated completion date
Draft report, spatial database and maps	May 2021
Final report	July 2021

Project risks

Risk	Mitigation measure
Knowledge gaps identified during this study have not been previously identified.	Add to project plan when project completed.

PROJECT 2

Establishment of baseline of groundwater chemistry and groundwater levels

Aim

The aim of this project is to establish a regional baseline of groundwater chemistry and groundwater levels in the productive aquifers overlying the Beetaloo Sub-basin. The aquifers to be considered should include the Cambrian Limestone Aquifers (CLA) and the underlying basalt and Lower Proterozoic sandstone. Where there is no existing information, new monitoring assets will need to be installed and sampled.

Objectives

The objectives of this project are to:

1. Consider and document the key criteria of baseline assessment of groundwater quality and levels in consideration of:
    - Knowledge gaps identified in Project 1.
    - Samples collected biannually for 18 months, from up to 50 bores.
    - Location, aquifer monitored and spatial distribution of bores.
2. Document groundwater quality including:
    - Physio-chemical – temperature, electrical conductivity, pH, dissolved oxygen, redox potential, alkalinity, total dissolved solids, total suspended solids.
    - Ions – calcium, magnesium, sodium, potassium, ammonia, phosphate, total phosphorus, carbonate, bicarbonate, chloride, fluoride, bromide, sulfate, nitrite, nitrate, total nitrogen, silica.
    - Hydrocarbons – total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH), benzene, toluene, ethylbenzene and xylene (BTEX), dissolved methane, dissolved ethane, dissolved propane.
    - Metals – arsenic, boron, cadmium, chromium, copper, iron, lead, lithium, manganese, mercury, selenium, zinc.
    - Isotopes – Gross Alpha and Beta radiation, oxygen-18 and deuterium, 14C, 13C, tritium on selected bores.
    - Water level information (i.e. meters below ground level (mbgl) or meters relative to Australian Height Datum (mAHD).
    - Identification of the specific groundwater system that is represented by the data.
    - Information requirements of other studies such as characterisation of aquifer parameters, connectivity between aquifers, groundwater-surface water interaction, recharge and discharge areas as recommended in Project 1.
3. Identify and sample existing groundwater bores to determine which bores could be used to provide information on hydrostratigraphy, groundwater chemistry and levels. This will include the following:
    - Consideration of bore depth, aquifer monitored, existing groundwater quality and level information, bore use, current status of bore and equipment.
    - Understanding of how existing bores owned by government and gas companies could be used to address knowledge gaps and inform baseline assessment.
    - Identify bores for gamma logging that would address data gaps in hydrostratigraphy.
    - Develop a method to select existing bores that could be used to inform the baseline assessment in consideration of the bore location, aquifer monitored, construction details and age. It is expected that the baseline assessment could include up to 50 bores and existing bores are to be utilised where possible. New monitoring bores may need to be drilled and installed to address data gaps.
    - Activities required to collect information which may include site inspections, survey elevation, confirm bore depth, downhole camera to inspect casing condition, measure water levels.
    - Collect groundwater samples in accordance with the Methodology for the Sampling of Groundwater (nt.gov.au/__data/assets/pdf_file/0014/203360/aa7-024-methodology-for-the-sampling-of-groundwater-advisory-note.pdf) with appropriate quality assurance and quality control (QA/QC).
    - Groundwater samples should be analysed for the range of parameters outlined in the SREBA Framework including QA/QC samples.
    - Assess the information to determine the specific aquifers and resource that should be targeted for detailed study. The assessment should determine whether or how the baseline study can be used as analogy for other Cambrian aquifer systems that have not been studied in the same detail.

4. Identify and install new groundwater bores to address data gaps identified. New monitoring bores will target specific aquifers to inform the baseline assessment in relation to hydrostratigraphy, groundwater quality and levels and other studies. This includes:
    - Location, target aquifer, bore design (depth, diameter, casing material, screened interval).
    - Approval requirements for installation of new bores.
    - Supervision of drilling and construction of new groundwater bores.
    - Groundwater sampling and laboratory analysis of specified parameters.
    - Groundwater level monitoring.
    - Survey elevation.
5. Review and compile GBA, GISERA and industry monitoring data for incorporation into the baseline assessments. This should include an annual workshop with key contacts from industry and government to discuss results work programs that have been completed or are about to commence in the Beetaloo Sub-basin area.
6. Document baseline of groundwater chemistry and groundwater levels including:
    - Identify bores included in the assessment including location, construction details, equipment and condition details, groundwater use, bore yields, owner details.
    - Water levels measurement and methods.
    - Water quality assessment.
    - Recommendations for ongoing monitoring required to inform the baseline assessment.

Project Scope

The following activities will be undertaken to establish a baseline of groundwater chemistry and levels in the productive aquifers overlying the Beetaloo Sub-basin:

Stage 1

Review existing studies and develop method to select existing bores

a. Review knowledge gaps identified in Project 1.

b. Review all information on existing monitoring bores, stock and irrigation bores and bores owned by mining and gas companies and document bore depth, aquifer monitored, existing groundwater quality and level information, bore use, current status of bore and equipment.

c. Develop requirements of baseline assessment of groundwater quality and levels in terms of aquifers monitored, number and locations of bores, water quality parameters and document approach in a discussion paper.

Stage 2

Collect baseline information from existing bores

d. Identify existing bores that have historical groundwater quality and level information to inform the baseline assessment.

e. Identify bores that have been replaced which may still be open and available for downhole logging and water level measurement (or even longer term monitoring).

f. Select bores for testing and arrange access to survey elevation, measure depth, downhole camera to confirm casing condition and depth, measure water levels and collect groundwater samples.

g. Select strategic bores that are of sufficient depth to yield useful geophysical (gamma) logging and/or EC logging information to assist in stratigraphic interpretation. These bores may be equipped and access will need to be arranged through the landholder.

h. Document the outcomes of the bore inspections and groundwater sampling methods and results in a technical report.

Stage 3

Install and collect groundwater samples from new monitoring bores to address data gaps (if required)

i. Identify number of new monitoring bores and monitoring objectives required to address the identified knowledge gaps in consideration of the requirements of this project and other related projects.

j. Submit any statutory approval applications required for bore works (e.g. AAPA Certificates, NLC permits, Bore Work Permits, working within a road reserve permits).

k. Coordinate analysis of groundwater samples with a NATA registered laboratory, including QA/QC samples and analysis.

l. Install data loggers in all new monitoring bores and existing bores where suitable.

m. Prepare a technical report describing the works undertaken to install the new monitoring bores, bore logs and construction details, groundwater sample method and field and laboratory results.

Stage 4

Groundwater Monitoring Baseline Report

n. The Groundwater Monitoring Baseline Report should contain detailed descriptions of the methods, results, analysis and synthesis products as well as cataloguing the data collated and collected during the project with appropriate metadata

o. Update spatial database collated in Project 1 with new monitoring assets and new data for existing bores

p. Recommendations for ongoing monitoring including sampling techniques, frequency and analytes.

Deliverables

- Paper outlining the key requirements criteria of baseline assessment of groundwater quality and levels.
- Technical report outlining the review of existing monitoring bores and information collected from selected existing bores.
- Technical report describing the identification, installation and groundwater sampling and analysis of the new bores.
- Groundwater Monitoring Baseline Report documenting the groundwater quality and level information from existing bores and new bores including recommendations for ongoing monitoring.

Project timeframe

Milestone to be achieved	Anticipated completion date
Stage 1 – review Project 1 and identify existing bores	May 2021
Stage 2 – commence monitoring of existing bores	July 2021
Stage 3 – identify need for new monitoring bores	May 2021
Stage 4 – drill/install new monitoring bores and commence data collection	July 2021
Groundwater quality and levels baseline report (Stage 4)	March 2022

Project risks

Risk	Mitigation measure
Scope for Stage 2 and 3 not well understood until Stage 1 and 2 complete.	Consultant to provide lump sum costs associated for Stage 1 initially and estimate of Stage 2 and 3 based on assumptions. Costs associated with Stage 2 and 3 to be refined on completion of each stage of works. Clear hold points
Uncertain drilling costs as number of new bores not known until Stage 1 and 2 complete	
Uncertain contractor costs	

PROJECT 3

Characterisation of intra-aquifer connectivity and aquifer parameters

Aim

The aim of this project is to undertake pumping tests on selected existing bores to estimate aquifer parameters in selected aquifers and characterise the connectivity within productive aquifers overlying the Beetaloo Sub-Basin. The aquifers to be considered should include the CLA and the underlying basalt and Lower Proterozoic sandstone. This information will allow estimation of the magnitude and lateral extent of impacts of water extraction and will be used to inform the update of the groundwater surface water model.

Objectives

The objectives of this project are to:

1. Identify existing bores for aquifer testing (step and constant rate pumping tests) in consideration of the hydrogeological conceptual model and knowledge gaps presented in Project 1, new bores installed in Project 2 and the Beetaloo Basin GBA Stage 2 report. The aquifer testing program will involve:
   - Single bore pumping tests on a selection of appropriate existing bores.
   - Long term pumping tests with multiple observation bores monitoring drawdown at a range of distances from the pumping bore and depths in the aquifer.
   - Recommend new bores to address data gaps in groundwater monitoring for the pumping tests.
2. Design and install new groundwater bores to address data gaps identified. New monitoring bores will target specific aquifers to monitor during the aquifer tests. This includes:
   - Location, target aquifer, bore design (depth, diameter, casing material, screened interval).
   - Approval requirements for installation of new bores.
   - Supervision of drilling and construction of new groundwater bores.
   - Groundwater sampling and laboratory analysis of specified parameters.
   - Groundwater level monitoring.
3. Undertake step tests and constant rate pumping tests on bores identified during Stage 1 to estimate aquifer parameters and characterise aquifer intra-connectivity in the major aquifers (Anthony Lagoon, Gum Ridge) and connectivity between aquifers and the underlying basalt and Lower Proterozoic sandstone.
4. Review and compile GBA, GISERA and industry monitoring data for incorporation into the baseline assessments. This should include an annual workshop with key contacts from industry and government to discuss results work programs that have been completed or are about to commence in the Beetaloo Sub-basin area.
5. Update hydrogeological conceptual model including documenting key uncertainties.

Project Scope

The following activities will be undertaken to characterise aquifer intra-connectivity and aquifer parameters:

Stage 1

Identify existing bores for aquifer testing (step and constant rate pumping tests) in consideration of the knowledge gaps identified in Project 1, new bores installed in Project 2 and results of the regional groundwater model.

a. Review previous NT Government studies, information on existing bores and pumping test analysis where pumping tests have been undertaken.

b. Review and analyse available groundwater extraction data from Origin Energy and Santos water supply bores to estimate aquifer parameters.

c. Identify existing bores that could be used for single bore aquifer testing and outline recommendations for the pumping test including bore yield and duration.

d. Identify NT Government and/or gas company bores that could be used for long term pumping tests with multiple observation bores and outline recommendations for the pumping test including bore yield, duration and monitoring bores.

e. Identify new observation bores required to support the long term pumping tests.

f. Document the findings of the review of existing pumping test data and recommend bores for aquifer testing and key elements of the pumping test design (yield, duration and monitoring bores).

g. Draft tender documentation for drilling and pumping test contractors based on Stage 1 recommendations for pumping tests.

Stage 2

Install new groundwater bores to address data gaps identified. New monitoring bores will target specific aquifers to inform the aquifer testing program. This includes:

a. Location, target aquifer, bore design (depth, diameter, casing material, screened interval).

b. Approval requirements for installation of new bores.

c. Supervision of drilling and construction of new groundwater bores.

d. Groundwater sampling and laboratory analysis of specified parameters. Collect groundwater samples and laboratory analysis including the analytes listed in Project 2.

e. Groundwater level monitoring.

f. Survey elevation.

Stage 3

Undertake step tests and constant rate pumping tests on bores identified during Stage 1 to estimate aquifer parameters and characterise aquifer intra-connectivity in Anthony Lagoon, Gum Ridge and underlying Bukalara Sandstone aquifers.

a. Supervise step tests to estimate pumping rate for constant rate pumping tests.

b. Supervise constant rate pumping tests on bores identified during Stage 1.

c. Measure groundwater levels in monitoring bores located at a range of distances from the pumping bore and different depths in the aquifer.

d. Monitor flow rate and groundwater quality parameters in the field (EC, pH, temperature) during the pumping test.

e. Analyse pumping test results using a suitable analytical approach program.

f. Document the aquifer testing program including pumping test design, implementation, results and analysis to estimate aquifer parameters.

Stage 4

Update hydrogeological conceptual model including documenting key uncertainties.

a. Formation depths, thickness.

b. Intra-aquifer connectivity.

c. Aquifer parameters from pumping test analyses.

d. Groundwater flow rates, directions, levels and trends.

e. Update Establishment of Groundwater Monitoring Baseline Report with groundwater quality results including detailed descriptions of the methods, results and analysis.

f. Describe key uncertainties with recommendation to address these in the future, including a suggested program of works and associated costs.

Deliverables

- Stage 1 report documenting outcomes of review of existing bores and recommendations for new bores.
- Report documenting installation of new monitoring bores, pumping tests and pumping test analysis and implications for updates to hydrogeological conceptual model including recommendations to updates of the hydrogeological conceptual model report where required based on new information.

Project timeframe

Milestone to be achieved	Anticipated completion date
Stage 1 report Tender documentation for pumping test contractors	July 2021
Commence installation of new bores Pumping tests Technical report documenting the outcomes of Stage 2	August 2021 October 2021 December 2021
Updated hydrogeological conceptual model report presented in Project 1 (Stage 3)	February 2022

Project timeframe

Risk	Mitigation measure
Scope for Stage 2 and 3 not well understood until Stage 1 complete	Consultant to provide lump sum costs associated for Stage 1 initially and estimate of Stage 2 and 3 based on assumptions. Costs associated with Stage 2 and 3 to be refined on completion of each stage of works. Clear hold points.
Uncertain drilling costs as number of new bores not known until Stage 1 and 2 complete	
Uncertain contractor costs	

PROJECT 4

Characterisation of groundwater and surface water interactions and recharge and discharge processes for regional aquifers overlying the Beetaloo Sub-basin

Aim

The aim of this project is to build on existing information to characterise and quantify the recharge and discharge processes for the CLA and Lower Proterozoic sandstone aquifers including groundwater surface water interactions. This information will also be used to inform the location of potential groundwater dependent ecosystems (aquatic and terrestrial) and make recommendations for additional work to address knowledge gaps. It will also be used to update the groundwater – surface water model. This project does not include assessment of the ecosystems that may be dependent on groundwater discharge.

Objectives

The objectives of this project are to:

1. Review groundwater surface water interaction for rivers, springs and groundwater dependent ecosystems (GDEs) including:

- Gaining and losing river reaches and baseflow contributions.
- Location of springs and wetlands.

2. Characterise and quantify recharge to regional aquifers overlying the Beetaloo Sub-basin, including diffuse and point source recharge.
3. Characterise and quantify discharge to regional aquifers overlying the Beetaloo Sub-basin.
4. Document the recharge and discharge processes for key aquifers.

Project Scope

The following activities will be undertaken to characterise groundwater and surface water interactions, recharge to and discharge from the regional aquifers overlying the Beetaloo Sub-basin:

Stage 1

Characterise groundwater surface water interaction for rivers, springs and wetlands by:

a. Review current knowledge of groundwater surface water interactions (rivers, springs and wetlands) in the Beetaloo Sub-Basin.

b. Prepare or update an existing depth to water table map across the study area (as defined in Project 1).

c. Identify gaining and losing river reaches in the Flora and Roper Rivers and key tributaries.

d. Quantify annual baseflow contribution in the Flora and Roper Rivers catchments using:

- Existing surface water flow and water quality data.
- Existing groundwater monitoring data to estimate hydraulic gradient towards the rivers and groundwater discharge rates.
- In gaining reaches, collect surface water and groundwater samples and analyse for salinity and major irons and stable isotopes during wet and dry seasons to understand changes in baseflow contributions.

Stage 2

Characterise and quantify recharge to regional aquifers overlying the Beetaloo Sub-basin.

a. Synthesise current knowledge of recharge to productive aquifers overlying the Beetaloo Sub-basin.

b. Use existing information including aerial imagery, depth to water table and groundwater salinity to describe areas of diffuse recharge, mountain front and/or block recharge and point source recharge (i.e. sinkholes).

c. Identify nearby bores for groundwater sampling to inform recharge at possible point source recharge locations.

d. Prepare maps of recharge areas for Anthony Lagoon aquifer, Gum Ridge aquifer and Lower Proterozoic sandstone aquifers where information is available.

e. Estimate recharge rates using chloride mass balance where new information is available.

f. Calculate apparent groundwater ages using isotope data where new information is available.

g. Estimate recharge rates and volumes to Anthony Lagoon aquifer, Gum Ridge aquifer and Lower Proterozoic sandstone aquifers where information is available.

Stage 3

Characterise and quantify discharge from regional aquifers overlying the Beetaloo Sub-basin.

a. Review current knowledge of discharge process for the Anthony Lagoon Formation, Gum Ridge aquifers and Lower Proterozoic sandstone aquifers where information is available.

b. Describe and quantify discharge processes, other than discharge to rivers and springs, such as aquifer through flow and evaporation.

Stage 4

Document the recharge and discharge processes for key aquifers, including groundwater surface water interactions.

a. Describe methods and document outcomes in a concise report.

b. Outline recommendations for update and recalibration of groundwater and surface water model.

Deliverables

- Technical report describing the recharge and discharge processes for the major aquifers overlying the Beetaloo Sub-basin and groundwater surface water interactions.
- Maps of recharge and discharge areas for regional aquifers in the Beetaloo Sub-basin.

Project timeframe

Milestone to be achieved	Anticipated completion date
Stage 1 – Characterise groundwater surface water interaction for rivers, springs and GDEs	July 2021
Stage 2 – Characterise and quantify recharge to regional aquifers overlying the Beetaloo Sub-basin	October 2021
Stage 3 – Characterise and quantify discharge from regional aquifers overlying the Beetaloo Sub-basin	January 2022
Stage 4 – Document the recharge and discharge processes for key aquifers, including groundwater surface water interactions	April 2022

Project risks

Risk	Mitigation measure
Scope for Stage 1 uncertain	Consultant to provide lump sum costs associated for task with known scopes in Stage 1 initially and provides hold points. Costs to be refined on completion of each task within Stage 1. Clear hold points
Uncertain drilling costs as number of new bores not known for Stage 1	

PROJECT 5

Update and recalibrate the groundwater - surface water model

Aim

To update and recalibrate the existing groundwater - surface water model with new data and information collected as part of projects undertaken through the SREBA baseline assessment. The groundwater – surface water model will provide a key tool for predicting regional impacts of unconventional gas developments.

Background

Knapton (2009) developed a coupled surface-groundwater model of the Roper River catchment in 2009 as part of the Gulf Water Study for the Department of Natural Resources, Environment, The Arts and Sport (now DEPWS). Knapton updated and re-calibrated this model in 2018 (Knapton, 2020).

The 2018 model covers the Cambrian Limestone Aquifers (CLA) in the Georgina, Wiso and Daly Basins and has been updated and refined with new information on rainfall, recharge areas, aquifer geometry and baseflow contributions. The surface and groundwater flow processes are modelled using FEFLOW together with MIKESHE and MIKE11 for the surface water processes.

Knapton (2020) recommended several improvements to the 2018 model including LiDAR survey of the groundwater management area near the headwaters of the Roper River, improving the recharge estimates, particularly in the Wiso Basin and additional cross section information for the MIKE11 model. Further work has been undertaken by DEPWS, CSIRO and GISERA, which can be used to improve the current surface-groundwater model. Examples of some of these projects are:

- Projects completed to inform the SREBA including:
  - Hydrogeological conceptual model for the Beetaloo Sub-basin and overlying aquifers (Project 1).
  - Establishment of baseline of groundwater chemistry and groundwater levels (Project 2).
  - Characterisation of intra-aquifer connectivity and aquifer parameters (Project 3).
  - Characterisation of groundwater and surface water interactions and recharge and discharge processes for regional aquifers overlying the Beetaloo Sub-basin (Project 4).
- Beetaloo Geological and Environmental Bioregional Assessment (Stage 2) (Huddlestone-Holmes *et al*, 2020).
- Beetaloo Geological and Environmental Bioregional Assessment – Impact analysis and management assessment (Stage 3) due to be completed in 2021.
- Beetaloo Sub-Basin Numerical Groundwater Model (Knapton, 2020).
- Additional studies completed by Gas Industry Social and Environmental Research Alliance (GISERA).

Objectives

The objectives of this project are to:

- Review the existing studies to inform the SREBA Baseline and GBA.
- Update and re-calibrate the existing groundwater surface water model with new information on formation thicknesses, aquifer parameters, groundwater flow directions, groundwater surface water interaction and water balance.
- Document the update and re-calibration of the groundwater surface water model in a concise report.

Project Scope

The following activities will be undertaken:

Stage 1

Review the technical reports developed to inform the SREBA Baseline, including but not limited to the following reports:

- Technical report documenting the hydrogeological conceptual model for the Beetaloo Sub-basin and overlying aquifers (Project 1).
- Groundwater Monitoring Baseline Report documenting the groundwater quality and level information from existing bores and new bores including recommendations for ongoing monitoring (Project 2).
- Report documenting installation of new monitoring bores, pumping tests and pumping test analysis and implications for updates to hydrogeological conceptual model (Project 3).
- Updated hydrogeological conceptual model report presented in Project 1 where required based on new information (Project 3).
- Technical report describing the recharge and discharge processes for the major aquifers overlying the Beetaloo Sub-basin and groundwater surface water interactions (Project 4).
- Beetaloo Geological and Environmental Bioregional Assessment (Stage 2) (Huddlestone-Holmes *et al*, 2020).
- Beetaloo Geological and Environmental Bioregional Assessment – Impact analysis and management assessment (Stage 3).
- Beetaloo Sub-basin Numerical Groundwater Model (Knapton, 2020).
- Additional studies completed by Gas Industry Social and Environmental Research Alliance (GISERA).

Stage 2

Update and re-calibrate the existing groundwater surface water model with new information in consideration of:

- New information on hydrostratigraphy including aquifer and aquitard extents and thicknesses and characterisation of deeper hydrogeological units.
- Improved understanding of aquifers behaving as one regional aquifer or several isolated aquifers within the regional aquifers.
- Revised aquifer parameters (hydraulic conductivity, transmissivity, storage).
- Additional data on groundwater levels and flow directions.
- Observed water level trends (time series) in monitoring bores.
- Recharge areas and recharge rates and/or volumes.
- Discharge processes for each aquifer and volumes.
- Groundwater surface water interactions along the Roper and Flora Rivers, including conceptualisation of gaining and losing reach and groundwater baseflow contributions.
- Locations of groundwater users and estimated volumes of groundwater use.
- Conceptual water balance of the regional groundwater system and the sustainable yield of the major aquifer systems.
- Calibrate the model in steady state and transient.

Stage 3

Document the update and re-calibration of the groundwater surface water model in a concise report:

- Document the hydrogeological conceptual model including the stratigraphy, faults, groundwater recharge and discharge processes, groundwater surface water interaction, groundwater use.
- Describe the numerical model design including the modelling objectives, approach, confidence in the model, software, model area, grid structure and model boundaries and representation of recharge and discharge.
- Outline the calibration approach, including steady state and transient calibrations and parameterisation approach.
- Describe the results of the calibration including the water budget and river fluxes.
- Recommendations for further work to improve the conceptualisation and model calibration.

Deliverables

- Technical report describing the key components of the groundwater surface water model including recommendations to address knowledge gaps.

Project timeframe

Milestone to be achieved	Anticipated completion date
Stage 1 – Review the technical reports developed to inform the SREBA Baseline	October 2022
Stage 2 – Update and recalibrate the existing groundwater surface water model with new information	January 2023
Stage 3 – Document the update and recalibration of the groundwater surface water model in a concise report	April 2023

Project risks

Risk	Mitigation measure
Scope undefined until Projects 1-4 are completed, so difficult to estimate fee at this stage	Set clear objectives for this project as new information becomes available.

PROJECT 6

Surface water flow characterisation for catchments overlying the Beetaloo Sub-basin

Aim

The aim of this study is to improve the understanding of overland surface flow behaviour across the Beetaloo region, including mapping of flow paths, interactions with groundwater and risk to environmental sites of significance.

Objectives

The objectives this project are to:

1. Undertake a literature review.
2. Document the surface water catchment characterisation including catchment definition and mapping of flow paths, collate existing hydrological and topographic data and identify additional data requirements.
3. Document knowledge gaps and additional data requirements.
4. Acquire additional data as required (and within available resources) to allow assessment of surface water resources and risks to surface water resources, including groundwater recharge zones and sites of conservation significance.
5. Define and assess risks to surface water resources, groundwater recharges zones and sites of conservation significance.
6. Recommend suitable monitoring regime to further assess surface water resources and monitor risks to surface water resources, groundwater recharge zones and sites of conservation significance.

Project Scope

The following activities will be undertaken to undertake a risk assessment to surface water resources, groundwater recharge zones and sites of conservation significance:

1. Undertake a literature review of, but not limited to, the following reports to document an overview of existing knowledge of the surface water catchment and sub-catchments:
    a. Gautam (2018) - Preliminary Assessment of Surface Water Resources and Flooding Potential within the Elsey Creek and Newcastle Creek Catchments.
    b. Petheram *et al* (2009) - Rainfall-runoff modelling across northern Australia.
    c. WRM Water & Environment Pty Ltd., (2019) – Daly Waters Flood Study, Department of Infrastructure, Planning and Logistics; Report No. 1488-01-D1.
2. Characterise the surface water drainage systems and collate the required data (e.g. topography, rainfall, flow, flow gaugings, ratings and anecdotal evidence) to facilitate model construction.
3. Identify additional data requirements, and capture the data if possible.
4. Undertake hydrological model construction for sub-catchments within the Beetaloo Sub-basin region.
5. Document the hydrological model development, calibration and validation.
6. Undertake hydraulic model construction for Lake Woods, Lake Tarrabool and Lake Sylvester including northern tributaries within the Beetaloo Sub Basin where necessary.
7. Document the hydraulic model development, calibration and validation.
8. Produce Maps indicating the inundation extent and depths of the 1% Annual Exceedance Probability (AEP) event, Maximum Probable Event and other flood extent identified as a requirement through the development of the project scope.
9. Document assessment of risks to surface water resources, groundwater recharge zones and sites of conservation significance within the Beetaloo Study Area.
10. Develop monitoring program to provide data for future assessment of surface water resources in the Beetaloo Study Area.

Deliverables

- Hydrological models of the surface water catchments overlying the Beetaloo Sub-basin.
- Hydraulic models for Lake Woods, Lake Tarrabool and Lake Sylvester including northern drainage systems where necessary.
- Report on model development, calibration and validation which should incorporate a description of the current understanding of the surface water systems overlying the Beetaloo Sub-basin and their characterisation.
- Flood extent geometry as ArcInfo shapefiles for all design events and defined depth ranges.
- Flood maps for each design event showing all depth ranges.
- Assessment of risks to surface water/wetlands, groundwater recharge zones and sites of conservation significance.
- Document monitoring program for further assessment of surface water resources.

The scope of works developed by the Northern Territory Floodplain Management Committee will be used as the standard to specify the format of the deliverables for this project, including file formats and naming conventions.

Project timeframe

Milestone to be achieved	Anticipated completion date
Literature review and data collation	May 2021
Model construction completed	April 2022
Final Report	October 2022

Project risks

Risk	Mitigation measure
Unknown knowledge gaps	Added to project plan for consideration when identified.
Poor spatial resolution of topographic data	Acknowledgement of uncertainty within Flood Study Report, possible barrier to undertaking flood study.
Poor temporal resolution of rainfall data	Acknowledgement of uncertainty within Flood Study Report.
Poor surface water data to develop/calibrate hydraulic models	Acknowledgement of uncertainty within Flood Study Report.

PROJECT 7

Cultural water practices in the Beetaloo Sub-basin

Aim

The researchers conducting Social, Cultural and Economic studies will consult with relevant local Aboriginal people and organisations in relation to cultural practices and uses of water in the Beetaloo Sub-basin. This project is a point of integration between the Social, Cultural and Economic studies, the Aquatic Ecosystems studies and the Water Quality and Quantity studies. With the agreement of knowledge holders information about cultural practices and indigenous uses of water in the Beetaloo Sub-basin will be described and documented and where appropriate this will inform elements of other SREBA studies, such as ecological studies of significant sites and/or species. Traditional owners, knowledge custodians and representative Aboriginal organisations will be consulted to plan how the findings and results of these studies may be used to inform risk assessments and regional water allocation planning processes.

Further detail about cultural practices and uses of water will be defined through consultation undertaken during the development of the Social, Cultural and Economic Scope of Works.

PROJECT 8

SREBA Water Baseline Report

Aim

The aim of this project is to summarise results of the above investigations and describe the updated understanding of the major aquifer systems. The water quality and quantity sub-components of the Water Baseline Report will be used to inform the assessment of potential impacts of shale gas development at project and regional scales.

Objectives

DEPWS, CSIRO and GISERA have completed a range of studies aimed at improving the knowledge of the hydrogeological conceptual understanding of the regional aquifers overlying the Beetaloo Sub-basin and informing the baseline for water resources. The information and outcomes presented in these studies will be used to inform the Water Baseline Report for the SREBA.

The objectives of this project are to:

1. Review the technical reports developed to inform the SREBA Baseline.
2. Where environmental water requirements have been established through other studies, recommend trigger levels for remedial action in the event of changed groundwater levels, fluxes and water quality indicators and describe possible remedial actions.
3. Prepare the Water Baseline Report – Water Quality and Quantity that addresses the requirements specified in the Final Report of the Scientific Inquiry into Hydraulic Fracturing in the Northern Territory in relation to groundwater flow, water quantity and quality. The report should highlight which objectives have been met and those that may require further investigation.
4. Collate database with all existing information on bores, stratigraphy, water levels, water quality, nominated trigger values, aquifer parameters.

Project Scope

The following activities will be undertaken:

Stage 1

Review technical report developed to inform the SREBA Baseline.

a. Projects completed to inform the SREBA including:
   - Hydrogeological conceptual model for the Beetaloo Sub-basin and overlying aquifers.
   - Establishment of baseline of groundwater chemistry and groundwater levels.
   - Characterisation of intra-aquifer connectivity and aquifer parameters.
   - Characterisation of groundwater and surface water interactions and recharge and discharge processes for regional aquifers overlying the Beetaloo Sub-basin.
   - Update and recalibration of the surface – groundwater model.
   - Surface water and flood studies for the Beetaloo Sub-basin.

b. Beetaloo Geological and Environmental Bioregional Assessment (Stage 2) (Huddlestone-Holmes *et al*, 2020).

c. Beetaloo Geological and Environmental Bioregional Assessment – Impact analysis and management assessment (Stage 3).

d. Beetaloo Sub-basin Numerical Groundwater Model (Knapton, 2020).

e. Additional studies completed by Gas Industry Social and Environmental Research Alliance (GISERA).

Stage 2

Where environmental water requirements have been established through other studies, recommend trigger levels for remedial action in the event of changed water quality indicators and describe possible remedial actions:

a. Develop response "trigger" values in consideration of the background water quality conditions.

b. Outline the rationale for the agreed trigger value.

Stage 3

Prepare a Water Baseline Report which includes the following:

a. Synthesize the information on the range of methods, results and analyses employed to collect the information that forms the basis for baseline assessment. This should include:
   - Descriptions of geology and hydrogeology sufficient to support assessment of both project and regional scale assessments.
   - Present the hydrogeological conceptual understanding including the natural recharge, discharge and groundwater flow.
   - Information on aquifer extents, hydraulic parameters for each aquifer and connectively between aquifers.
   - Data on groundwater levels and flow directions in each aquifer.
   - Water balance quantification of recharge, discharge and groundwater flow.
   - Present water quality data.

b. Describe surface water features (rivers, springs and wetlands).

c. Develop a strategy to address knowledge gaps including additional monitoring or investigations required to provide new information. Further investigations should be prioritised and with a detailed project plan, timeline and estimated cost.

d. Describe the ongoing monitoring program with reference to the following:
   - Monitoring objectives.
   - Financial resourcing of the monitoring.
   - Sample locations, sampling frequency and techniques.
   - Analysis indicators to support the agreed trigger levels.
   - Review and assessment of the monitoring program.

Stage 4

Collate database with all existing information on bores, stratigraphy, water levels, water quality, nominated trigger values, aquifer parameters.

a. Catalogue data collected and collated in recent years to support the development of the Water Baseline Report. Data should be collated in an information management system developed specifically for the SREBA.

b. Develop web-enabled and/or interactive maps to facilitate communication of results to a broad range of audiences.

Deliverables

- Water Baseline Report describing the key components of the groundwater surface water model including recommendations to address knowledge gaps.
- SREBA information management system and web-enabled and/or interactive maps.

Project timeframe

Milestone to be achieved	Anticipated completion date
Stage 1 – Review technical reports developed to inform the SREBA Baseline	April 2022
Stage 2 - Recommend trigger levels	June 2022
Stage 3 - Prepare a Water Baseline Report	July 2022
Stage 4 – Collate database	December 2022

ABORIGINAL KNOWLEDGE AND VALUES

The researchers conducting Social, Cultural and Economic studies will consult with relevant local Aboriginal people and organisations in relation with indigenous ecological knowledge and with the agreement of the knowledge holders, document information about significant aquatic ecosystems, flora and fauna, and cultural water practices.

There will be opportunities for participation by local Aboriginal people in the studies, including in field research and data collection which will be identified through consultation. The Aboriginal Areas Protection Authority will be engaged to provide advice on access to sites for the water studies.

Responsibilities

Consultants, researchers and contractors carrying out these studies will report to DEPWS as the project manager for the SREBA program of work. Preliminary findings, data, and final results will be reported to DEPWS, and all material and data will become the intellectual property of the Northern Territory Government.

Access permissions

Permission must be obtained from the relevant landowners before entering properties and undertaking fieldwork. This includes pastoral properties, Indigenous managed/owned lands, parks and reserves and crown land.

The SREBA Engagement Manager is the focal point for all stakeholder engagement and communication for the program. The SREBA Engagement Manager will liaise with landholders and relevant Land Councils to obtain permissions for access. Research teams can then directly contact individual landholders to arrange access, and will be required to observe landholder protocols such as advance notice, vehicle hygiene requirements and site inductions. Research teams will be provided with a briefing pack that includes vehicle hygiene certification documents, SREBA key contact details, specific landholder requirements, SREBA Factsheets, and other relevant documentation.

The SREBA management team will liaise directly with the Aboriginal Areas Protection Authority (AAPA) to obtain clearances and certificates for bore drilling and field work, and field work teams will abide by the conditions of certificates or guidance provided by AAPA.

Communication and stakeholder engagement

The SREBA stakeholder engagement plan outlines the strategies for engaging with key stakeholders. Researchers carrying out the studies will be required to contribute to stakeholder engagement activities coordinated through the SREBA management team, including:

- Field reports with summary survey results sent to landholders upon completion of field work.
- Radio interviews and information sessions to inform the community about the studies, what will be done, how the information will be used and where people can find further information.
- Closed social media groups for interested parties to receive updates and briefings on progress, field visits summaries and alerts for upcoming activities.
- Presentation to the Beetaloo Regional Reference Group (BRRG) at the commencement of the studies to inform the group of the scope, scale and timing of the studies and to seek feedback.
- Progress report presentations to the BRRG to update the group and provide any preliminary results.
- Final results, findings, models and monitoring plans presented to the BRRG at the completion of the studies.
- Final results, findings, models and monitoring plans presented in scientific seminars.
- Results, finding and models and monitoring plans published on the DEPWS website and made publicly available in user-friendly formats.

Researchers carrying out the Water Quality and Quantity studies will provide updates to the DEPWS SREBA management team on progress and issues on a regular basis.

DATA AND INFORMATION MANAGEMENT

Data collected and generated through SREBA studies should be open access, except where it is identified as restricted or sensitive for cultural or privacy reasons. The information generated will be used by different stakeholders for different purposes and will be made available through Northern Territory Government websites.

The Water Baseline Report for a SREBA will contain detailed descriptions of the methods, results, analyses and synthesis products, as well as cataloguing the data collated and collected during the project with appropriate metadata.

Summary outputs from the assessment will be in formats that are readily available, and comprehensible, to a broad audience (such as web-enabled, interactive maps). Effective public communication of results will be informed by a SREBA-wide communication plan.

Data will be stored in the information management system developed for the SREBA and curated under a data management plan developed for the water component. The data management plan should identify owners and data custodians for all datasets, and any data restrictions.

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