WATER FOR ECONOMIC DEVELOPMENT – REGIONAL WATER STRATEGY

RAPAD

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Queensland Government

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EXECUTIVE SUMMARY

BACKGROUND

Central Western Queensland Remote Area Planning and Development (RAPAD) Board represents the region's local governments and is the peak regional economic development and advocacy body for the Central West Queensland region. Central to RAPAD's mission is facilitating growth and diversification of the region's economy and leading powerful advocacy to government to address the region's service and infrastructure needs.

To achieve this mission, RAPAD is developing a regional water strategy, which seeks to understand how water can be properly utilised to achieve transformation change in the region's economy and can lead to long-term sustainability of the region's communities.

Combined with the strategy, an action plan outlines how the region can make meaningful progress towards realising the opportunity with clear roles and responsibilities for local government, the Queensland and Australian Governments (as a regulator and a funder of infrastructure) and private industry.

To deliver this strategy, RAPAD has engaged AEC Group Pty Ltd (AEC) to lead the stakeholder engagement, economic analysis (including demand assessment), strategy formation and action planning. AEC has engaged SMEC to deliver the water supply assessment.

Critically, this document outlines the full long term potential of the region – the opportunities explored to drive jobs and economic growth for the region are significant and will require many years of effort and application to achieve.

SITUATIONAL ANALYSIS

Key points include:

- Water resources in the RAPAD region come from the Georgina, Diamantina, Cooper Creek and Burdekin catchments (surface water) and the Great Artesian Basin (groundwater).
- Water resources in the RAPAD region are demonstrably underutilised. The region's surface water catchments have with large volumes of unallocated water (over 50% in the Georgina and Diamantina Catchments) coupled with very low proportion of resource allocated to productive use (0.2% of Maximum Available Flow).
- The RAPAD region includes a number of population centres with centralised Sewerage Treatment Plants (STPs), which produce treated water that can be beneficially used in a number of ways (instead of current practices where treated sewerage is discharged into rivers or evaporated in ponds). The total estimated volume of water that could be reused from STP's is 925.1 ML.
- Future water demand is likely to come from the following areas:
  - Mineral mining and processing
  - Irrigated agriculture (including production of fodder for drought preparedness)
  - Production of green hydrogen for heavy transport
  - Geothermal energy production (this opportunity is a closed system and does not extract water).

REGIONAL WATER STRATEGY

RAPAD's mission (relating to this strategy) is to advocate for the maximum sustainable amount of available water resources to enable long-term economic development and diversification in Central West Queensland.

Key outcomes sought from this strategy to benefit the Central Western Queensland region include:

- Improved awareness of water-related economic development opportunity amongst regional stakeholders
- Sale/ uptake of unallocated water resources across the different catchments/ sources
- Infrastrucutre has been delivered to improve water resource access
- Policy change to support resource access:
  - enabling basin-level water trading
  - expanding allocation of resource to 10% (ensuring 90% of water for environmental flow)
- Increased private investment in the region in water-related industries.

ACTION AND IMPLEMENTATION PLAN

To achieve the strategy outcomes, RAPAD can undertake the following lines of effort.

1 Economic development planning (due diligence on infrastructure upgrades and stakeholder capacity building)

2 Advocacy (for infrastructure investment, sale of existing unallocated water, water policy (increased resource access) and support for economic development planning)

3 Investment attraction (due diligence on opportunities and direct engagement).

ECONOMIC IMPACT OF STRATEGY

The economic impacts of the strategy are outlined in Table ES.1 and include:

- Increase in current Gross Regional Product (GRP) by 36% (current GRP = $1.01 B)
- Increase in current employment by 45% (current employment PoW = 5,597 FTE)
- Increase in population by 37% (current estimated residential population – ERP is 10,721)
- Growth in annual tax revenue (from additional economic activity) of $91.3 M

Table ES.1. Economic Impacts of Regional Water Strategy

Enabled Activity	Gross Regional Product - Total ($M)	Employment - Total (FTE)	Additional Taxation Revenue ($M)
Irrigated agriculture (unallocated water)	$22.5	206	$5.6
Irrigated agriculture (Under allocated water)	$163.4	1,499	$40.7
Extractive resources	$92.2	443	$28.3
Hydrogen production	$89.9	379	$16.7
Total	**$368.0**	**2,527**	**$91.3**

Note: Totals may not sum due to rounding.
Source: AEC.

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1. INTRODUCTION

1.1 Background

Central Western Queensland Remote Area Planning and Development (RAPAD) Board represents the region's local governments and is the peak regional economic development and advocacy body for the Central West Queensland region. Central to RAPAD's mission is facilitating growth and diversification of the region's economy and leading powerful advocacy to government to address the region's service and infrastructure needs.

To achieve this mission, RAPAD is developing a regional water strategy, which seeks to understand how water can be properly utilised to achieve transformation change in the region's economy and can lead to long-term sustainability of the region's communities.

The formation of the strategy is to:

- Be informed by an analysis of both supply and demand opportunities
- Quantify the direct and indirect economic benefits of realising the opportunities (where adequate supply enables the opportunity to be achieved)
- Identify locally driven, bottom-up approaches to achieving the strategy outcomes
- Be verified through stakeholder engagement across the region.

Combined with the strategy, an action plan outlines how the region can make meaningful progress towards realising the opportunity with clear roles and responsibilities for local government, the Queensland and Australian Governments (as a regulator and a funder of infrastructure) and private industry.

To deliver this strategy, RAPAD has engaged AEC Group Pty Ltd (AEC) to lead the stakeholder engagement, economic analysis (including demand assessment), strategy formation and action planning. AEC has engaged SMEC to deliver the water supply assessment.

1.2 PURPOSE OF THIS REPORT

The purpose of this report is to present the regional water strategy (the strategy) for Central West Queensland, including definition of the propose of the strategy (RAPAD's role), outcomes sought from the strategy and actions required to realise the target outcomes in the strategy.

It is important to note that this report should be read in conjunction with the supporting analysis outlined in the following reports:

- Water for Economic Development – Demand Assessment (AEC, 2023)
- Water for Economic Development in Central Western Queensland (SMEC, 2023).

1.3 APPROACH

The approach taken for this demand analysis involved the following elements.

- **Situational Analysis (Section 2):** Profiles the key drivers of supply and demand for water resources
- **Regional Water Strategy (Section 3):** Presents the propose of the strategy (RAPAD's role) and the outcomes sought from implementing the strategy.
- **Action and Implementation Plan (Section 4):** Identifies the range of future actions to be taken by RAPAD to implement the identified strategy.
- **Economic Impact of Strategy (Section 5):** Quantifies the potential range of direct and indirect economic impacts of realising the identified water-related economic development opportunities in the RAPAD region where full uptake of available resources is realised.

2. SITUATIONAL ANALYSIS

2.1 APPROACH

This section presents an overview of the detailed supply and demand analysis of the RAPAD region. This section has been prepared to inform the regional water strategy (Section 3)

This section should be read concurrently with the supporting analysis outlined in the following reports:

- Water for Economic Development – Demand Assessment (AEC, 2023)
- Water for Economic Development in Central Western Queensland (SMEC, 2023).

2.2 OVERVIEW OF WATER RESOURCES

Water resources in the RAPAD region come from the Georgina, Diamantina, Cooper Creek and Burdekin catchments (surface water) and the Great Artesian Basin (groundwater).

Figure 2.1 Water Catchments in the RAPAD Region

Source: SMEC (2023), AEC.
Note: Map showing Diamantina and Georgina Sub-Catchments (red), Cooper Creek Sub-Catchments (blue) and Burdekin Sub-Catchments (yellow) and Great Artesian Basin aquifers (shaded areas) across the RAPAD region.

2.3 WATER ALLOCATIONS AND RESOURCE UTILISATION

Water resources in the RAPAD region are demonstrably underutilised. The region's catchments have large volumes of unallocated water (over 50% in the Georgina and Diamantina Catchments) coupled with very low proportion of resource allocated to productive use (Table 2.1 and Table 2.2).

Underutilisation of resources occurs in two forms:

- **Unallocated:** Where water is allocated in the relevant water plan but is held in reserve (either general or strategic) and is not productively utilised.
- **Under allocated:** Where water is physically available but is not allocated as a reserve in the relevant water plan for future productive use. Under allocated resources are those in excess of unallocated resources.

Table 2.1. Surface Water Catchments – Resource Allocation and Utilisation

Surface Water Catchment	Current Allocation (ML)	Unallocated water (ML)	% Resource allocated	Under-allocated water (ML)
Georgina & Diamantina	7,108	13,500	0.3%	677,311
Cooper	17,788	2,200	0.3%	560,013
Burdekin (Belyando - Suttor)	82,425	139,200	13.8	0
Total	**103,084**	**154,900**	-	**1,237,324**

Source: Queensland Government (2017, 2019a,b)
Note: Under-allocated water assumes 10% use of available water resources.

Table 2.2. Groundwater Basin – Resource Allocation and Utilisation (ML)

<table>
<tr><th rowspan="2">Groundwater Sub-Basin</th><th rowspan="2">Current Allocation</th><th colspan="4">Unallocated Water</th></tr>
<tr><th>General Reserve</th><th>State Reserve</th><th>ATSI Reserve</th><th>Total</th></tr>
<tr><td>Betts Creek Beds</td><td>0</td><td>0</td><td rowspan="2">1,500</td><td rowspan="2">45</td><td rowspan="10"></td></tr>
<tr><td>Galilee Clematis</td><td>605</td><td>455</td></tr>
<tr><td>Eromanga Cadna-owie</td><td>150</td><td rowspan="5">1,545</td><td rowspan="8">16,400</td><td rowspan="8">190</td></tr>
<tr><td>Eromanga East Hooray</td><td>1,450</td></tr>
<tr><td>Eromanga North Hooray</td><td>2719</td></tr>
<tr><td>Eromanga South Hooray</td><td>4,818</td></tr>
<tr><td>Eromanga West Hooray</td><td>315</td></tr>
<tr><td>Eromanga Precipice</td><td>150</td><td>365</td></tr>
<tr><td>Eromanga Wallumbilla</td><td>567</td><td>0</td></tr>
<tr><td>Winton Mackunda</td><td>104</td><td>0</td></tr>
<tr><td>Total</td><td>10,878</td><td>2,365</td><td>17,900</td><td>235</td><td>20,500</td></tr>
</table>

Source: SMEC (2023), AEC (2023).
Note: Insufficient data exists to identify under-allocation of groundwater resources

2.4 BENEFITICAL REUSE OPPORTUNITIES

The RAPAD region includes a number of population centres with centralised Sewerage Treatment Plants (STPs), which produce treated water that could be beneficially used in a number of ways (instead of current practices where treated sewerage is discharged into rivers or evaporated in ponds). Table 2.3 includes estimated average throughput of municipal sewerage treatment plants.

Table 2.3. Estimated STP Throughput (ML)

LGA	Location	Estimated Throughput (ML)
Boulia SC	Boulia	30.8
Winton SC	Winton	102.9
Barcaldine RC	Barcaldine	240.5

LGA	Location	Estimated Throughput (ML)
Barcaldine RC	Alpha	30.8
Barcaldine RC	Aramac	63.0
Barcaldine RC	Muttaburra	39.6
Blackall-Tambo	Blackall	36.8
Blackall-Tambo	Tambo	6.4
Diamantina SC	Birdsville	15.0
Diamantina SC	Bedourie	36.7
Longreach RC	Longreach	260.8
Longreach RC	Illfracombe	13.1
Longreach RC	Isisford	48.6
Total RAPAD	**-**	**925.1**

Source: AEC (2023).
Note: STP throughput is not measured by LGAs. STP throughput is estimated to be approximately 15% of reticulated water use.

2.5 FUTURE WATER DEMAND

Based on stakeholder engagement and economic analysis, the following activities are expected to be the key use drivers of demand for future water that have been identified and quantified (AEC, 2023) include:

- Regional opportunities:
  - Improving drought preparedness = 2 GL (potentially utilising beneficial reuse of waste water)
  - Irrigated agriculture = 261 GL
  - Green hydrogen for heavy transport = 40 ML – 189 ML (requiring beneficial reuse of waste water)
- Specific place-based opportunities:
  - Blackall QWool Project = 550 ML
  - Barcaldine Renewable Energy Zone = 386 ML
  - Geothermal Electricity Generation = 0 ML (closed system)
  - Mineral mining and processing = 850 – 2,220 ML.

A number of additional beneficial reuse opportunities have been identified, including:

- Town sewerage
- Industrial water use
- Water from gas extraction (coal production areas only; other gas developments are conventional and do not produce large volumes of water).

3. WATER STRATEGY

3.1 APPROACH

This section confirms the propose of the strategy (RAPAD's role) and the outcomes sought from implementing the strategy.

Key Findings:

- RAPAD's mission (relating to this strategy) is to advocate for the maximum sustainable amount of available water resources to enable long-term economic development and diversification in Central West Queensland.
- Key outcomes sought to benefit the Central Western Queensland region from this strategy include:
  - Improved awareness of water-related economic development opportunity amongst regional stakeholders
  - Sale/uptake of unallocated water resources across the different catchments/ sources
  - Infrastructure has been delivered to improve water resource access
  - Policy change to support resource access (enabling water trading within each basin and expanding allocation of resource)
  - Increased private investment in the region in water-related industries.

3.2 RAPAD'S ROLE

RAPAD's role (relating to this strategy) is to advocate for the maximum sustainable amount of available water resources to enable long-term economic development and diversification in Central West Queensland.

The stakeholders RAPAD is to advocate to include:

- The Queensland Government (as resource regulator and infrastructure funder)
- Investors (both local and external proponents/investors to realise the identified opportunities).

3.3 OUTCOMES SOUGHT

Key outcomes sought from this strategy include:

1 Improved resource monitoring and data collection, specifically:
  - Gauging stations: Georgina Basin sub-catchments: Upper and Lower Diamantina, Lower Georgina.

2 Improved awareness of water-related economic development opportunity amongst regional stakeholders, including:
  - Irrigators: drought resilience and irrigated agriculture (cropping and cattle fattening)
  - Local governments: beneficial reuse (recycled water for hydrogen)
  - Manufacturers: chemical manufacturing and other industrial processes (agriculture value adding – wool).

3 Sale of unallocated water resources in the different catchments/ sources across the RAPAD region.

4 Infrastructure has been delivered to improve resource access, including:
  - Longreach water security project
  - Sewerage upgrade and water recycling for hydrogen

5 Policy change to support resource access, including:
  - Enable trading of water licences within each basin

- Review of water plans (expand available allocation of the resource)

6 Increased private investment in the region in water-related industries, including:

- Agriculture/farming
- Resource projects (Boulia – copper & Barcaldine – coal)
- Geothermal energy
- Manufacturing (BREZ, QWOOL)
- Hydrogen enabled transport and machinery.

4. ACTION AND IMPLEMENTATION PLAN

4.1 APPROACH

This section identifies the range of future actions to be taken by RAPAD (and its member LGAs) to implement the identified strategy.

Key findings:

To achieve the strategy outcomes, RAPAD can undertake the following lines of effort:

1 Economic development planning (due diligence on infrastructure upgrades and stakeholder capacity building)

2 Advocacy (for infrastructure investment, sale of existing unallocated water, water policy (increased resource access) and support for economic development planning)

3 Investment attraction (due diligence on opportunities and direct engagement)

4.2 LINES OF EFFORT

To achieve the strategy outcomes, RAPAD (and its member LGAs) can undertake and implement, with its key local government stakeholders, the following lines of effort:

1 Economic development planning, targeting:
   - a Business cases on water infrastructure upgrades, namely upgrading municipal STPs to provide water for hydrogen production.
   - b Stakeholder capacity building, including:
     - i Soil suitability mapping across the RAPAD region
     - ii Landholder engagement campaign to improve awareness of placed based opportunities for:
       - Alternative cropping opportunities and financial returns from undertaking alternative activities
       - Off stream water storage design and water harvesting opportunities.

2 Advocacy (Queensland Government) to secure:
   - a Funding for:
     - i Economic development planning (item 1 above)
     - ii Delivering new infrastructure for water security (such as Longreach Thomson River Weirs project)
     - iii Additional gauging stations to improve data on resource availability
   - b Sale of existing unallocated water
   - c Update of water plans to enable more access to resources.

3 Investment attraction, including:
   - a Opportunity due diligence to identify:
     - i Scale of market opportunity
     - ii Key proponents/investor groups
   - b Preparation of engagement material
   - c Engagement with identified investors/investor groups.

5. ECONOMIC IMPACT OF STRATEGY

5.1 APPROACH

This section identifies the potential direct and indirect economic impacts of realising the identified water-related economic development opportunities in the RAPAD region where full uptake is achieved.

The types of economic benefits assessed include:

- Direct and indirect economic activity (Gross Regional Product) and employment (Full Time Equivalent)
- Additional government revenue generated, based on the additional economic activity
- Population impacts of a step-change in economic activity.

It is important to note that this is a high level assessment, designed to quantify the order of magnitude impact water-related economic development initiatives could have on the regional economy where the opportunities are developed. It takes no consideration of the constraints (infrastructure, skills and labour access) that may need to be overcome or delivered to achieve this level of activity – i.e. roads and infrastructure upgrades or development that may be required to facilitate these opportunities, which would in themselves generate additional economic activity.

5.1.1 Economic Impact Assessment

Economic modelling in this section estimated the net economic activity supported by the development of water resources in the RAPAD region. The unlocking of water resources in the region provides opportunities to develop irrigated agriculture, resource extraction (copper mining) and hydrogen production. Input-Output modelling is used to examine the direct and flow on [1] activity expected to be supported within the RAPAD region annually once the opportunity is realised and in steady state operations. A description of the Input-Output modelling framework used is provided in Appendix A.

Input-output modelling describes economic activity by examining four types of impacts:

- **Output**: Refers to the gross value of goods and services transacted, including the costs of goods and services used in the development and provision of the final product. Output typically overstates the economic impacts as it counts all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once.
- **Gross product**: Refers to the value of output after deducting the cost of goods and services inputs in the production process. Gross product (e.g., Gross Regional Product (GRP)) defines a true net economic contribution and is subsequently the preferred measure for assessing economic impacts.
- **Income**: Measures the level of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the project.
- **Employment**: Refers to the part-time and full-time employment positions generated by the economic stimulus, both directly and indirectly through flow-on activity, expressed in full time equivalent (FTE) positions/ FTE job years[2].

5.1.2 Government Revenues

Indicative estimates of taxation revenue to the Queensland and Australian Government have been developed based on benchmarks of taxation revenue received compared to relevant Queensland and Australian measures and applied to results from Input-Output modelling for the RAPAD region between FY2026 and FY2050 outlined in section 5.3.4. RAPAD region results were used, as modelling of impacts to Queensland and Australia was not

[1] Both production induced (Type I) and consumption induced (Type II) flow-on impacts have been presented in this report. Refer to Appendix A for a description of each type of flow-on impact.

[2] Where one FTE job year is equivalent to one person working full time for a period of one year.

undertaken, and as such will exclude government revenues supported through flow-on activity outside of the RAPAD region.

The following benchmarks were applied by taxation item:

- **Personal income tax** (Australian Government): total income tax received (ABS, 2023 a) compared to total wages and salaries paid to Australian employees (ABS, 2023 b; ABS, 2023 c) between FY2013 and FY2022. This was applied to estimates of incomes paid in the RAPAD region from the modelling.
- **Fringe benefits tax** (Australian Government): total fringe benefits tax received (ABS, 2023 a) compared to total wages and salaries paid to Australian employees (ABS, 2023 b; ABS, 2023 c) between FY2013 and FY2022. This was applied to estimates of incomes paid in the RAPAD region from the modelling.
- **Company income tax** (Australian Government): total company tax received (ABS, 2023 a) compared to total gross profit of businesses in Australia (i.e., total GDP less total wages and salaries paid to employees) (ABS, 2022d) between FY2013 and FY2022. This was applied to estimates of GRP less incomes paid in the RAPAD region from the modelling. Goods and Services Tax (GST) (Queensland Government): total GST received (ABS, 2023 a) compared to total Australian GDP (ABS, 2021a) between FY2013 and FY2022. This was applied to estimates of GRP for RAPAD region from the modelling.
- **Payroll tax** (Queensland Government): total payroll tax received (ABS, 2023 a) compared to total wages and salaries paid to Queensland employees (ABS, 2023 b; ABS, 2023 c) between FY2013 and FY2022. This was applied to estimates of incomes paid in the RAPAD region from the modelling.
- **Resource Royalties tax** (Queensland Government: Royalties estimates were calculated by applying the current resource royalty rate of 5.0% to the estimated copper mining output of $150.2 million (Queensland Revenue Office, 2023).

Both direct and flow-on impacts are included in the estimation of the above taxation revenues.

The estimates of Queensland and Australian Government revenue supported by the enabled activity are indicative only based on the above benchmarking approach.

5.1.3 Population Impacts

The residential population was calculated by applying the RAPAD Region's current local ratio of FTEs (by Place of Work) per population of 1.9 residents per FTE worker to the EIA Outcomes (ABS, 2023 c).

5.2 ENABLED ACTIVITY

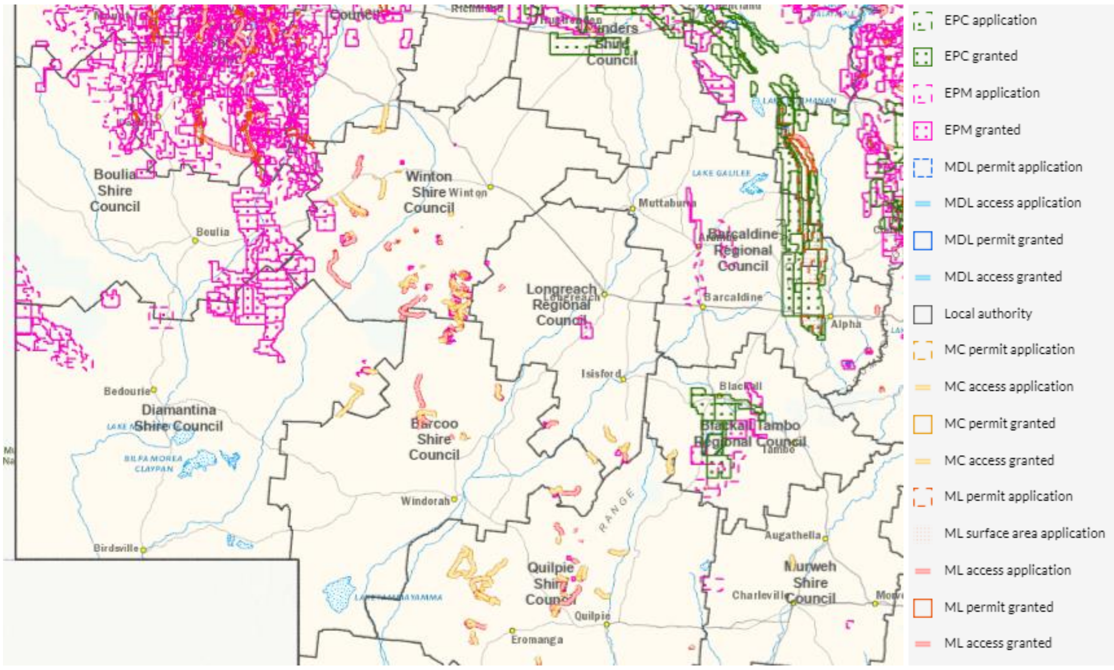
The identified opportunities that can be enabled through additional water resource access can be allocated to three primary activities:

- Extractive resources (copper mining)
- Irrigated agriculture (use of both unallocated water and under-allocated water)
- Hydrogen production (beneficial reuse of municipal STP throughput).

5.2.1 Extractive Resources

The RAPAD region has a number of extractive resource development opportunities, including both minerals (coal and non-coal resources) and gas (conventional and coal-seam gas). Figure 5.1 provides an overview of mineral exploration permits in the RAPAD region.

Figure 5.1. Mineral Resources Permits in the RAPAD Region



Source: GeoResGlobe (2023).
Note to key:

- EPC = Exploration Permit (Coal)
- EPM = Exploration Permit (Minerals)
- MDL = Mineral Development Licence
- MC = Mining Claim
- ML = Mining Lease

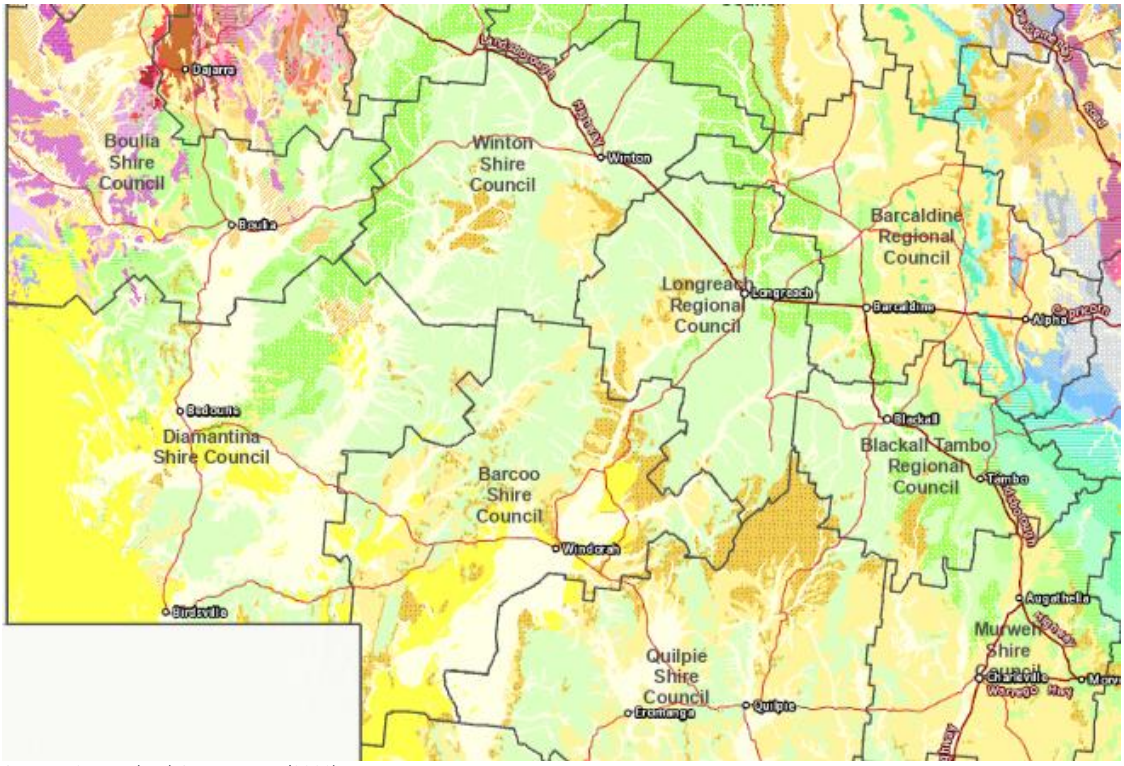
For the purposes of this analysis, it is assumed that two non-coal mineral resource developments (copper mines) in the vicinity of the Boulia Shire Council proceed. The value of direct mining activity is estimated to be $150.2 million in mining related economic output, equivalent to twice the average mine output over the past five years in the Cloncurry Shire ($75.1 million each mine).

The total water required for this opportunity is estimated to be 5,000 ML (2,500 ML for each mine) (AEC, 2023).

5.2.2 Irrigated Agriculture

The RAPAD region has large areas of land potentially suitable for irrigated agriculture (including the production of fodder to both quicken livestock turnoff and/or increase carcase weight and improve drought resilience, as well as irrigated cropping – cereals, non-cereal crops and cotton). Figure 5.2 below shows the areas potentially suitable for irrigated agriculture in the RAPAD region (identified as green and dark green, white, and beige).

Figure 5.2. Surface Geology of the RAPAD Region



Source: Queensland Government (2023).
Key:

- White: Recent Quaternary Alluvial Systems
- Green and dark green: Tertiary-early Quaternary clay plains
- Beige: Tertiary-early Quaternary loamy and sandy plains and plateaus
- Yellow: Quaternary inland dunefields

Utilising all unallocated water resources and increasing surface water resource allocation in the Georgina and Diamantina and Cooper Creek catchments to 10% Mean Average Flow (MAF) represents only 0.53% utilisation of potential good quality agricultural land in the RAPAD region (0.07% from unallocated water and 0.47% from under allocated water).

This means that only relatively small areas of potentially good quality agricultural land are likely to be developed, even with considerably increased water for irrigation.

Increased value of production

Within the RAPAD region, 93.7% of the value of agricultural production is generated by the production of cattle and calves. The value of this activity across the RAPAD region, relative to the area of land utilised is outlined in Table 5.1 below.

Table 5.1. Value of Cattle Production in RAPAD Region

LGA	Grazing Area (ha)	Output per ha ($)
Boulia	5,694,170	$10.55
Diamantina	6,282,153	$10.55
Barcoo	5,964,745	$10.55
Winton	5,352,794	$10.55
Longreach	3,025,177	$15.71
Barcaldine	4,424,156	$44.11
Blackall Tambo	2,436,936	$44.11
Weighted average - RAPAD		**$17.96**

Source: ABS (2022a), ABS (2022b).

Considering the opportunity for land use change with additional water resources, Table 5.2 profiles benchmarked estimates of a range of alternative irrigated agricultural activities and their expected economic output.

The following selection criteria were used to identify benchmark LGAs to estimate the economic output per ha of agricultural production, based on each agricultural land use:

- **Fed cattle:** More than 50% of water used to irrigate pasture to fed off, 50% of agricultural land is improved pasture, 50% of agricultural output is cattle and calves, less than 30% of agricultural value is milk and milk products.
- **Irrigated cotton cropping:** LGAs with the largest areas of irrigated cotton cropping (at least 750ha of land used for cropping).
- **Irrigated cereal cropping:** At least 20% of agricultural value is cereal cropping and at least 20% of agricultural land is used for cropping, at least 1,000 ha used for cereal cropping, more than 100ML used to irrigate crops.
- **Irrigated non-cereal cropping:** At least 15% of agricultural value is non-cereal cropping and at least 15% of agricultural land is used for cropping, more than 100ML used to irrigate crops.

Table 5.2. Value of Alternative Irrigated Agriculture Land Uses

Benchmark LGA	Area utilised (ha)	Output per ha ($)
Fed Cattle		
Towong (VIC)	106,083	$718.86
Glen Innes Severn (NSW)	198,273	$301.73
Kyogle (NSW)	68,692	$409.39
Wodonga (VIC)	11,670	$624.58
Weighted average	**-**	**$445.77**
Irrigated Cotton		
Maranoa (QLD)	942	$9,968.08
Bogan (NSW)	6,291	$8,683.01
Coonamble (NSW)	950	$8,598.78
Bourke (NSW)	2,247	$8,415.28
Warren (NSW)	4,187	$8,053.91
Brewarrina (NSW)	2,524	$7,759.43
Goondiwindi (QLD)	17,227	$7,633.34
Lachlan (NSW)	4,640	$7,580.42
Balonne (QLD)	22,408	$7,311.73
Weighted average	**-**	**$7,731.68**
Irrigated Cereal Cropping		
Ararat (VIC)	74,568	$1,448.06
Liverpool Plains (NSW)	113,565	$1,447.28
Knox (VIC)	1,120	$1,327.45
Griffith (NSW)	32,413	$1,283.06
Pyrenees (VIC)	40,172	$1,273.92
Moira (VIC)	122,475	$1,236.30
Light (SA)	40,020	$1,178.75
Greater Hume Shire (NSW)	73,937	$1,167.71
Junee (NSW)	57,428	$1,149.72
Berrigan (NSW)	47,236	$1,144.09
Weighted average	**-**	**$1,279.71**
Irrigated Non-cereal Cropping		
Ararat (VIC)	47,983	$1,526.11
Buloke (VIC)	135,891	$960.41

Benchmark LGA	Area utilised (ha)	Output per ha ($)
Hindmarsh (VIC)	62,310	$1,203.72
Yorke Peninsula (SA)	109,100	$1,494.41
Yarriambiack (VIC)	171,985	$1,305.82
Wakefield(SA)	66,687	$884.91
Weighted average	**-**	**$1,221.26**

Source: ABS (2022a), ABS (2022b), ABS (2022c).
Note: Numbers may not add due to rounding.

For the purposes of this analysis, it is assumed that enabled areas will be equally used across the four different irrigation types, that is 25% for each activity of:

- Fed cattle
- Irrigated cotton
- Irrigated cereal cropping
- Irrigated non-cereal cropping.

Activity Enabled by Existing Allocations

The RAPAD region has an estimated 154,900 ML of unallocated surface water and 20,500 ML of groundwater resources 175,400 ML in total). Assuming 5,000 ML of groundwater are utilised for resource projects in the vicinity of Boulia, 170,400 ML of water is theoretically available to support additional irrigated agriculture.

Table 5.3 below outlines how water resources were distributed across the RAPAD region, accounting for the proportion of potentially good quality agricultural land in each catchment across each LGA. Table 5.4 below outlined the enabled irrigation area based on the use of existing unallocated water resources, based on an estimated irrigation rate of 14 ML/ha (DNRM, 1984).

Table 5.3. Distribution of Existing Allocations

Water Source	Available/ Unallocated Water (ML)	Boulia	Diamantina	Barcoo	Winton	Longreach	Barcaldine	Blackall-Tambo
Surface Water								
Georgina & Diamantina	13,500	34%	16%	10%	40%	-	-	-
Cooper Creek	2,200	-	-	20%	4%	17%	26%	33%
Burdekin (Belyando-Suttor)	139,200	-	-	-	-	-	100%	-
Groundwater								
All sub-basins	20,500	14%	7%	14%	19%	8%	17%	20%
Total	**170,400**							

Source: AEC.

Table 5.4. Land Enabled by Utilising Existing Allocations (Ha)

Water Source	Boulia	Diamantina	Barcoo	Winton	Longreach	Barcaldine	Blackall-Tambo
Groundwater	160	75	154	212	92	187	227
Surface water	327	154	125	396	27	9,983	53
Total	**487**	**229**	**279**	**608**	**119**	**10,171**	**279**

Source: AEC.

Activity Enabled by Additional Resource Utilisation

Surface water resources in the RAPAD region are considerably under-allocated, with only 0.3% (Georgina and Diamantina) and 0.3% (Cooper Creek) of Mean Annual Flow (MAF) in the Lake Bye Basin catchments allocated for economic use (SMEC, 2023). Increasing the allocation of surface water resources to 10% will continue to ensure 90% allocation of water resources for environmental purposes, while also enabling considerable additional economic development opportunity.

The volume of additional surface water allocation and enabled irrigation area at 10% MAF is presented in Table 5.5 below. It is important to note that no assessment of the potential under allocation of groundwater resources has been undertaken due to lack of available data.

Table 5.5. Land Enabled by Utilising Additional Resource Allocation (Ha)

Water Source	Available/ Under-allocated Water (ML)	Boulia	Diamantina	Barcoo	Winton	Longreach	Barcaldine	Blackall-Tambo
Surface Water								
Georgina & Diamantina	677,311	16,389	7,704	4,722	19,564	0	0	0
Cooper Creek	560,013	0	0	7,931	1,565	6,790	10,341	13,373
Burdekin (Belyando-Suttor)	0	0	0	0	0	0	0	0
Total	**1,237,324**	16,389	7,704	12,653	21,129	6,790	10,341	13,373

Note: average water consumption was conservatively estimated at 14 ML/ha based on advice from the Queensland Government contained in DNRM (1984)
Source: AEC.

5.2.3 Green Hydrogen Production

The RAPAD region has considerable opportunity to expand the production of green hydrogen as a sustainable transport fuel and for peak dispatch of stored renewable energy. As most of the major towns in the RAPAD region are situated along major freight routes and there is an emerging opportunity to generate green hydrogen to be used in long-haul transport. Liquid fuels are also the RAPAD region's largest imports.

A key component in the production of renewable/green hydrogen is the use of non-potable water. The primary source of this water is treated sewerage water. Based on the region's estimated effluent throughput, the RAPAD region could produce up to 92,393 tonnes of green hydrogen annually (through a distributed supply network, co-located with existing sewerage treatment facilities in key population centres).

For comparison, the Queensland Government's Hydrogen Production and Export Opportunities report has the Abbot Point terminal export catchment having a hydrogen production capacity of 1.38Mt per annum and the Port of Townsville export catchment having a hydrogen production capacity of 1.15Mt per annum (Queensland Government, 2022).

The operational benefits of hydrogen production, based on industry benchmarks, is included in Table 5.6 below.

Table 5.6. Green Hydrogen Operational Activity Assumption

Capital Item	Operational Activity per Tonne of Production
Revenue	
Revenue	$1,812.0
Operating Activity	
Water	$37.7
Electricity	$856.2
Labour	$65.8
Other	$203.4
Employment	
FTE	0.001

Source: AEC (2021).

5.2.4 Summary of Enabled Activity

Table 5.7 below presents the modelled activities, primary industry sector and expected economic output (for Input-Output modelling purposes). Additional detail on the model drivers are included in section 5.21 to section 5.2.3.

Table 5.7. Enabled Activity Model Drivers

Enabled Activity	IO Industry	Expected Output ($M)	Water Use (ML)
Extractive resources	Non-Ferrous Metal Ore Mining (100%)	$150.2	5,000 ML
Irrigated agriculture (unallocated water)	Other Agriculture (cotton) Sheep, Grains, Beef and Dairy Cattle	$23.5 $9.0	163,747 ML
Irrigated agriculture (Under allocated water)	Other Agriculture (cotton) Sheep, Grains, Beef and Dairy Cattle	$170.8 $65.1	1,299,605 ML
Hydrogen production	Basic Chemical Manufacturing (100%)	$167.6	925 ML
Total	-	**$586.2**	-

Note: Totals may not sum due to rounding.
Source: AEC.

5.3 ECONOMIC IMPACT ASSESSMENT

5.3.1 Irrigated Agriculture

Activity Enabled by Existing Allocations

Production of irrigated agriculture using unallocated water is estimated to also support the following within the RAPAD region:

- $22.5 million in Gross Regional Product (GRP) (including $15.0 million in direct activity)
- $15.7 million in incomes and salaries paid to households (including $11.3 million in direct wages)
- 206 FTE jobs (including 155 FTE jobs directly related to irrigated agriculture production).

Table 5.8. Total Economic Activity Supported by Unallocated Water used in Irrigated Agriculture

Impact	Output ($M)	Gross Regional Product ($M)	Incomes ($M)	Employment (FTEs)
Initial Stimulus in Local Economy	$32.5	$15.0	$11.3	155
Direct Requirements Impacts*	$10.1	$4.7	$2.9	34
Industry Support Impacts*	$1.6	$0.8	$0.6	6
Household Consumption Impacts	$3.2	$1.9	$0.9	11
Total Impacts in Local Economy	**$47.4**	**$22.5**	**$15.7**	**206**

Note: *Production induced flow-on (Type I) Impacts. Figures may not add due to rounding.
Source: AEC.

Activity Enabled by Additional Resource Utilisation

Production of irrigated agriculture using under allocated water is estimated to also support the following within the RAPAD region:

- $163.4 million in Gross Regional Product (GRP) (including $109.0 million in direct activity)
- $114.2 million in incomes and salaries paid to households (including $82.2 million in direct wages)
- 1,499 FTE jobs (including 1,127 FTE jobs directly related to irrigated agriculture production).

Table 5.9. Total Economic Activity Supported by Under Allocated Water used in Irrigated Agriculture

Impact	Output ($M)	Gross Regional Product ($M)	Incomes ($M)	Employment (FTEs)
Initial Stimulus in Local Economy	$235.9	$109.0	$82.2	1,127
Direct Requirements Impacts*	$73.3	$34.3	$21.2	247
Industry Support Impacts*	$11.9	$6.1	$4.1	42
Household Consumption Impacts	$23.3	$14.0	$6.7	83
Total Impacts in Local Economy	**$344.5**	**$163.4**	**$114.2**	**1,499**

Note: *Production induced flow-on (Type I) Impacts. Figures may not add due to rounding.
Source: AEC.

5.3.2 Extractive Resources

The development of new copper mines in the RAPAD region is estimated to support the following additional activity:

- $92.2 million in GRP (including $42.9 million in direct activity)
- $53.3 million in incomes and salaries paid to households (including $20.1 million in direct wages)
- 443 FTE jobs (including 109 FTE jobs direct related to copper mining).

Table 5.10. Total Economic Activity Supported by Resource Extraction

Impact	Output ($M)	Gross Regional Product ($M)	Incomes ($M)	Employment (FTEs)
Initial Stimulus in Local Economy	$150.2	$42.9	$20.1	109
Direct Requirements Impacts*	$78.4	$36.4	$25.8	249
Industry Support Impacts*	$12.8	$6.4	$4.3	44
Household Consumption Impacts	$10.9	$6.5	$3.1	40
Total Impacts in Local Economy	**$252.4**	**$92.2**	**$53.3**	**443**

Note: *Production induced flow-on (Type I) Impacts. Figures may not add due to rounding.
Source: AEC.

5.3.3 Green Hydrogen Production

Green hydrogen production in the RAPAD region due to beneficial reuse of treated effluent is estimated to contribute:

- $89.9 million in GRP (including $24.3 million in direct activity)
- $33.8 million in incomes and salaries paid to households (including $6.1 million in direct wages)
- 379 FTE jobs (including 93 FTE jobs directly related to hydrogen production).

It is important to note that the economic impacts of hydrogen production have been calculated in aggregate across the 13 communities with sewerage treatment plants across RAPAD region.

Table 5.11. Total Economic Activity Supported by Green Hydrogen Production

Impact	Output ($M)	Gross Regional Product ($M)	Incomes ($M)	Employment (FTEs)
Initial Stimulus in Local Economy	$167.6	$24.3	$6.1	93

Impact	Output ($M)	Gross Regional Product ($M)	Incomes ($M)	Employment (FTEs)
Direct Requirements Impacts*	$90.1	$48.6	$18.6	186
Industry Support Impacts*	$20.2	$10.1	$5.8	59
Household Consumption Impacts	$11.4	$6.8	$3.3	42
Total Impacts in Local Economy	**$289.4**	**$89.9**	**$33.8**	**379**

Note: *Production induced flow-on (Type I) Impacts. Figures may not add due to rounding.
Source: AEC.

5.3.4 Summary of Findings

Table 5.12 below presents the summary of findings from the EIA.

Table 5.12. Summary of EIA Outcomes

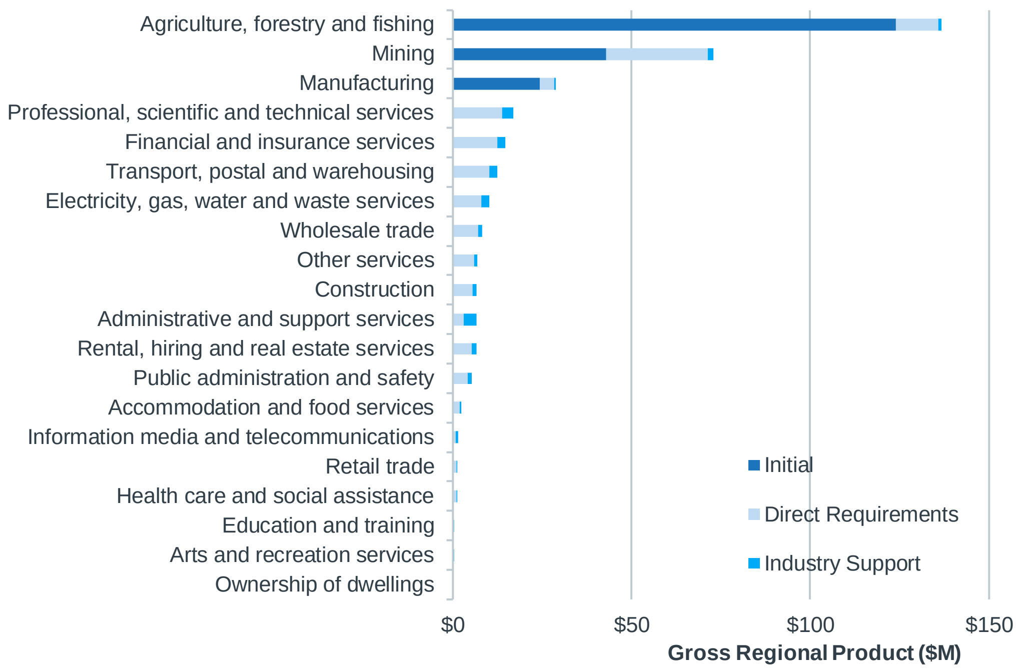
Drive of Demand	Gross Regional Product ($M)			Employment (FTE)		
	Initial	Flow-on	Total	Initial	Flow-on	Total
Irrigated agriculture (unallocated resources)	$31.1	$15.5	$46.6	329	109	438
Irrigated agriculture (under allocated resources)	$246.6	$123.0	$369.6	2,613	864	3,477
Extractive Resources	$42.9	$49.3	$92.2	109	334	443
Green Hydrogen Production	$24.3	$65.6	$89.9	93	286	379
Total	**$344.9**	**$253.3**	**$598.2**	**3,143**	**1,593**	**4,736**

Note: Totals may not sum due to rounding.
Source: AEC.

Major industry beneficiaries include (in terms of GRP):

- Agriculture, forestry and fishing (GRP $136.7 million)
- Mining (GRP $72.9 million)
- Manufacturing (GRP $28.7 million).

Figure 5.3. Gross Regional Product (GRP) Impacts by Industry ($M)



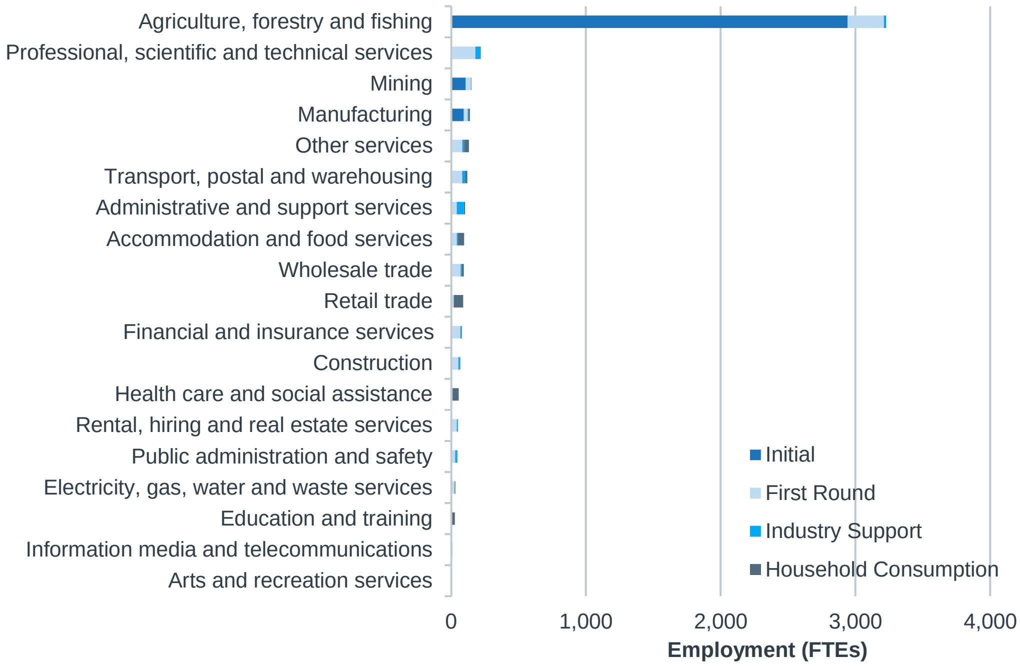
Source: AEC.

Major industry beneficiaries include (in terms of employment):

- Agriculture, forestry and fishing (1,411 FTEs)

- Mining (148 FTEs)
- Professional, scientific and technical services (139 FTEs).

Figure 5.4. Employment Impacts by Industry (FTEs)



Source: AEC.

5.4 CONTRIBUTION TO GOVERNMENT REVENUES

Additional economic activity from the development of additional water resources in the RAPAD region is estimated to generate $91.3 million in additional taxes. $25.7 million or 28.2% of the total taxes going to the Queensland Government with $91.3 million or 71.8% of the total taxes going to the Federal Government. Table 5.13 provides a detailed breakdown of tax contributions.

Table 5.13. Tax Contribution of Developments to Government Revenues

Tax Revenue	Irrigated Agriculture (Unallocated Water)	Irrigated Agriculture (Under Allocated Water)	Resource Extraction	Green Hydrogen Production	Total
State Taxes					
Payroll Tax	$0.4	$3.0	$1.4	$0.9	$5.7
GST	$0.8	$5.5	$3.1	$3.0	$12.5
Resource Royalties	-	-	$7.5		$7.5
Sub-total	**$1.2**	**$8.6**	**$12.0**	**$3.9**	**$25.7**
National Taxes					
Income Tax	$3.8	$27.6	$12.9	$8.2	$52.5
Fringe Benefits	$0.1	$0.6	$0.3	$0.2	$1.1
Company Tax	$0.5	$3.9	$3.1	$4.5	$12.0
Sub-Total	**$4.4**	**$32.1**	**$16.3**	**$12.8**	**$65.6**
Total	**$5.6**	**$40.7**	**$28.3**	**$16.7**	**$91.3**

Note: Totals may not sum due to rounding.
Source: AEC.

5.5 POPULATION IMPACTS

The residential population was calculated by applying the RAPAD Region's local ratios of FTEs (by Place of Work) per population of 1.9 residents per FTE worker to the EIA Outcomes. Resource extraction is assumed to not create any additional population in the RAPAD region as it is likely to be developed with a fly-in fly-out workforce.

Table 5.14 provides an overview of the additional population created in the RAPAD region due to the enabled economic activity. The population impacts represent a 37.2% increase in the region's population (current estimated residential population – ERP is 10,721).

Table 5.14. Population Impacts

Development	Total FTEs Created	Additional Population Created
Irrigated Agriculture (Unallocated Water)	206	393
Irrigated Agriculture (Under Allocated Water)	1,499	2,855
Resource Extraction	443	0
Green Hydrogen Production	379	721
Total	**2,527**	**3,969**

Note: Totals may not sum due to rounding.
Source: AEC.

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APPENDIX A: INPUT-OUTPUT METHODOLOGY

INPUT-OUTPUT MODEL OVERVIEW

Input-Output analysis demonstrates inter-industry relationships in an economy, depicting how the output of one industry is purchased by other industries, households, the government and external parties (i.e. exports), as well as expenditure on other factors of production such as labour, capital and imports. Input-Output analysis shows the direct and indirect (flow-on) effects of one sector on other sectors and the general economy. As such, Input-Output modelling can be used to demonstrate the economic contribution of a sector on the overall economy and how much the economy relies on this sector or to examine a change in final demand of any one sector and the resultant change in activity of its supporting sectors.

The economic contribution can be traced through the economic system via:

- **Initial stimulus (direct) impacts**, which represent the economic activity of the industry directly experiencing the stimulus.
- **Flow-on impacts**, which are disaggregated to:
    - **Production induced effects (type I flow-on)**, which comprise the effects from:
        - Direct expenditure on goods and services by the industry experiencing the stimulus (direct suppliers to the industry), known as the first round or direct requirements effects.
        - The second and subsequent round effects of increased purchases by suppliers in response to increased sales, known as the industry support effects.
    - **Household consumption effects (type II flow-on)**, which represent the consumption induced activity from additional household expenditure on goods and services resulting from additional wages and salaries being paid within the economic system.

These effects can be identified through the examination of four types of impacts:

- **Output**: Refers to the gross value of goods and services transacted, including the costs of goods and services used in the development and provision of the final product. Output typically overstates the economic impacts as it counts all goods and services used in one stage of production as an input to later stages of production, hence counting their contribution more than once.
- **Gross product**: Refers to the value of output after deducting the cost of goods and services inputs in the production process. Gross product (e.g., Gross Regional Product) defines a true net economic contribution and is subsequently the preferred measure for assessing economic impacts.
- **Income**: Measures the level of wages and salaries paid to employees of the industry under consideration and to other industries benefiting from the project.
- **Employment**: Refers to the part-time and full-time employment positions generated by the economic shock, both directly and indirectly through flow-on activity, and is expressed in terms of full time equivalent (FTE) positions.

Input-Output multipliers can be derived from open (Type I) Input-Output models or closed (Type II) models. Open models show the direct effects of spending in a particular industry as well as the indirect or flow-on (industrial support) effects of additional activities undertaken by industries increasing their activity in response to the direct spending.

Closed models re-circulate the labour income earned as a result of the initial spending through other industry and commodity groups to estimate consumption induced effects (or impacts from increased household consumption).

MODEL DEVELOPMENT

Multipliers used in this assessment are derived from sub-regional transaction tables developed specifically for this project. The process of developing a sub-regional transaction table involves developing regional estimates of gross production and purchasing patterns based on a parent table, in this case, the 2018-19 Australian transaction table (ABS, 2021a).

Estimates of gross production (by industry) in the study areas were developed based on the percent contribution to employment (by place of work) of the study areas to the Australian economy (ABS, 2012; ABS, 2017; ABS, 2021b; DoESE, 2021), and applied to Australian gross output identified in the 2018-19 Australian table.

Industry purchasing patterns within the study area were estimated using a Flegg Location Quotient approach, as described in Flegg *et al*. (2021), with a fixed degree of convexity applied to the regional size scalar. Regional final demand estimates (except exports) developed based on the regional inter-industry sales estimated using the Flegg Location Quotient relative to national inter-industry sales and final demand estimates for each industry (noting regional exports are assumed to reflect the remainder of total uses).

Employment estimates were rebased from 2018-19 (as used in the Australian national Input-Output transaction tables) to current year values using the Wage Price Index (ABS, 2021c).

MODELLING ASSUMPTIONS

The key assumptions and limitations of Input-Output analysis include:

- **Lack of supply-side constraints:** The most significant limitation of economic impact analysis using Input-Output multipliers is the implicit assumption that the economy has no supply-side constraints so the supply of each good is perfectly elastic. That is, it is assumed that extra output can be produced in one area without taking resources away from other activities, thus overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.
- **Fixed prices:** Constraints on the availability of inputs, such as skilled labour, require prices to act as a rationing device. In assessments using Input-Output multipliers, where factors of production are assumed to be limitless, this rationing response is assumed not to occur. The system is in equilibrium at given prices, and prices are assumed to be unaffected by policy and any crowding out effects are not captured. This is not the case in an economic system subject to external influences.
- **Fixed ratios for intermediate inputs and production (linear production function):** Economic impact analysis using Input-Output multipliers implicitly assumes that there is a fixed input structure in each industry and fixed ratios for production. That is, the input function is generally assumed linear and homogenous of degree one (which implies constant returns to scale and no substitution between inputs). As such, impact analysis using Input-Output multipliers can be seen to describe average effects, not marginal effects. For example, increased demand for a product is assumed to imply an equal increase in production for that product. In reality, however, it may be more efficient to increase imports or divert some exports to local consumption rather than increasing local production by the full amount. Further, it is assumed each commodity (or group of commodities) is supplied by a single industry or sector of production. This implies there is only one method used to produce each commodity and that each sector has only one primary output.
- **No allowance for economies of scope:** The total effect of carrying on several types of production is the sum of the separate effects. This rules out external economies and diseconomies and is known simply as the "additivity assumption". This generally does not reflect real world operations.
- **No allowance for purchasers' marginal responses to change:** Economic impact analysis using multipliers assumes that households consume goods and services in exact proportions to their initial budget shares. For example, the household budget share of some goods might increase as household income increases. This equally applies to industrial consumption of intermediate inputs and factors of production.
- **Absence of budget constraints:** Assessments of economic impacts using multipliers that consider consumption induced effects (type two multipliers) implicitly assume that household and government consumption is not subject to budget constraints.

Despite these limitations, Input-Output techniques provide a solid approach for taking account of the inter-relationships between the various sectors of the economy in the short-term and provide useful insight into the quantum of final demand for goods and services, both directly and indirectly, likely to be generated by a project.

In addition to the general limitations of Input-Output analysis, there are two other factors that need to be considered when assessing the outputs of sub-regional transaction table developed using this approach, namely:

- It is assumed the sub-region has similar technology and demand/ consumption patterns as the parent (Australia) table (e.g. the ratio of employee compensation to employees for each industry is held constant).
- Intra-regional cross-industry purchasing patterns for a given sector vary from the national tables depending on the prominence of the sector in the regional economy compared to its input sectors. Typically, sectors that are more prominent in the region (compared to the national economy) will be assessed as purchasing a higher proportion of imports from input sectors than at the national level, and vice versa.

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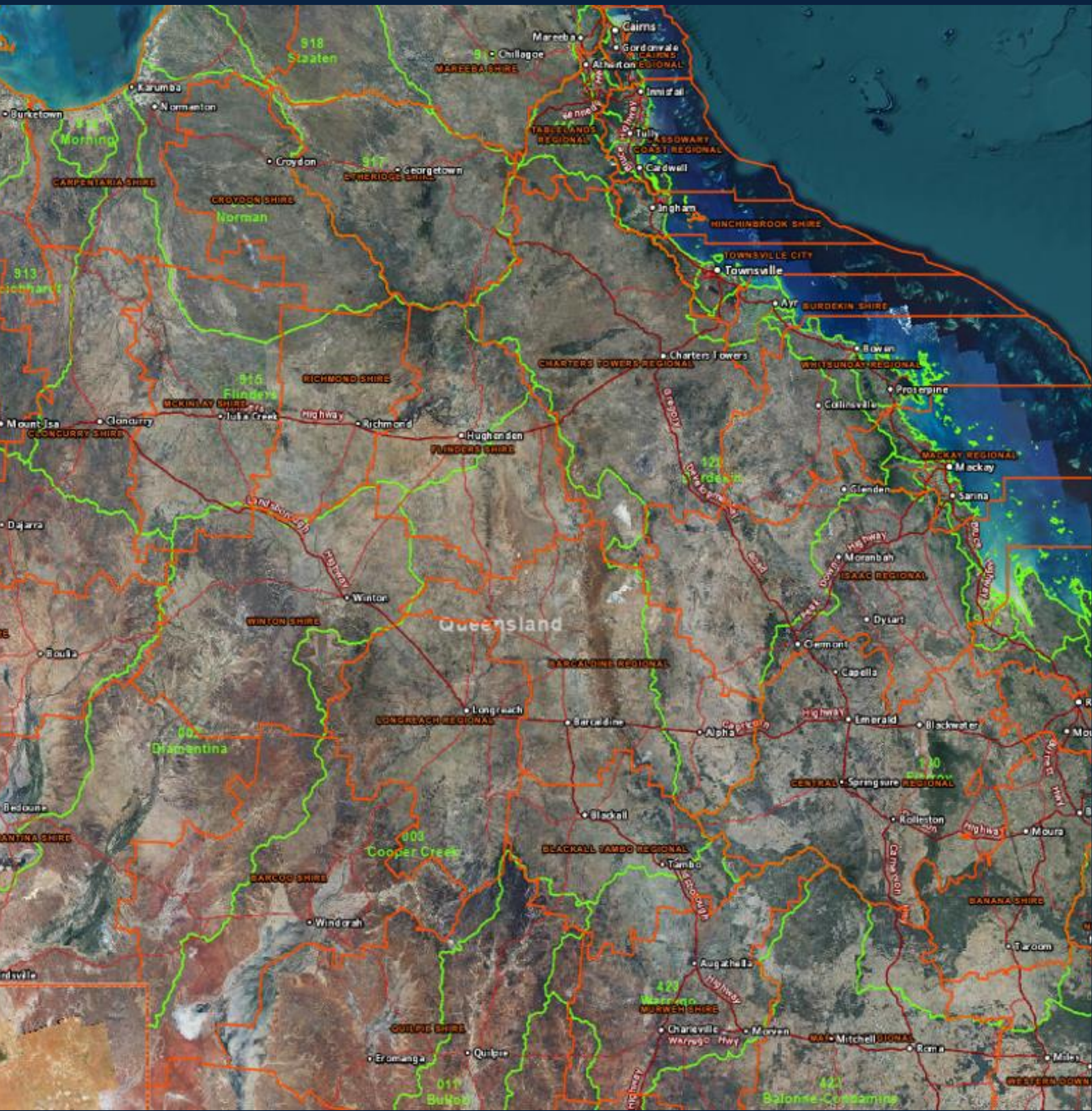

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Technical Report

RAPAD - Water for Economic Development in Central Western Queensland

Client Reference No. 30035724
Prepared for: AEC
9 June 2023

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1. Executive Summary

The Remote Area Planning and Development Board (RAPAD) has expressed interest in gaining a deeper understanding of the water resources in Central Western Queensland. In order to achieve this objective, a comprehensive assessment of the water supply was conducted, focusing on the catchment areas of Georgina and Diamantina, Cooper Creek, Burdekin Basin, and the Great Artesian Basin. These assessments were aligned with the water plans and water resource plans of each catchment area.

The goal of this assessment was to determine the availability and diversity of water resources in the RAPAD region and address water allocation within the aforementioned catchment areas. To accomplish this, the assessment methodology involved an analysis of existing water plans, a comparison of allocated volumes with streamflow data, and the identification of potential under-allocation of water resources.

The key findings of the assessment reveal the following:

- Current surface water licences in the Georgina and Diamantina plan area are negligible, whilst unallocated surface water reserves represent less than 1% of the total surface water flows.
- Current surface water licences combined with unallocated surface water reserves in the Cooper Creek plan area represent less than 1% of total surface water flows.
- Current surface water allocations in the Belyando-Suttor sub-catchment of the Burdekin Basin plan area represent approximately 6% of available surface water flows and unallocated reserves represent an additional 9%.
- Surface water extractions in the Belyando-Suttor sub-catchment of the Burdekin Basin plan area are much higher than those in the Georgina and Diamantina and Cooper Creek plan areas. This is because the Burdekin has larger and more reliable flow, which has generated a greater level of development.
- Surface water extractions in the Georgina and Diamantina and Cooper Creek plan areas are negligible compared to groundwater extractions from the GAB, which is a larger and more reliable resource.
- The GAB has 2,365 ML of unallocated general reserves and 17,900 ML of unallocated strategic reserves.
- There are unallocated surface water reserves of 13,500 ML in the Georgina Diamantine plan area which includes 1,500 ML for State Significant Projects with the remainder for “Any Use”.
- There are unallocated surface water reserves of 2,200 ML in the Cooper Creek catchment, which are made up of 1,300 ML for projects of State or Regional significance, 500 ML for Town Water Supply, 200 ML for Indigenous uses and 200 ML for general but non-irrigation use.
- The largest opportunity for surface water development is in the Belyando-Suttor sub-catchment of the Burdekin Basin, which has 130,000 ML of general reserves and 20,000 ML of strategic reserves.
- There is also the potential to access 30% of the savings from capping existing bores in the GAB.

Based on the assessment, untapped water resources have been identified that could support economic expansion within the region. It is crucial for RAPAD and stakeholders to recognize these opportunities and collaborate with the Queensland government, particularly the Department of Regional Development Manufacturing and Water (DRDMW), to address how best to secure water to meet emerging requirements.

In conclusion, the water supply assessment conducted to understand the water resources with the RAPAD in Central Western Queensland, provides insights into the availability and utilization of water resources and highlights the unique characteristics, challenges, and opportunities present in each catchment area. By capitalizing on available resources RAPAD can work towards implementing effective solutions that promote economic growth and ensure long-term water security for Central Western Queensland.

2. Introduction

2.1 Purpose

This report presents the findings of a water supply assessment for surface water and groundwater resources within the Remote Area Planning and Development Board (RAPAD) region. The region contains the Georgina and Diamantina, Cooper Creek and Burdekin Basin surface water catchments, and is underlaid by the Great Artesian Basin (GAB) which supplies ground water.

The assessment has been structured to report on water resources in each surface water catchment and in the GAB. Organizing the assessment by catchment and groundwater management areas aligns with documentation associated with the Queensland water plans.

The primary objective of this report is to inform RAPAD about the availability and diversity of water resources in Central Western Queensland, which is crucial for promoting economic growth in the region.

2.2 Remote Area Planning and Development Board (RAPAD)

RAPAD is a not-for-profit organization that was established in 1974 as a regional planning authority for the outback region of Queensland which aims to foster economic and social development in the area. RAPAD works closely with communities, businesses, and governments to identify opportunities for growth and development, and to implement initiatives that will help to build sustainable and resilient communities. Some of the areas of focus for RAPAD include agriculture, tourism, infrastructure, and community development.

RAPAD's membership comprises seven local government councils in the remote outback region of Queensland, as listed below and included in Figure 1:

- Barcaldine Regional Council
- Barcoo Shire Council
- Blackall-Tambo Regional Council
- Boulia Shire Council
- Diamantina Shire Council
- Longreach Regional Council
- Winton Shire Council

The region includes the following towns/centres:

- Barcaldine
- Blackall
- Longreach
- Winton
- Barcoo (which includes the town of Jundah)
- Diamantina (which includes the town of Bedourie)
- Boulia (which includes the town of Boulia)

These townships are located in remote and sparsely populated areas of Queensland and face unique challenges in terms of economic and social development.

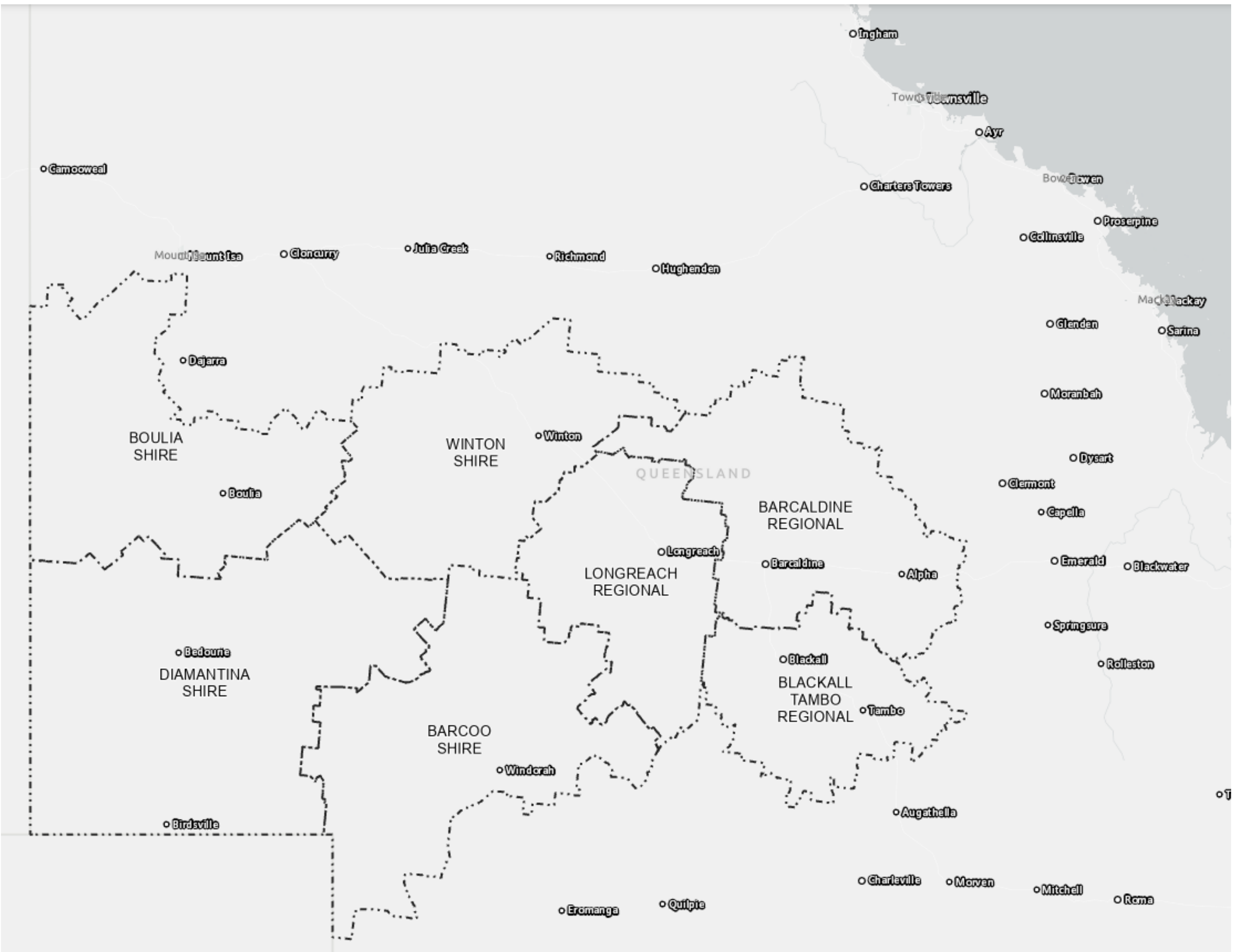

Figure 1: RAPAD Map

2.3 Document Reference

This report draws on information from documents related to water management in Queensland including Water Plans, Resource Operation Plans and Regional Water Supply Security Assessments. These documents were obtained from the website of the Department of Regional Development Manufacturing and Water (DRDMW). A list of the reference documents is included in Table 1.

Table 1: List of the documents reference

	Title	Document Link	Year	Updated Date
1	Unallocated water	https://www.business.qld.gov.au/industries/mining-energy-water/water/catchments-planning/unallocated-water	-	-
2	Water supply schemes and water management areas	https://www.business.qld.gov.au/industries/mining-energy-water/water/water-markets/current-locations	-	-
3	Georgina and Diamantina Resource Operations Plan 2006	https://www.rdmw.qld.gov.au/__data/assets/pdf_file/0016/106045/gd-rop.pdf	-	-
4	Georgina and Diamantina water plan area	https://www.business.qld.gov.au/industries/mining-energy-water/water/catchments-planning/water-plan-areas/georgina-diamantina	2004	2017

	Title	Document Link	Year	Updated Date
5	Cooper Creek water plan area	https://www.business.qld.gov.au/industries/mining-energy-water/water/catchments-planning/water-plan-areas/cooper-creek	2011	2011
6	Cooper Creek Resource Operations Plan	https://www.rdmw.qld.gov.au/__data/assets/pdf_file/0006/110787/cooper-creek-resource-operations-plan.pdf	2013	2013
7	Burdekin Basin water plan area	https://www.business.qld.gov.au/industries/mining-energy-water/water/catchments-planning/water-plan-areas/burdekin	2007	2007
8	Burdekin Basin Water Management Protocol 2016	https://www.rdmw.qld.gov.au/__data/assets/pdf_file/0008/1447478/burdekin-basin-water-management-protocol-2019.pdf	2016	2019
9	Burdekin Groundwater Management Area	https://www.rdmw.qld.gov.au/?a=109113:policy_registry/wsr-burdekin-gma.pdf	2013	2022
10	Water Entitlement Viewer	https://qgsp.maps.arcgis.com/apps/MapSeries/index.html?appid=610e67fd52e24dbf9168ed812137ff5c	-	-

2.4 Overview of the Catchment Areas and GAB

2.4.1 Georgina and Diamantina

The Georgina and Diamantina catchment area, located in the Channel Country of western Queensland, spans over 426,000 square kilometres, refer to Figure 2. The area is mainly flat, with some low hills and mesas incorporating various landscape types, including grassland plains, sand dunes and rocky outcrops. Geological surveys show that the region has rich sedimentary rock formations, including sandstones, mudstones and siltstones, which are primarily responsible for the region's unique landscape and topography.

The climate is hot and semi-arid, with low rainfall and high evaporation rates. Average annual rainfall in the region is around 300-500 millimetres, with most of the rainfall occurring during the summer months. Temperature can be extreme, with average maximum temperatures ranging from 30°C to 40°C during the summer months, dropping to around 15°C during the winter months.

The Diamantina River is an important waterway in the region and is approximately 900 kilometres long. It rises in the eastern corner of the Northern Territory and meanders through south-western Queensland through arid and semi-arid landscapes. The Diamantina River merges with the Georgina River near the town of Birdsville, forming part of the Lake Eyre Basin system. The main tributaries of the Diamantina River are the Wilson River and Macumba River. The Wilson River flows south from the Northern Territory, while the Macumba River originates in the ranges near the Queensland and South Australia border.

The Georgina River stretches for approximately 640 kilometres through an arid and sparsely populated region of central and north-western Queensland. It originates in the Selwyn Range, near the border between Queensland and the Northern Territory and flows in a north-easterly direction before eventually joining Eyre Creek, forming the Flinders River system. One of the key tributaries of the Georgina River is the Burke River, which converges with the Georgina River near the small town of Boulia. The Burke River originates in the northern Simpson Desert and flows southwest, joining the Georgina River. Minor tributaries include the Hamilton, Cornish, and Sandover rivers.

The Georgina and Diamantina catchment forms part of the Lake Eyre Basin, which is one of the largest internally draining river systems globally. Lake Eyre Basin fills with water only during rare flood events.

Both the Georgina and Diamantina Rivers are intermittent rivers, meaning that they do not flow continuously. During periods of heavy rainfall, these rivers can experience significant floods, which have important ecological implications for the surrounding areas. Figure 3 shows the major water bodies within the Georgina and Diamantina catchments.

These rivers, along with their tributaries, contribute to the unique and fragile ecosystems of central and north-western Queensland. They provide crucial water sources for wildlife and support a range of vegetation communities and incorporate numerous waterholes and wetlands that provide essential habitat for a range of aquatic and bird species.

The rivers and water bodies are of cultural significance to the local indigenous communities. These rivers also play a role in sustaining pastoral and agricultural activities in the region, including irrigation in some areas.

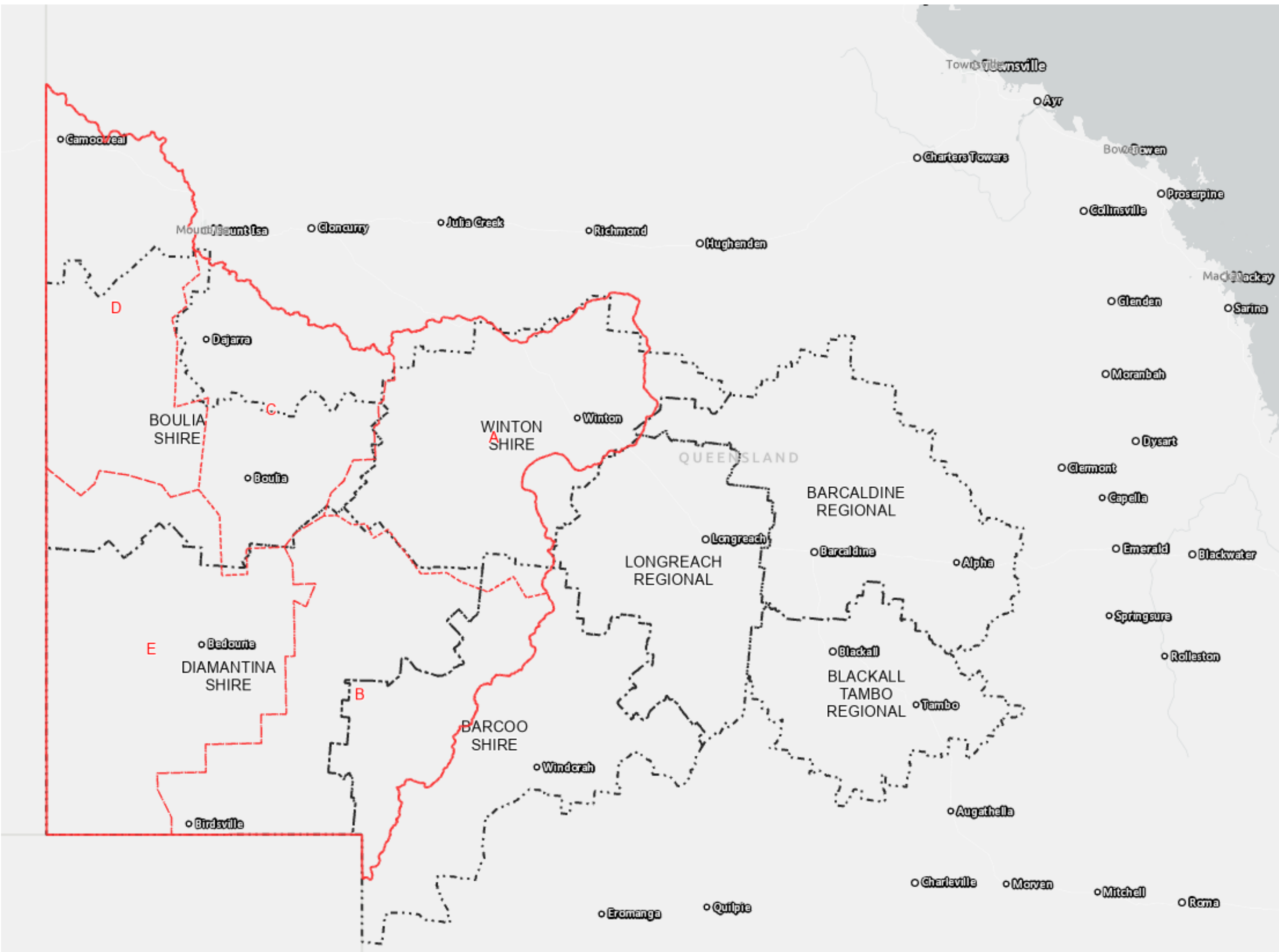

Figure 2: Georgina and Diamantina catchment area and its sub catchments in red.

Figure 3: Georgina and Diamantina Basin and Main Water Bodies.

2.4.2 Cooper Creek

The Cooper Creek catchment is located in an arid and semi-arid zone of central Australia, covering an area of approximately 281,000 square kilometres, refer to Figure 4. The topography of the region is varied, with the catchment comprising both flat and undulating terrain. The western portion of the catchment is characterized by rolling sand dunes, whilst the eastern portion is marked by stony hills and plateaus.

Geological surveys show that the Cooper Creek catchment area is rich in sedimentary rock formations, including sandstones, limestones, and shales. These formations have played a crucial role in shaping the topography of the region and provide valuable insights into the geological history of the area.

The Cooper Creek system is one of the largest river systems in Australia. It originates in the eastern highlands of Queensland and flows for approximately 1,300 kilometres before emptying into Lake Eyre. The catchment includes numerous waterholes and wetlands that provide important habitat for a range of aquatic and bird species. The catchment area of Cooper Creek encompasses the sub-catchments of Thomson River, Barcoo River, and Cooper Creek itself. The Thomson River incorporates both permanent and semi-permanent waterholes and collects water from various creeks throughout central Queensland, starting from as far north as Charters Towers. The Thomson River takes shape at Muttaburra and continues its course through Longreach and Jundah before merging with the Barcoo River at Windorah. Adjacent to the Thomson River sub-catchment lies the Barcoo River, extending southward. Key towns along the Barcoo River include Barcaldine and Blackall. This extensive catchment area encompasses portions of Barcaldine, Barcoo, Blackall-Tambo, Longreach, and a small part of Quilpie Shire. The main watercourses in the Cooper Creek Basin are shown in Figure 5. The junction of the Barcoo River and the Thomson River represents the commencement of true channel country, which is characterised by many intertwined rivulets or braided channels that can extend over a width of up to 80 km.

The climate is hot and dry, with low rainfall and high evaporation rates. The average annual rainfall is around 250 millimetres, with most of the rain falling during the summer months. Annual rainfall is highly variable. The temperature in the region can be extreme, with average maximum temperatures ranging from 30°C to 40°C during the summer months, dropping to around 20°C during the winter months. These climatic conditions have important implications for water resource management and other engineering activities in the region.

Given the aridity in the Cooper Creek catchment, water is scarce and managing it is a crucial concern for the local citizens and businesses, including agriculture, mining, and tourism.

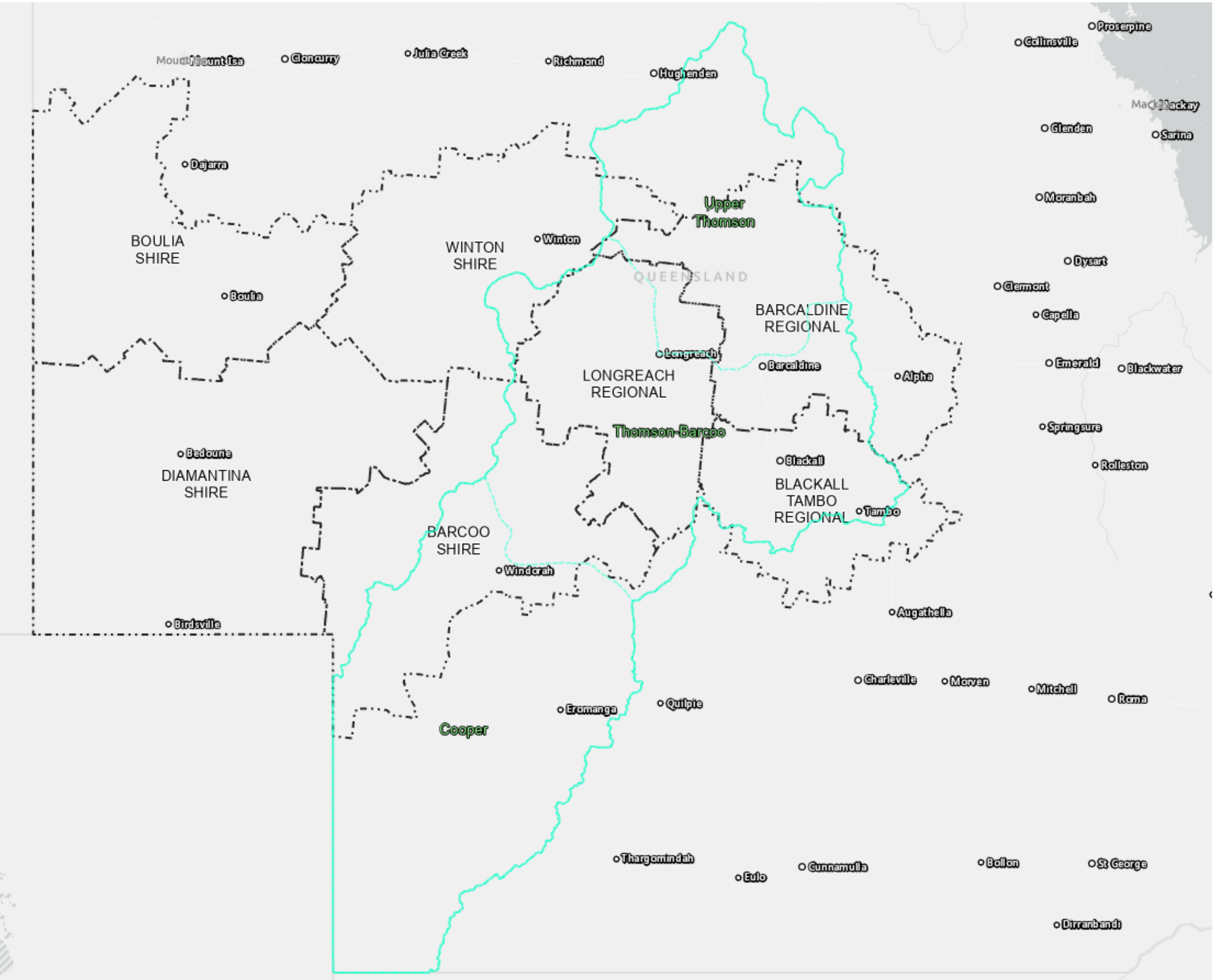

Figure 4: Map of Cooper Creek Catchment and its sub catchments in green.

Figure 5: Cooper Creek Basin and Main Watercourses

2.4.3 Burdekin Basin

The Burdekin catchment area is located in northern Queensland and covers an area of approximately 134,000 square kilometres, refer to Figure 6. Only a small portion of the Upper Burdekin Basin lies within the RAPAD region. The Burdekin Basin is characterized by diverse topography, including coastal plains, plateaus, and mountain ranges.

Geological surveys show that the region contains a variety of rock formations, including granite, sandstone, and basalt. The highlands and plateaus consist mainly of igneous rocks, while the lowlands are dominated by sedimentary rocks.

Climate in the Burdekin catchment area is tropical, with hot and humid summers and mild winters. The average annual rainfall in the region is around 800-1200 millimetres, with most of the rain falling during the summer months. Cyclones and severe weather events can bring significant rainfall to the region.

The hydrology of the Burdekin catchment is dominated by the Burdekin River, which has one of the largest flood discharges in Australia. The river system originates in the Great Dividing Range and flows for approximately 1,000 kilometres before emptying into the Coral Sea. The catchment contains several smaller rivers and creeks, as well as numerous wetlands and lagoons.

The catchment supports a wide range of agricultural activities, including sugarcane, cattle grazing, and horticulture. The region also includes a large mining industry. The Burdekin catchment is significant for its biodiversity and cultural heritage, with a number of important wetlands and cultural sites located within the region.

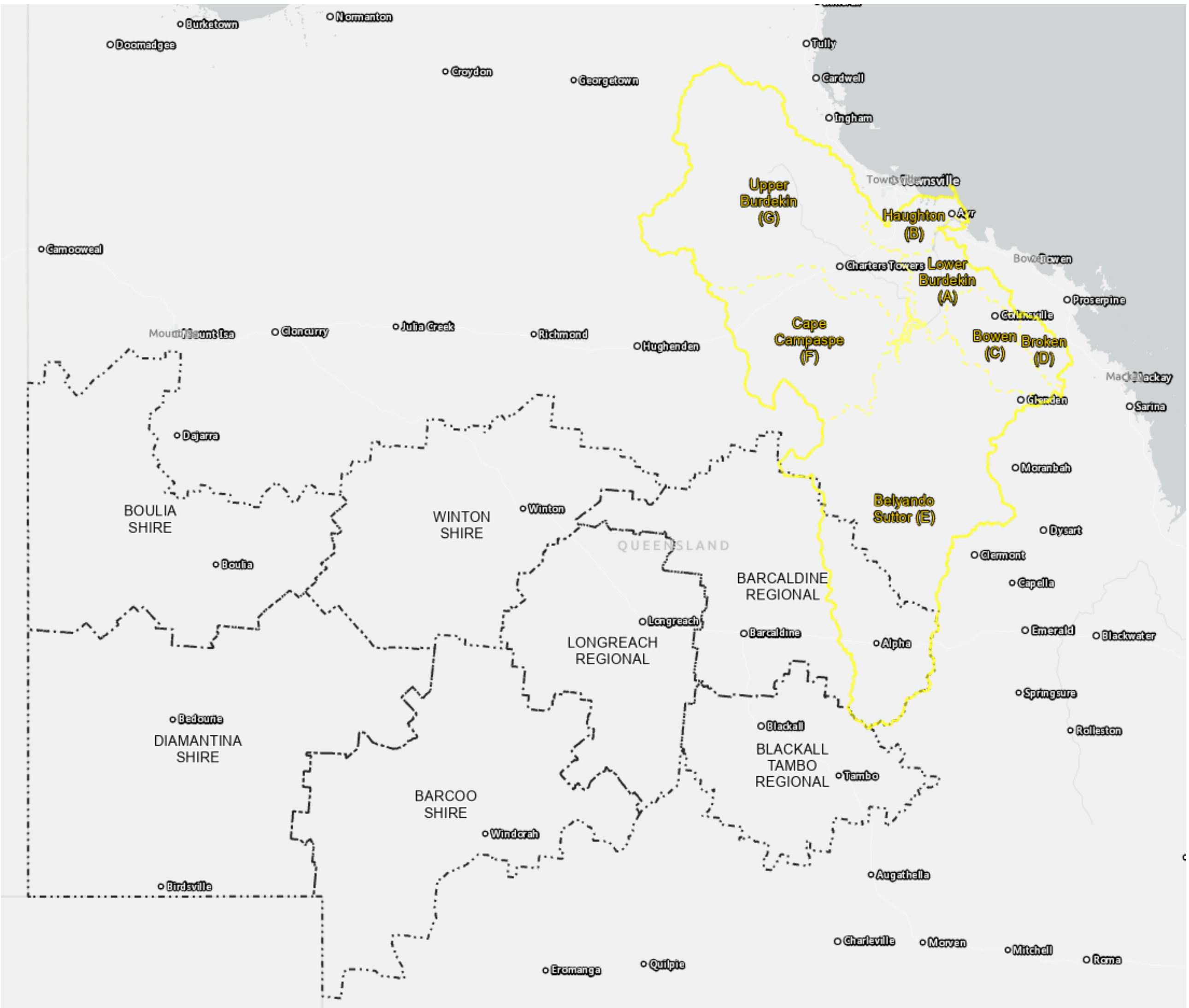

Figure 6: Map of Burdekin Basin and its sub catchments in yellow.

2.4.4 Great Artesian Basin

The GAB is one of the largest underground water reservoirs in the world, covering an area of around 1.7 million square kilometres beneath parts of Queensland, New South Wales, South Australia, and the Northern Territory. A map of the Great Artesian Basin and its sub-basins is included in Figure 7. Most of the RAPAD region is underlaid by the GAB, which extends over a much larger area.

The Great Artesian Basin is a complex geological feature consisting of several sedimentary basins and structural depressions, including the Eromanga Basin, the Surat Basin, and the Carpentaria Basin. This report will explore the Eromanga subarea, which is located within the RAPAD area.

The GAB is estimated to contain around 65,000 cubic kilometres of water. Water in the GAB originates from rainfall that occurs in the recharge zones, which are located in the highlands surrounding the GAB. Water percolates through permeable rock formations, eventually flowing towards the Basin's discharge zones, which are typically located in the western and southern parts of the Basin. Water in the Basin is under high pressure, causing it to rise to the surface as natural springs in some areas.

The GAB is home to many unique and essential ecosystems, such as springs and wetlands, which provide a habitat for a vast array of plant and animal species.

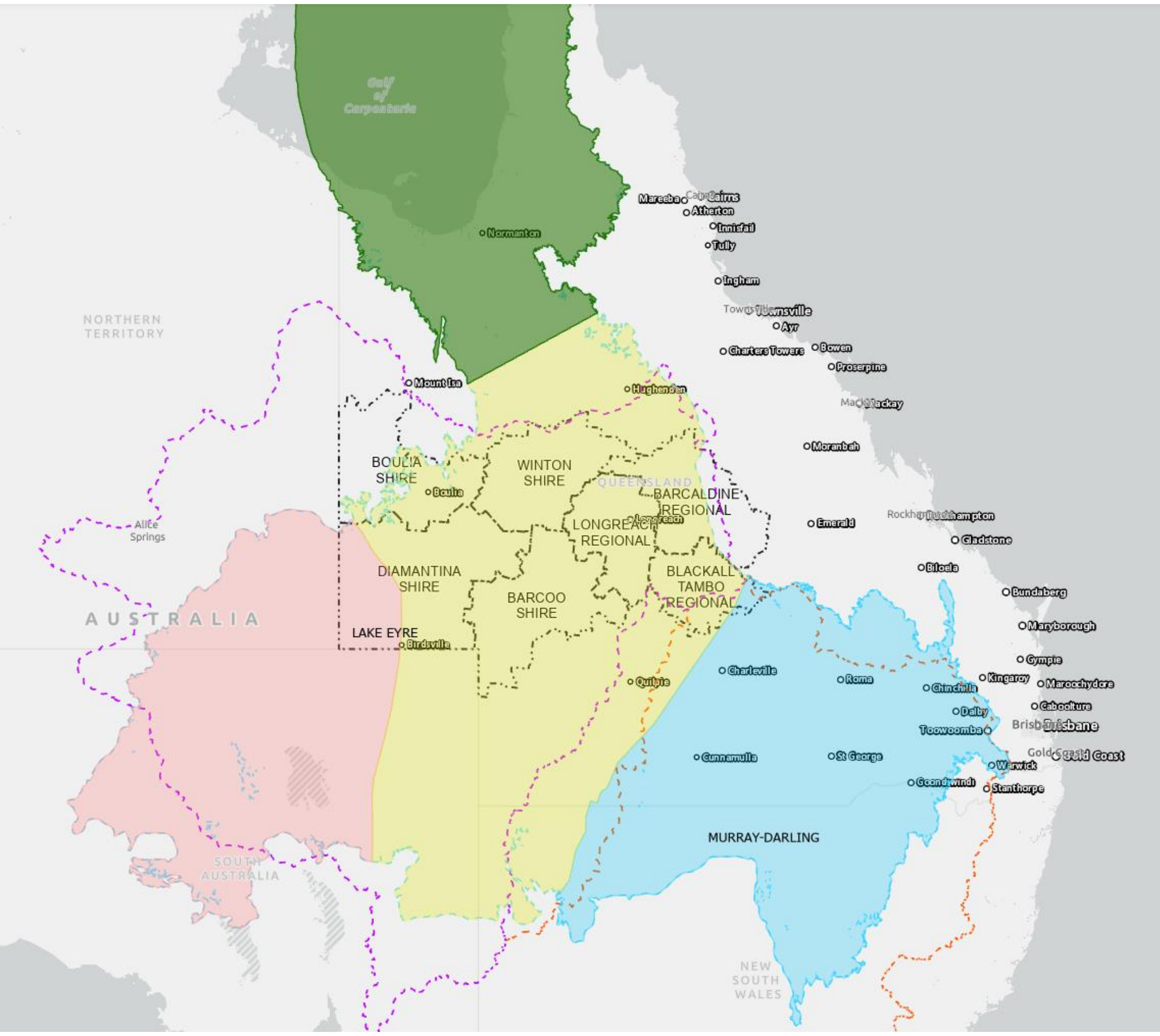

Figure 7: Map of the Great Artesian Basin and its sub basins.

3. Overview of Water Resource Governance

3.1 Water Regulations in Queensland

Water in Queensland is regulated through the implementation of water plans that outline how water resources are managed within specific water management areas. These plans are developed and implemented by the Department of Regional Development Manufacturing and Water (DRDMW) in collaboration with local stakeholders, including water users, communities, and Indigenous groups.

Water resource plans in Queensland are required to address the following key processes and elements of the water regulation:

- **Water Planning Process:** The development of water resource plans follows a structured process involving assessment, consultation, and plan preparation, including development and evaluation of scientific studies, data collection, and analysis to understand the water availability, demand, and environmental requirements of a particular region.
- **Stakeholder Consultation:** Throughout the water planning process, stakeholders such as water users, local communities, environmental groups, and Indigenous communities are consulted to ensure their interests and

concerns are taken into account. Public consultation and engagement are key components of the water planning process to ensure transparency and inclusiveness.

- **Water Allocation Framework:** Water resource plans establish a framework for allocating water resources within a region. This framework determines the rights and obligations of water users, including entitlements, allocations, and conditions for water use. It aims to balance the needs of various users, while ensuring sustainable water management and protection of the environment.
- **Sustainable Yield and Water Availability:** Water resource plans assess the sustainable yield of water sources and determines the available water for allocation. They consider factors such as rainfall patterns, streamflow data, groundwater recharge rates, and environmental flow requirements to ensure that water use is within sustainable limits.
- **Environmental Considerations:** Protecting and managing the environment is a crucial aspect of water resource planning. Water plans include provisions for maintaining adequate environmental flows to support ecosystem health, protect sensitive habitats, and manage water quality to minimize adverse impacts on aquatic ecosystems.
- **Water Monitoring and Reporting:** Water resource plans establish monitoring and reporting requirements to assess the status of water resources, track water usage, and ensure compliance with the regulations. Regular monitoring helps in evaluating the effectiveness of the plans and informs any necessary adjustments.
- **Review and Adaptive Management:** Water resource plans are periodically reviewed (approximately every 10 years) and updated to adapt to changing circumstances, new data, and evolving water management priorities. The review process involves consultation with stakeholders and the incorporation of new scientific knowledge and management practices.
- **Climate Change:** Climate change can have significant impacts on water availability and quality, which will be taken into account in future water plan revisions. Adaptive management strategies will be incorporated into water allocation plans to enhance resilience and the ability adapt to changing hydrological conditions.

3.2 Categories of Water Entitlements

Water plans often segregate entitlements into different categories to ensure effective allocation and utilization. Within the context of the overall supply structure, the following sections will provide insights into the specific categories of water entitlements including:

- Supplemented water;
- Unsupplemented water; and
- Unallocated water.

3.2.1 Supplemented Water

Supplemented water refers to water that can be stored and delivered to meet the demand for various purposes such as domestic, industrial, agricultural, or environmental needs. This is typically done through the construction of infrastructure such as dams, weirs and pipelines which store water during periods of high rainfall and transport water to demand centres as required.

Supplemented sources improve the reliability of water supply, especially during dry periods. However, it is important to ensure that supplementation does not negatively impact the natural ecosystem, such as through altering water flows, affecting water quality, or disrupting wildlife habitats.

3.2.2 Unsupplemented Water

Unsupplemented water refers to the natural water supply that is not augmented by any human intervention or infrastructure. It is the water that is available in a given area from natural sources such as rivers, lakes, groundwater, and rainfall. Unsupplemented water allocations typically include rules that specify when water can be taken and how much can be taken. For example, water can only be taken from a river when flows exceed a particular threshold and there will typically be a limit on the rate of extraction. Essentially, unsupplemented water is extracted on an opportunistic basis.

Understanding the characteristics of unsupplemented water sources, such as the seasonal variability, water quality, and flow rates, is crucial for assessing its suitability for different uses.

3.2.3 Unallocated Water

Unallocated water is the volume of water that has been reserved in the relevant water plan for a specific purpose or geographic area, but has not yet been allocated to any particular user or application. This means that unallocated water is available for distribution, but has not yet been assigned to any specific use or individual. Unallocated reserves attempt to anticipate future requirements to meet to meet population growth, or to support economic development.

Unallocated water can be viewed as a potential source of water for future use.

3.3 Other Regulatory Instruments

Several other regulatory instruments may influence water resources development on the RAPAD region. Two key instruments are described below.

Channel Country Strategic Environmental Area

The Regional Planning Interests Act of 2014 was introduced to manage the impact of resources activities and other prescribed activities on areas of regional interest. The Act identifies four areas of regional interest:

i. Priority Agricultural Areas
ii. Priority Living Areas
iii. Strategic Cropping Areas
iv. Strategic Environmental Areas

Four Strategic Environmental Areas have been established, with the Channel Country being one of those areas. The construction of water storages (dams and weirs) and irrigation development may be subject to controls under this legislation.

Regulatory Impact Statement for Lake Eye

The Lake Eye Basin has global ecological importance and regional First Nations cultural significance, being a rare example of intact dryland rivers, floodplains and connected alluvial hydrology. The Queensland Government aims to ensure long-term protection of the Lake Eye Basin. A Regulatory Impact Statement (RIS) is being developed as an important step in developing a future framework for managing the Lake Eye Basin. Current Land uses in the Lake Eye Basin include grazing, farming, mineral mining and oil and gas exploration. These permitted practices currently have a low environmental impact. Future proposals for development in the region will require approvals under this framework and will be required to demonstrate they do not have a negative impact and may be subject to constraints if approved.

4. Georgina and Diamantina Basins

4.1 Resource Assessment – Georgina Basin

4.1.1 Climate & Rainfall

The catchment area of the Georgina River encompasses a vast region in Queensland and the Northern Territory. This river system is fed by more than 36 tributaries, including the Georgina River, Burke River, Hamilton River, Eyre Creek, and Wills Creek. Its origin lies to the northwest of Mt Isa, with three main tributaries: The Buckle, Sander, and Ranken rivers, the latter two having their sources in the Northern Territory. Additionally, the catchment receives inflow from numerous creeks and rivers, with the Burke and Hamilton Rivers being the primary contributors. These rivers take their headwaters from the Selwyn Range and flow southward. Boulia and Camooweal are located in the northern part of this region.

To the north of Marion Downs, the Burke River merges with the Georgina River and the Hamilton River joins to the south. At Marion Downs, the Georgina River expands into braided channels and spreads across vast floodplains as it continues its journey towards Bedourie. It is at this point that the channel country meets the Simpson Desert.

The Georgina River catchment spans four local governments, namely Cloncurry, Mt Isa, Boulia, and Diamantina, before reaching the South Australian border and continuing on to Lake Eyre via Kati Thanda.

Key climate observations are:

- Over the past 30 years, the annual rainfall in the region has been relatively stable, with an increase of approximately 20mm/a. However, rainfall still experiences natural fluctuations. Dry years have been recorded six times, while wet years have occurred eleven times, with the remaining years falling within the average.
- Although there have been increases in wet season rainfall in certain areas, Boulia has experienced a decrease in rainfall during the wet season (December to February). Specifically, from 1959-1988 to 1989-2018, the rainfall in Boulia during the wet season has declined by 9mm/a, dropping from 207mm/a to 198mm/a.
- Rainfall in the south-western part of the region (particularly around Birdsville) has been unreliable and has been moderately reliable around Boulia during the monsoon season. Across the region, rainfall during the early wet months is generally unreliable.
- On average, there are two useful rain events per year. Between 1900 and 2019 there have only been 13 summer seasons that did not experience a 50mm rain event, indicating an 11% risk of such an occurrence in any given year.
- While there have been decreases in winter rainfall, Boulia has observed compensatory increases in spring and early summer precipitation.

Figure 8 provides annual rainfall data for six locations in the catchment, whilst Figure 9 provides summary annual rainfall statistics for these locations. (These data were sourced from the Georgina River Catchment Local Knowledge Map, a publication by Resilient Queensland Reconstruction Authority.)

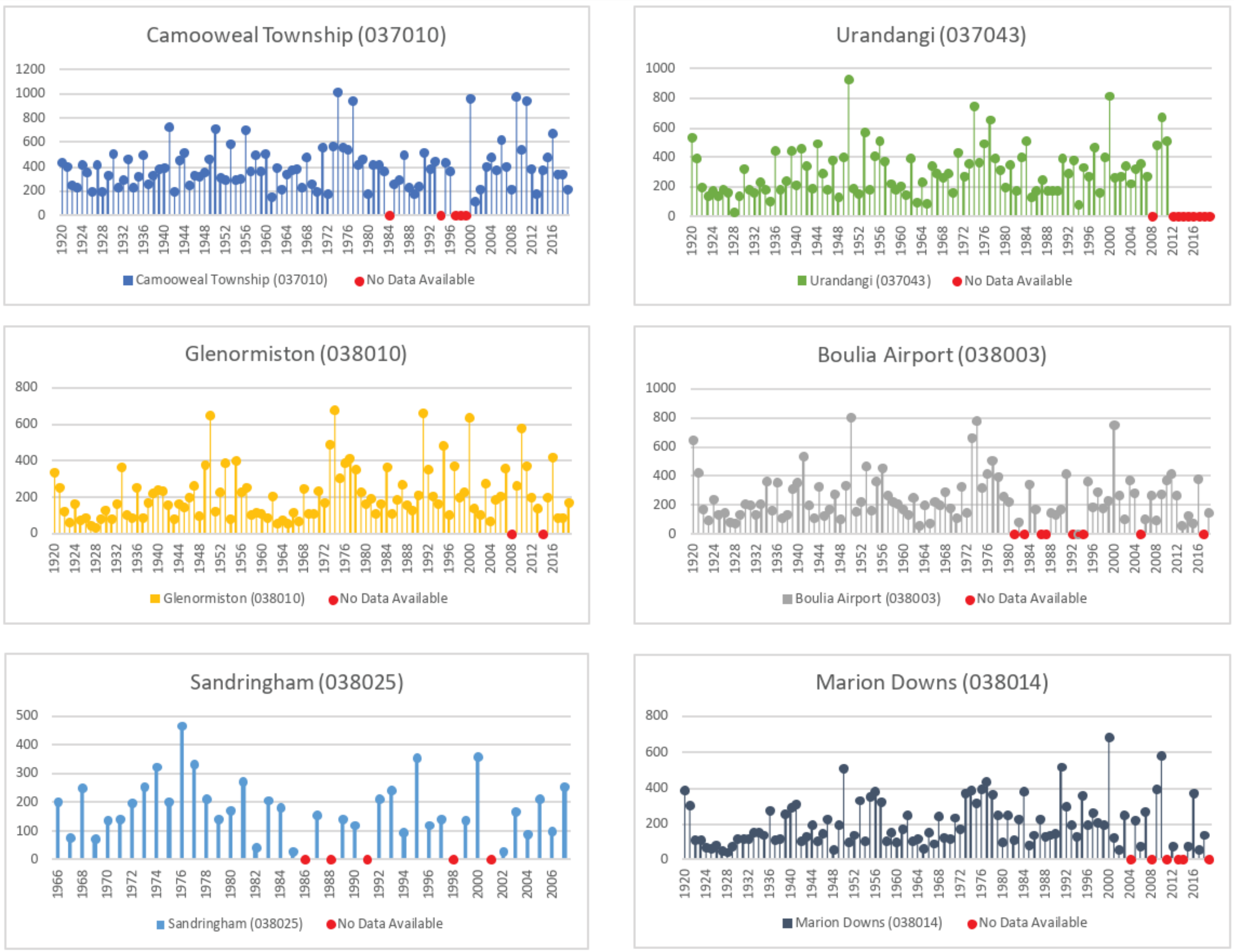

Figure 8: Rainfall data for 6 localities in the Georgina Basin

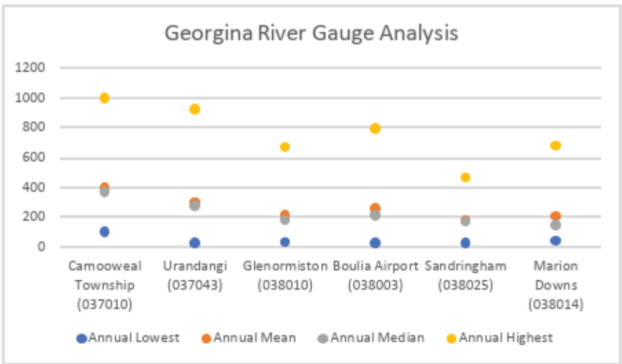

Figure 9: Georgina precipitation.

4.1.2 Water Flow Monitoring

The Georgina Basin has two stream flow gauging stations being the Georgina River at Roxborough Downs (ID: 001203A) and the Burke River at Boulia (ID: 001202A). The location of these stations is shown in Figure 10, whilst annual flow statistics are provided in Table 2. Annual flows are highly variable, as with all rivers in the RAPAD region, with flow being dominated by a few major events, as illustrated in Figure 11. For example, the mean annual flow (MAF) of the Georgina River at Roxborough Downs is approximately 1,090,500ML/a, however the minimum recorded annual flow of 4,620 ML/a is several orders of magnitude smaller than the MAF, whilst the maximum annual flow of 6,312,700 ML/a six times larger than the MAF. Flows are also highly seasonal, as illustrated in Figure 12. Most flows occur in the wet season, which extends from January to March, with very little flow in the remaining months.

Table 2: Annual Streamflow Statistics for Georgina basin.

Site	Minimum Annual Flow (ML/a)	Maximum Annual Flow (ML/a)	Mean Annual Flow (ML/a)	Median Annual Flow (ML/a)	Sub catchment (refer Figure 2)
Georgina River at Roxborough Downs	4,620	6,312,710	1,090,500	468,330	D - Upper Georgina
Burke River at Boulia	1,100	2,578,000	344,126	195,416	C - Burke and Hamilton

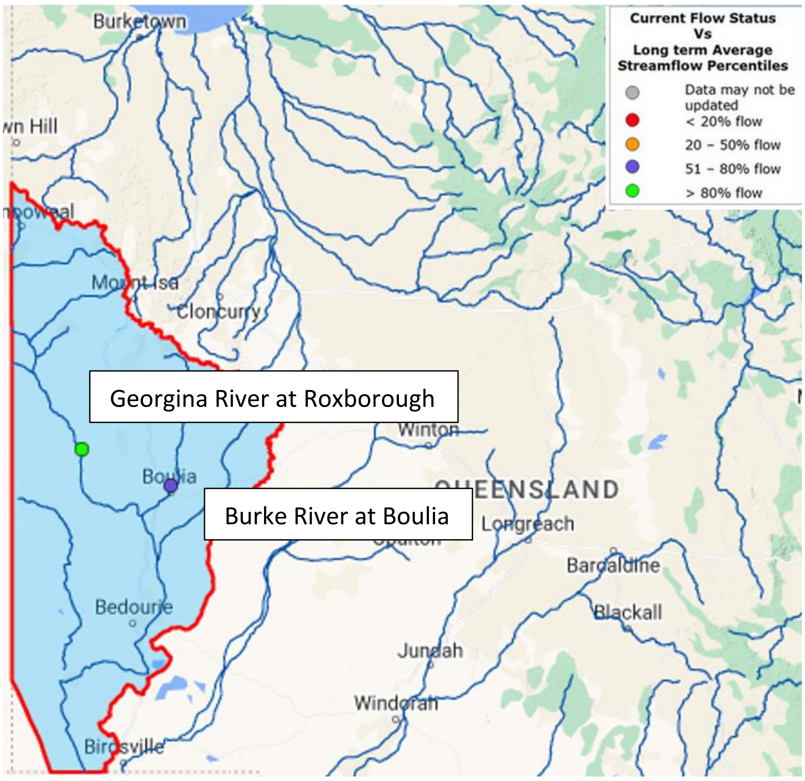

Figure 10: Georgina Basin and its water monitoring locations.

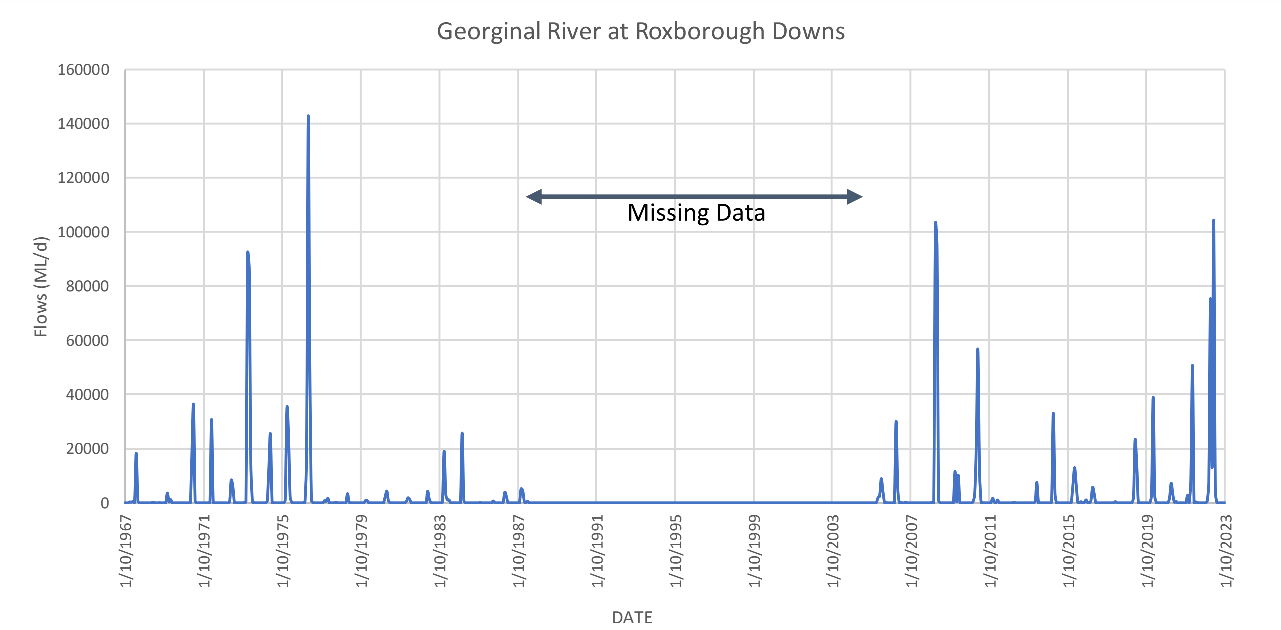

Figure 11: Annual Flows Georgina River at Roxborough Downs

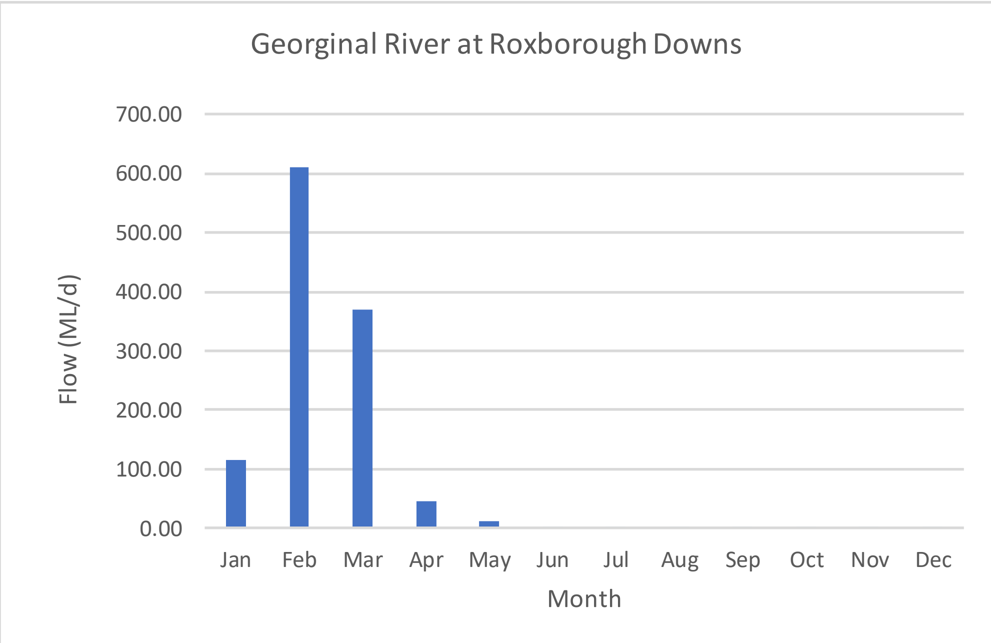

Figure 12: Monthly Flows Georgina River at Roxborough Downs

4.1.3 Significant Waterholes and Wetlands

Table 3 provides a list of significant waterholes and wetlands in the Georgina and Diamantina catchment (extracted from the Georgina and Diamantina Resource Operations Plan of 2006). These waterholes and wetlands serve as crucial storage and recharge points, retaining water even when river flows are reduced or intermittent. They provide essential habitats and watering points for a variety of wildlife, including migratory birds, aquatic species, and terrestrial animals, supporting ecosystems, biodiversity and contributing to the overall health and resilience of the environment.

Moreover, these waterholes and wetlands often serve as important cultural and recreational sites for local communities, indigenous groups, and visitors. They have spiritual and historical significance and may be utilized for traditional practices, tourism, and recreational activities such as fishing, boating, and birdwatching.

During times of drought, when river flows are diminished, these waterholes and wetlands become critical sources of water for both wildlife and livestock. They can sustain local communities by providing access to water resources when other sources may be scarce or inaccessible.

Table 3: Significant Waterholes and Wetlands.

Number	Name	Management Area
GD1	Paravituari Waterhole	Burke and Hamilton
GD2	Jimburella Waterhole	Burke and Hamilton
GD5	Lake Katherine	Upper Georgina
GD6	Roxborough Waterhole	Upper Georgina
GD7	Linda Creek Waterhole (Toko Gorge)	Lower Georgina
GD8	Waukaba Waterhole	Upper Georgina
GD11	Lake Mary	Upper Georgina
GD12	Lake Mipia Area	Lower Georgina
GD13	Muncoonie Lakes Area	Lower Georgina
GD14	Lake Namabooka Area	Lower Georgina
GD15	Wheeler Creek Junction	Lower Georgina
GD16	Lake Torquinie Area	Lower Georgina
GD17	Lake Philippi	Lower Georgina
GD18	Lewis Lagoon Floodout	Burke and Hamilton
GD19	Austral Limestone Aggregation	Upper Georgina
GD25	King Creek Floodout Area	Lower Georgina

4.2 Resource Assessment – Diamantina Basin

4.2.1 Climate & Rainfall

The Diamantina River Basin has been subjected to extensive analysis in recent years, with researchers seeking to understand the weather and climate patterns in the region. A BoM 2018 report analysed 30 years of data from 1989 to 2018 and provides valuable insights into the region's weather and climate. The report includes focus on annual rainfall, which has remained relatively stable over the past three decades. While there have been natural fluctuations resulting in six dry years and eleven wet years, the annual rainfall has increased by approximately 20mm/a. This data sets the foundation for further exploration into the weather patterns and climate changes occurring in the Diamantina River Basin. Key observations are:

- Annual rainfall in the Diamantina River Basin has increased by approximately 20mm/a over the past 30 years, with natural fluctuations resulting in six dry years and eleven wet years.
- On average, the Diamantina River at Birdsville remains dry for five months or 40% of each year.
- Minor floods occur on average once every two years.
- Rainfall in the south-western part of the Birdsville region has been unreliable, particularly during the early wet months.
- Useful rain events typically occur twice a year. The term "useful rain" provides significant benefits in terms of water supply, agricultural productivity, and other related factors.
- Between 1900 and 2019 there have only been 13 summer seasons without a 50mm rain event, representing an 11% risk of this happening any given year.

Figure 13 provides annual rainfalls for six locations within the catchment, whilst Figure 14 provides annual summary rainfall statistics for these locations (these data are sourced from the Diamantina River Catchment Local Knowledge Map, a publication by the Resilient Queensland Reconstruction Authority).

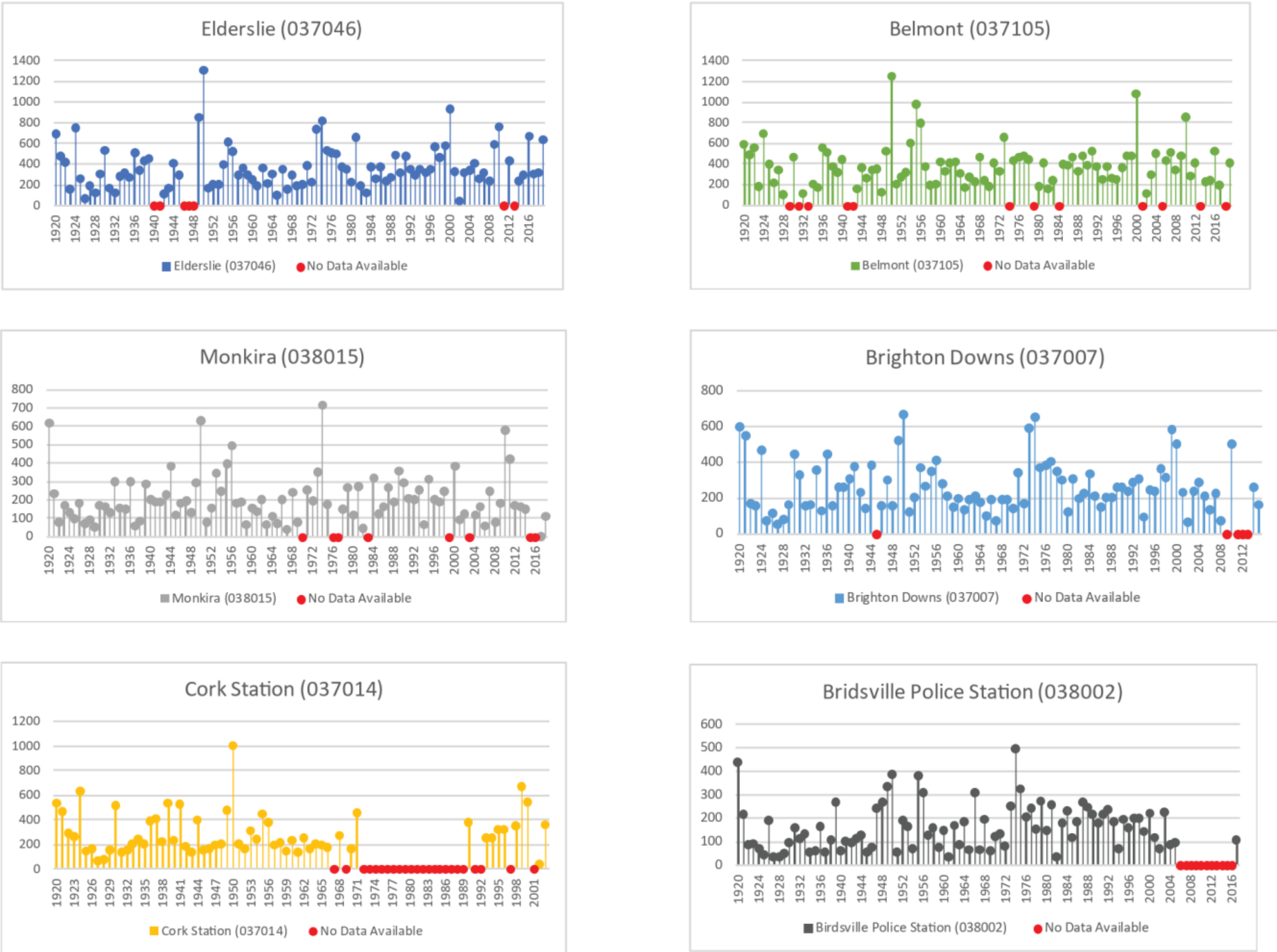

Figure 13: Rainfall data for 6 localities in the Diamantina Basin.

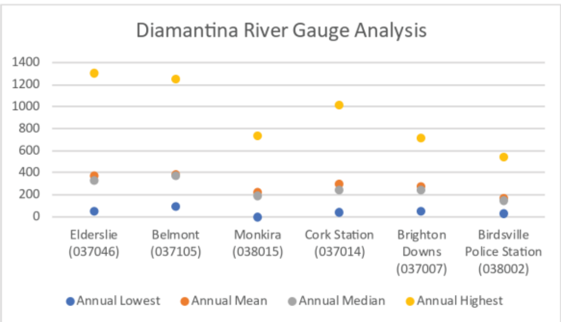

Figure 14: Diamantina precipitation.

4.2.2 Water Flow Monitoring

The Diamantina Basin has two stream flow gauging stations being the Diamantina River at Diamantina Lakes (ID: 002104A) and Mills Creek at Oondoroo (ID: 002105A). The location of these stations is shown in Figure 15 whilst annual flow statistics are provided in Table 4. The MAF of Mills Creek at Oondoroo is approximately 38,000ML/a, whilst the MAF of the Diamantina River at Diamantina Lakes is approximately 1,850,000ML/a. Flows are highly seasonal and vary significantly from year to year.

Table 4: Annual Streamflow Statistics for Diamantina Basin

Site	Min Annual Flow (ML/a)	Max Annual Flow (ML/a)	Mean Annual Flow (ML/a)	Median Annual Flow (ML/a)	Sub catchment (refer Figure 2)
Mills Creek at Oondoroo	142	148,040	38,360	24,170	A - Upper Diamantina
Diamantina River at Diamantina lakes	73,810	10,520,520	1,847,640	896,610	A - Upper Diamantina + B - Lower Diamantina

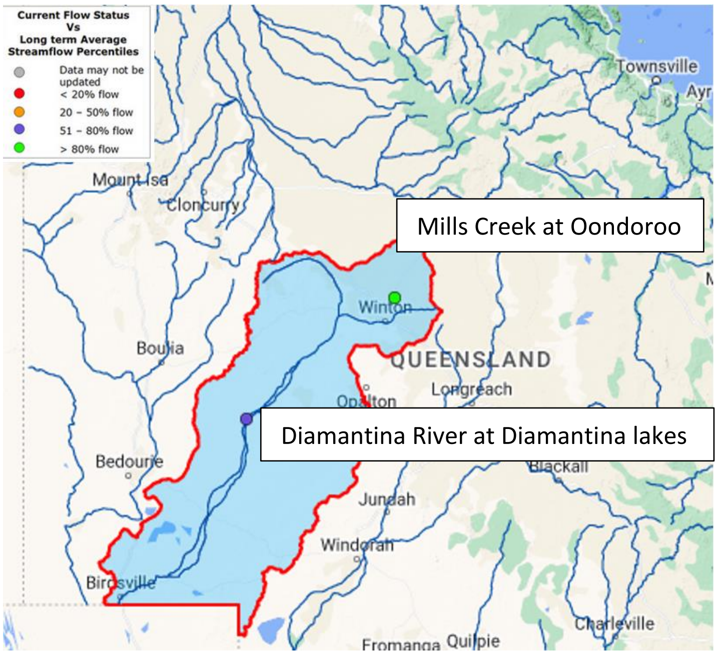

Figure 15: Diamantina Basin and its water monitoring locations.

4.2.3 Significant Waterholes and Wetlands

Table 5 provides a list of waterholes and wetlands and their corresponding management areas in the Diamantina catchment (extracted from the Georgina and Diamantina Resource Operations Plan of 2006). During times of drought, when river flows are diminished, these waterholes and wetlands become critical sources of water for both wildlife and livestock. They can sustain local communities by providing access to water resources when other sources may be scarce or inaccessible.

Table 5: Significant Waterholes and Wetlands.

Number	Name	Management Area
GD3	Cork Waterhole	Upper Diamantina
GD4	Jardine Waterhole	Lower Diamantina
GD9	Combo Waterhole	Upper Diamantina
GD10	Conn Waterhole	Upper Diamantina
GD20	Diamantina Lakes	Lower Diamantina
GD21	Lake Constance	Lower Diamantina
GD22	Diamantina Overflow Swamp Region	Lower Diamantina
GD23	Birdsville - Durrie Waterhole Agg.	Lower Diamantina
GD24	Merabooka and Yetcherie Creek Junc.	Lower Diamantina

5. Cooper Creek Catchment

5.1 Resource Assessment Cooper Creek Basin

5.1.1 Climate & Rainfall

According to the Bureau of Meteorology (BoM, 2018), the weather and climate characteristics in the Cooper Creek Basin over the past 30 years (1989-2018) are as follows:

- Annual rainfall has remained relatively stable, fluctuating naturally, with an increase of around 20mm/a over the last three decades. While there were six dry years and eleven wet years during this time, the majority of the years experienced average rainfall.
- Wet season rainfall has increased in some areas, such as Longreach where the average rainfall during the wet season was 344mm, 24mm higher than the previous 30-year period (1959-1988).
- Rainfall has been moderately reliable in the northeast of the region around Longreach during monsoon season, but less so during the early wet season. Useful rain events ("useful rain events" refer to rainfall occurrences that are considered beneficial or valuable for the region. Specifically, it indicates rainfall that provides significant benefits in terms of water supply, agricultural productivity, and other related factors) occur on average twice a year.
- As of 2019, there have only been 13 summer seasons since 1900 that have not had a 50mm rain event, representing a 5% risk of occurrence in any given year.
- Longreach has experienced runs of 10 or more consecutive days with temperatures exceeding 42°C during 2014-2018. The last time Longreach had 10 consecutive days with temperatures exceeding 42°C prior to 2014 was in 1913.

Figure 16 provide a plot of mean annual rainfalls for five locations within the catchment, whilst Figure 17 provides a summary of mean annual rainfall statistics. These data are sourced from the Cooper Creek Basin Catchment Local Knowledge Map, a publication by the Resilient Queensland Reconstruction Authority specifically tailored to the Cooper Creek Basin.

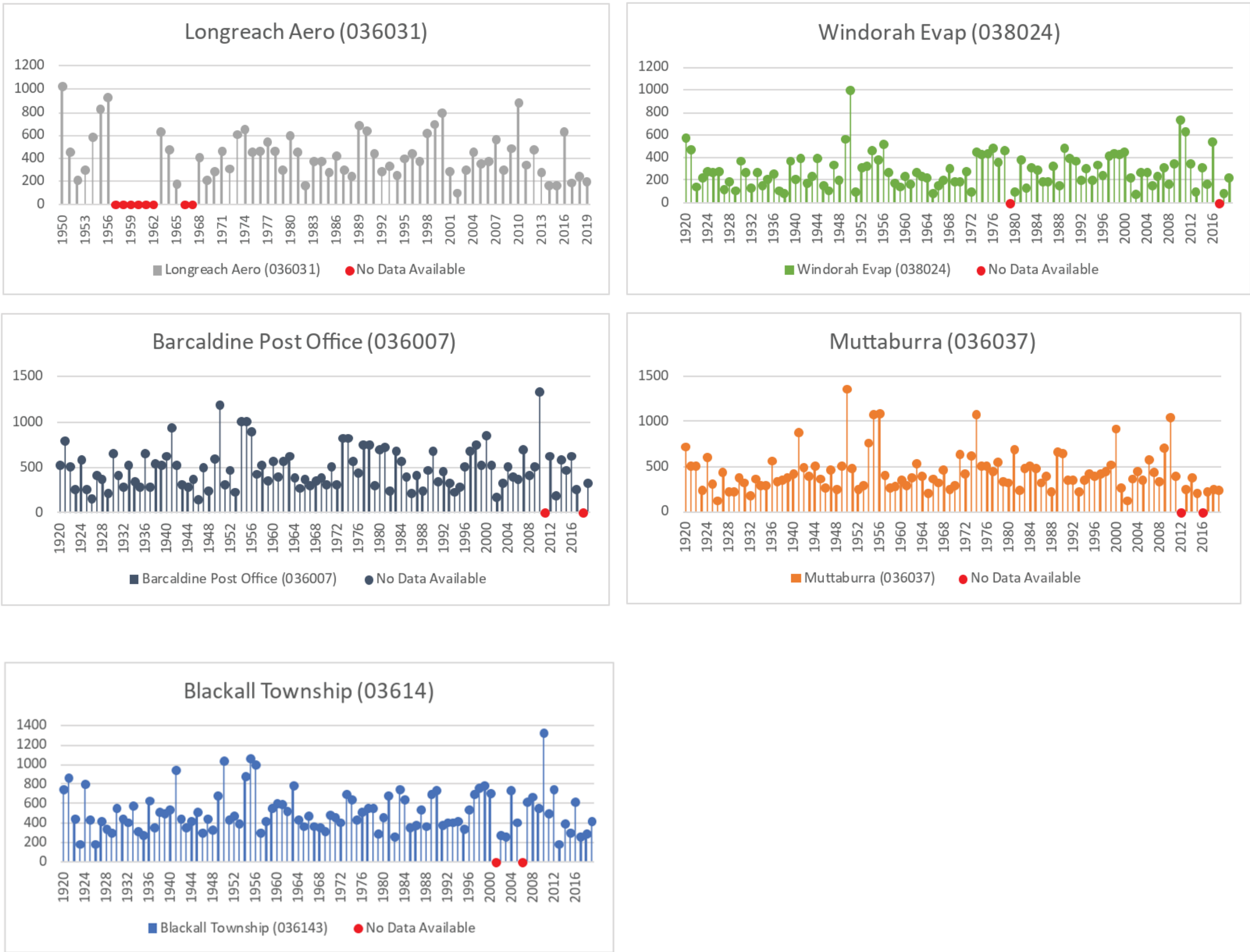

Figure 16: Rainfall data for 5 localities in the Cooper Creek Basin.

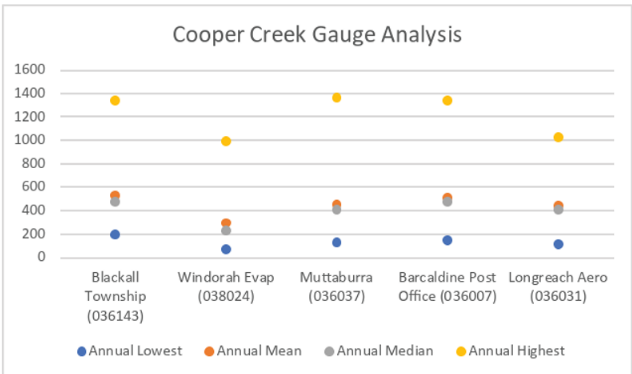

Figure 17: Cooper Creek Basin precipitation.

5.1.2 Water Flow Monitoring

The Cooper Creek Catchment has 8 stream flow gauging stations which are listed below. The location of the stations is shown in Figure 18, whilst annual flow statistics are provided in Flows are highly seasonal and vary significantly from year to year.

Table 6.

1. Cooper creek at Nappa Merrie (003103A),
2. Barcoo River at Retreat (003301B),
3. Thomson River at Stonehenge (003203A),

4. Barcoo River at Blackall (003303A),
5. Alice River at Barcaldine (003302A),
6. Thomson river at Longreach (003202A),
7. Darr River at Darr (003205A),
8. Cornish Creek at Bowen Downs (003204A).

Flows are highly seasonal and vary significantly from year to year.

Table 6: Annul Streamflow Statistics in Cooper Basin.

Site	Min Annual Flow (ML/a)	Max Annual Flow (ML/a)	Mean Annual Flow (ML/a)	Median Annual Flow (ML/a)	Sub catchment
Cooper Creek @ Nappa	24,850	13,459,890	1,093,100	263,020	Cooper
Barcoo River @ Retreat	40,390	5,635,340	872,190	453,190	Thomson-Barcoo
Thomson River @ Stonehenge	100,000	15,403,130	2,075,210	1,061,610	Thomson-Barcoo
Barcoo River @ Blackall	40,390	5.635,340	872,190	453,190	Thomson-Barcoo
Alice River @ Barcaldine	534	712,270	57,130	23,090	Upper Cooper Creek
Thomson river at Longreach	19,090	10,769,950	1,073,870	563,760	Upper Cooper Creek
Darr River @ Dar	61	353,560	44,130	12,270	Upper Cooper Creek
Cornish Creek @ Bowen Downs	12,820	3,023,570	282,545	183,780	Upper Cooper Creek

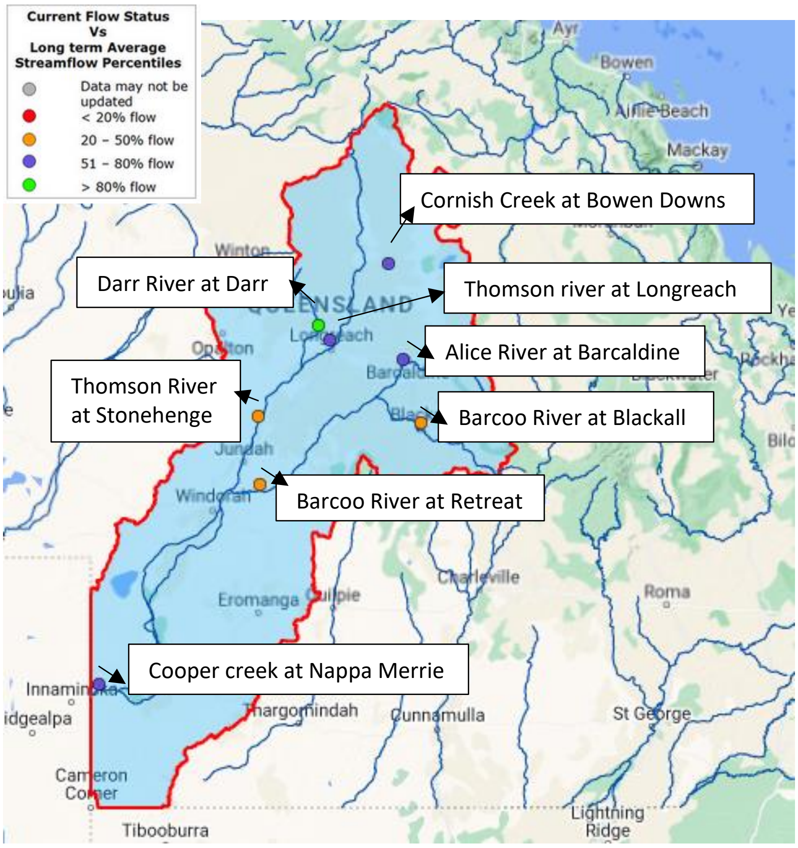

Figure 18: Cooper Basin and its water monitoring locations.

5.1.3 Significant Waterholes and Wetlands

Table 7 presents a list of protected watercourses, lakes and waterholes in the Cooper Creek Catchment. As noted previously these waterholes and wetlands serve as crucial storage and recharge points, retaining water even when river flows are reduced or intermittent.

Table 7: Protected water sources in Cooper Creek.

Protected Watercourse	Sub catchment
Alice River	Upper Thomson
Aramac Creek	Upper Thomson
Barcoo River	Thomson–Barcoo
Cooper Creek	Cooper
Cornish Creek	Upper Thomson
Darr River and Maneroo Creek	Thomson–Barcoo
Kyabra Creek	Cooper
Landsborough Creek	Upper Thomson
Powell Creek	Thomson–Barcoo
Ravensbourne Creek	Thomson–Barcoo
Thomson River	Upper Thomson/Thomson–Barcoo
Torrens Creek	Upper Thomson
Towerhill Creek	Upper Thomson
Vergemont Creek	Thomson–Barcoo
Protected Waterhole or Lake	Sub catchment
Arning Waterhole	Cooper
Baryulah Waterhole	Cooper
Big Tooley Wooley Waterhole	Cooper
Bogaller Waterhole	Cooper
Boomerang Waterhole	Thomson-Barcoo
Burleway Waterhole	Cooper
Caukingburra Swamp	Upper Thomson
Curlew Waterhole	Cooper
Currareva Waterhole	Cooper
Currawonga Waterhole	Cooper
Eulbertie Waterhole	Cooper
Eulotean Waterhole	Cooper
Gallina Waterhole	Cooper
Kyabra Waterhole	Cooper
Lake Buchanan	Upper Thomson
Lake Cuddapan	Cooper
Lake Dunn	Upper Thomson
Lake Galilee	Upper Thomson
Lake Yamma Yamma	Cooper

Protected Watercourse	Sub catchment
Little Tooley Wooley Waterhole	Cooper
Lower Thylungra Waterhole	Cooper
Maapoo Waterhole	Cooper
Meringhina Waterhole	Cooper
Mitchell Swamp	Cooper
Murken Waterhole	Cooper
Naccowlah Waterhole	Cooper
Nappapethera Waterhole	Cooper
Nockabooka Waterhole	Cooper
Nockanoora Waterhole	Cooper
Owwirree Waterhole	Cooper
Pelican Waterhole	Lower Thomson
Springfield (Bayrowah) Waterhole	Cooper
Tabbareah Waterhole	Cooper
Tanbar Waterhole	Cooper
Tookabarnoo Waterhole	Cooper
Whitula Waterhole	Cooper
Wombunderry Waterhole	Cooper

6. Burdekin Basin

6.1 Introduction

The Burdekin Basin has a complex network of rivers, streams, and wetlands, which are fed by rainfall and surface water runoff. The Basin has seven sub catchments areas that are summarized in Table 8. This report specifically assesses the Belyando Suttor sub-catchment area of the Burdekin Basin, as it is the only sub-catchment relevant to the RAPAD region.

Table 8: Burdekin Basin sub catchment area and primary land use.

Sub-catchment area	Location	Area (km²)	Primary land use
A - Lower Burdekin	Lower part of Burdekin River catchment, downstream of Burdekin Falls Dam to Ayr	9,700	Agriculture (sugarcane farming)
B - Haughton	North of Lower Burdekin, includes Haughton River catchment	3,200	Grazing and agriculture
C - Bowen	North of Haughton, includes Bowen River catchment	4,900	Grazing and agriculture
D - Broke	East of Bowen, includes Broken River catchment	3,200	Grazing and mining
E - Belyando Suttor	**West of Bowen, includes Belyando and Suttor River catchments**	**23,000**	**Grazing**
F - Cape Campaspe	North of Belyando Suttor, includes Cape and Campaspe River catchments	21,000	Grazing
G - Upper Burdekin	Upper part of Burdekin River catchment, upstream of Burdekin Falls Dam	65,000	Grazing and mining

6.2 Resource Assessment - Belyando-Suttor

6.2.1 Climate & Rainfall

The Belyando-Suttor sub catchment experiences a tropical savanna climate, influenced by seasonal variations and monsoons. The region experiences a distinct wet and dry season. The wet season typically occurs between November and April, characterized by increased rainfall and occasional tropical cyclones. During this period, the sub catchment receives a significant amount of rainfall, contributing to the replenishment of water sources such as watercourses, lakes, and springs.

The dry season, which spans from May to October, is characterized by reduced rainfall and higher evaporation rates. This season often sees a decrease in water availability and an increase in water demand for various purposes, including irrigation and domestic use.

6.2.2 Water Flow Monitoring

6.2.2.1 Belyando-Suttor

The Belyando-Suttor sub-catchment includes one stream flow gauging station on Native Companion Creek at Violet Grove (ID 120305A). The location of this gauging station is shown in Figure 19. Statistics of annual flows are provided in Table 9. The MAF is approximately 53,000ML/a.

Table 9: Suttor Streamflow Data.

Site	Minimum Annual Flow (ML/a)	Maximum Annual Flow (ML/a)	Mean Annual Flow (ML/a)	Median Annual Flow (ML/a)	Sub catchment
Native Companion Creek @ Violet Grove	130	525,610	53,370	20,780	Belyando Suttor

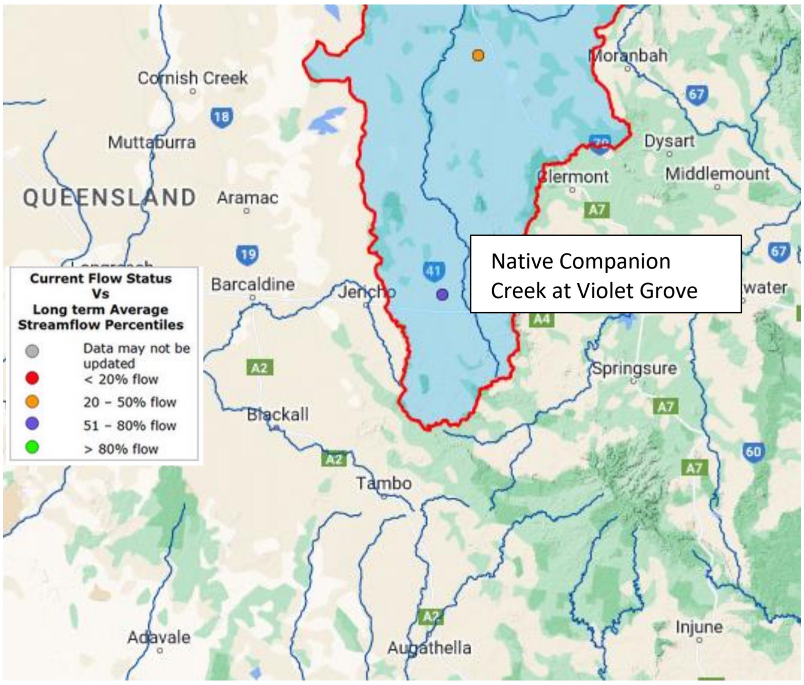

Figure 19: Suttor sub catchment area and its water monitoring location.

6.2.3 Significant Waterholes and Wetlands

Table 10 provides an overview of significant wetlands and waterholes in the Belyando-Suttor sub-catchment. As noted previously these waterholes and wetlands serve as crucial storage and recharge points, retaining water even when river flows are reduced or intermittent.

Table 10: Significant Waterholes and Wetlands.

Type	Name
River	Belyando River
River	Suttor River
Creek	Corella Creek
Creek	Four Mile Creek
Creek	Beelbee Creek
Creek	Gleeson Creek
Creek	Glenalvon Creek
Waterhole	Suttor River Waterhole
Waterhole	Corella Waterhole

7. Great Artesian Basin (GAB)

7.1 Introduction

The Great Artesian Basin is a crucial water resource that serves domestic, agricultural, and industrial needs in arid and semi-arid regions. It consists of sedimentary rock layers that hold vast amounts of water underground. Some water in the basin can be thousands of years old due to its depth and size. Rainfall in the eastern ranges and uplands replenishes the basin's water.

Artesian wells have played a vital role in agricultural irrigation, livestock watering, and human consumption where surface water is scarce. Accessing water from the basin traditionally involved drilling boreholes or wells, allowing water to flow naturally under pressure. However, uncontrolled flow from these wells resulted in water wastage and depletion. Management practices, such as capping and piping, have been implemented to regulate water flow, increase efficiency, and reduce pressure losses and ensure the long-term sustainability of the Great Artesian Basin.

Authorities monitor and regulate water extraction to balance human needs with the preservation of the basin's ecological and cultural significance. However, the basin's groundwater is finite, and recharge rates have naturally declined over time, leading to a decrease in overall water volume and pressure. Human water extraction has accelerated this decline, underscoring the importance of responsible water usage. The growing demand for water, including from expanding industries and new users like geothermal power production, poses challenges to the basin's health. Decision-making regarding new developments within the basin is subject to state and territory legislation and environmental assessments.

The Great Artesian Basin stores a vast volume of water estimated at 64,900 million ML, annual extraction and discharge are relatively small in comparison. For example, extraction in New South Wales represents less than 0.02% of the estimated storage. However, this extraction has had a significant impact on groundwater levels and flows from bores and springs in specific areas.

7.2 Basin Recharge and Natural Discharge

The Great Artesian Basin can be influenced by changes in recharge, with recharge areas primarily located on the eastern margins of the Carpentaria, Eromanga, and Surat Basins in Queensland and New South Wales, as well as the western margin of the Eromanga Basin in South Australia, the Northern Territory, and Queensland.

Only a small percentage of rainfall in these recharge areas actually filters into the basin aquifers, with higher rates observed in north Queensland compared to other regions. Surface channels and water storage areas play a crucial role in aquifer recharge, especially during heavy rainfall events, and changes in land use and vegetation cover can impact this process. Climate change can also affect recharge, by altering rainfall patterns.

The basin's waters flow into numerous waterways, providing base flows during periods of low rainfall. The basin is home to more than 460 spring groups that support unique wetland ecosystems and hold cultural and ecological significance. However, some springs have been impacted by reduced flow and land use changes, while uncontrolled flows from the basin can affect biodiversity and environmental values. Climate change may lead to increased extraction of basin water, as other water sources become less reliable.

7.3 Water Extraction

Extraction rates from the Great Artesian Basin are undergoing changes driven by improved management practices and the growing value placed on the basin's water resources. These changes bring increased benefits to the community. In Queensland, for instance, water extraction in 2016 was estimated at around 315,000 ML/year, a reduction from the peak extraction of approximately 750,000 ML/year in the 1910s. Within Queensland, almost 50% of basin water use is attributed to stock and domestic water extraction for the pastoral industry, amounting to 156,000 ML/yr. While half of this water still flows uncontrolled from bores, the other half is delivered through piped systems, representing a significant improvement over the past two decades. Other uses, including industrial, town, and intensive agricultural purposes, consume approximately 91,000 ML/yr. The petroleum and coal seam gas industry extracts approximately 64,000 ML/year, which accounts for 20% of Queensland's basin water use. This is a notable increase from 6,300 ML/year a decade ago when conventional oil and gas production dominated. It is important to note that these figures differ from those presented in the Frontier Economics 2016 report, as they pertain to a specific case study in Queensland.

There is a concern within the community that new users may impact the security of existing water entitlements and environmental assets. If extraction occurs in areas already experiencing stress, it becomes crucial to explore opportunities for minimizing additional extraction and maximizing water savings through improved efficiency and innovation.

8. Resource Regulation

This section provides detailed information on the management and allocation of water resources within each catchment.

8.1 Georgina and Diamantina Water Plan

Two key documents address the management of water in the Georgina and Diamantina catchment being:

- the Water Plan (Georgina and Diamantina) 2004, and
- the Resource Operations Plan.

The Georgina and Diamantina Water Plan 2004 and associated Resource Operations Plan apply to surface water, overland flow water and hydraulically linked groundwater not connected to the GAB. They outline various arrangements, including the release of unallocated water, the establishment of conditions for new and existing licenses, outline requirements for water and ecosystem monitoring, and provide a framework for plan amendments through public notification and consultation. The Water Plan area is shown in Figure 20.

The Water Plan provides up to 13,500 megalitres of unallocated water, which has been categorized based on the different needs within the catchment. This includes 1,500 megalitres of unallocated water reserved for projects of state significance, offering potential economic opportunities for the region.

A key priority of the Water Plan is to ensure that any release of new water resources is carefully managed to protect the natural assets of the area. The Plan emphasizes sustainable development and management practices to prevent any adverse environmental impacts.

8.1.1 Water Licences and Unallocated Reserves

8.1.1.1 Current Licences

The water licences in the Georgina and Diamantina Plan Area are summarised in Table 11. There are currently no supplemented surface water licences, and no ground water licences (not including those associated with the GAB) and only 108 ML of unsupplemented surface water licences.

Table 11: Current Licences Georgina and Diamantina Plan Area.

Water Plan (Cooper Creek) 2011	Total Nominal Volume ML
Supplemented Surface Water	0
Unsupplemented Surface Water	108
Supplemented Ground Water	0
Unsupplemented Ground Water	0

8.1.1.2 Unallocated Water Reserves

The Water Plan provides a total of 13,500 ML/a of unallocated reserves, which includes 12,000 ML/a for any use and 1,500ML/a for projects of State significance. The 12,000 ML/a of allocations provided for general use have been divided into two categories. Category A is typically allocated for high-security water use, such as for domestic and stock purposes, town water supply, and industrial use. Category B, on the other hand, is generally allocated for low-security water use, such as for irrigation, and can be subject to more variable seasonal availability. The region has been divided into five zones and allocations have been assigned to each zone to ensure equitable access to water for people located throughout the region. Please refer to Table 12 for the specific details.

Table 12: Georgiana and Diamantina unallocated water reserves.

Water Management Area	Category A Maximum Annual Take (ML)	Category A Lot Size (ML)	Category B Maximum Annual Take (ML)	Category B Lot Size (ML)	Use	Nominal Volume ML
A - Upper Diamantina	6,000	200	1,500	10	Any	7,500
B - Lower Diamantina	600	200	400	10	Any	1,000
C - Burke and Hamilton	1,000	200	500	10	Any	1,500
D - Upper Georgina	600	200	400	10	Any	1,000
E - Lower Georgina	600	200	400	10	Any	1,000
-	-	-	-	-	A project of State significance	1,500

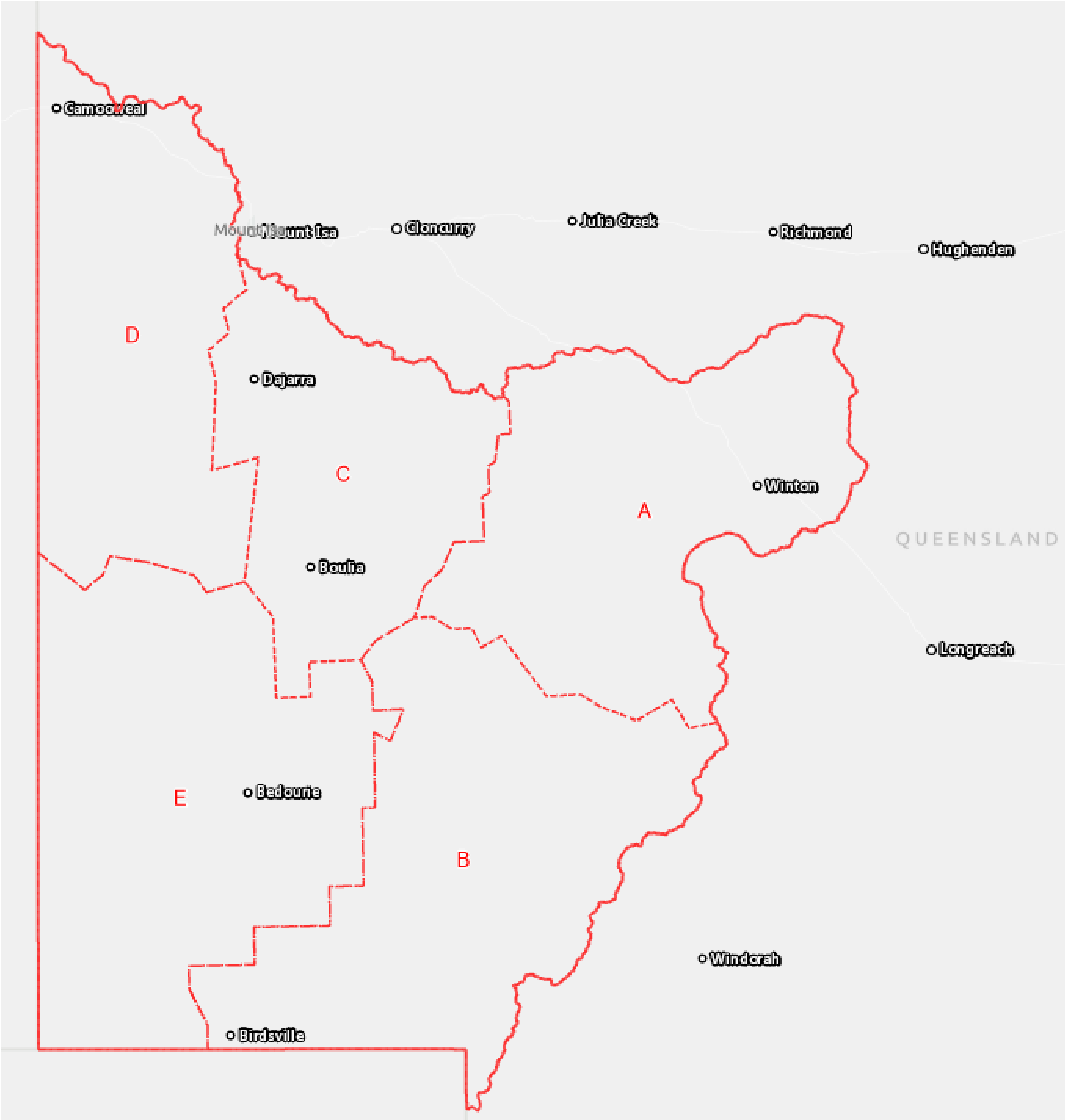

Figure 20: Georgina and Diamantina Water Plan catchment area map.

8.1.2 Water Trading

The Plan does not currently allow for water trading.

8.1.3 Applying for Unallocated Water

Individuals and entities entitled to own land or who have a registered lease can apply for a water licence. Rules involving release of allocations can be summarized as follows:

- Separate processes will be undertaken for category A and category B water in each water management area.
- Category A or category B unallocated water can be released through a tender or a fixed price determined by the chief executive.
- The results of a tender may influence the chief executive in determining a fixed price, which can be reassessed at their discretion.

- The right to apply for a water licence will be sold in lots, with no restriction on the number of lots that can be purchased by a single applicant.
- There is no restriction on the number of lots of category A unallocated water that can be purchased or used on a single lot on plan.
- A maximum of 150 megalitres of water originally purchased as category B unallocated water can be used on a single lot.
- The process for releasing unallocated water is initiated by an entity submitting an expression of interest specifying the type, volume, and water management area.
- A tender process will be used for the first sale of water in each water management area.
- If no unallocated water is sold in a tender process due to not meeting the minimum price, a new tender process for that water will not be initiated for at least two years, unless there is demonstrated market demand.
- After the first sale of water, the use of a tender process or a fixed price is at the discretion of the chief executive.
- The release of category A or category B unallocated water in a specific water management area cannot commence until an initial expression of interest is received.

8.1.4 Resource Utilisation

Table 13 provides information on the five water management areas. It includes data on the estimated mean annual flow (MAF) for the water management areas and the size of the allocations as a percentage of the MAF.

The five water management areas, namely Upper Diamantina, Lower Diamantina, Burke and Hamilton, Upper Georgina, and Lower Georgina, have relatively low allocations compared to the MAF. The allocation percentage for the entire catchment area is 0.26%. This percentage indicates that the proportion of water allocated in relation to the available water resources is small and the impact on the environment at these levels of allocation is likely to be negligible. The low level of allocation is due to the low historical demand for water allocations. It also suggests a cautious approach to water allocation, with an emphasis on efficient utilization and considerations of environmental sustainability.

It is noted that MAF's are biased by a few large events and are not a good indicator of general water availability. Hence, assessment of water availability for a particular use need to consider water availability throughout the year and across years, as well as competing environmental needs.

Table 13: Total surface water allocations as percentage of mean annual flow.

Water Management Area	Sub Catchment Area (km²)	Name of Reference Flow Gauging Station	Mean Annual Flow GS (ML)	Area Gauging Station (km²)	Area Ratio	Estimated MAF Water Management Area (ML)	Allocations as per Water Plan (ML) *	Allocation percentage (%)
CURRENT ALLOCATIONS								
All Georgina & Diamantina							108	
UNALLOCATED RESERVES								
A - Upper Diamantina	54,416	Mills Creek at Oondooroo	38,360	2,642	20.60	790,080	7,500	0.95%
B - Lower Diamantina	59,790	Diamantina River at Diamantina Lakes	1,847,640	54,130	1.10	2,040,830	1000	0.05%
C - Burke and Hamilton	38,861	Burke River at Boulia	344,120	14,850	2.62	900,530	1500	0.17%

Water Management Area	Sub Catchment Area (km²)	Name of Reference Flow Gauging Station	Mean Annual Flow GS (ML)	Area Gauging Station (km²)	Area Ratio	Estimated MAF Water Management Area (ML)	Allocations as per Water Plan (ML) *	Allocation percentage (%)
D - Upper Georgina	48,846	Georgina River at Roxborough Downs	1,090,500	118,400	0.05	449,890	1000	0.22%
E - Lower Georgina	64,100	No gauging station in that area	-	-	-	573,900#	1500	0.26%
TOTAL ALLOCATIONS								
All Georgina & Diamantina	266,013					4,181,330	12,608	0.26%

* Total allocations represent the existing allocations plus unallocated reserves.

8.2 Cooper Creek Water Plan

Cooper Creek Catchment Area is governed by two key documents:

- Water Plan (Cooper Creek) 2004;
- the Cooper Creek Resource Operations Plan.

These documents form the foundation of a comprehensive framework aimed at managing and utilizing water resources in a responsible manner within the Cooper Creek catchment area. They facilitate the availability of water for future development and enable the relocation of water licenses within specific areas of the catchment. By adhering to the requirements outlined in the Water (Cooper Creek) Plan 2011, the Resource Operations Plan establishes sustainable management rules for surface water resources within the designated plan area. The Water Plan area is shown in Figure 21.

Under this plan, a well-defined process is established for the release of up to 2,200 megalitres of unallocated water. These unallocated reserves aim to support future growth and economic opportunities in the region. Additionally, an Indigenous reserve comprising 200 megalitres is set aside to assist projects that help Aboriginal communities achieve their economic and social aspirations.

The Resource Operations Plan facilitates the exploration of small-scale irrigation possibilities. It achieves this by allowing for the permanent and seasonal transfer of water licenses associated with the Longreach Waterhole, as well as the permanent transfer of irrigation licenses currently tied to the Currareva Waterhole. These measures aim to support and enable sustainable irrigation practices in the region, while promoting economic prosperity.

8.2.1 Water Licences and Unallocated Reserves

8.2.1.1 Current Licences

Table 14 shows details of water licences for the Cooper Creek region. There are currently no supplemented surface water licences, and no ground water licences (not including those associated with the GAB) but 14,551 ML of unsupplemented surface water licences.

Table 14: Surface Water Licenses.

Water Plan (Cooper Creek) 2011	Total Nominal Volume ML
Supplemented Surface Water Allocation	0
Unsupplemented Surface Water Allocation	14,551
Supplemented Ground Water	0
Unsupplemented Ground Water	0

8.2.1.2 Unallocated Reserves

The Cooper Creek Water Plan outlines various unallocated water reserves with specific volumes and purposes. These reserves aim to address different needs within the region and support sustainable water management practices. A summary of the unallocated water volumes within the Cooper Creek Catchment is included in Table 15. Note that the general reserve and Indigenous reserve do not allow the water to be used for irrigation.

Table 15: Unallocated reserves in selected water management areas in Cooper Creek.

Purpose	Type of Reserve	Volume of Unallocated Water (ML)
Indigenous community	Non-irrigation	200
General reserve	Non-irrigation	200
State or regional project	Strategic	1,300
Town and community water supply	Community	500
TOTAL		2,200

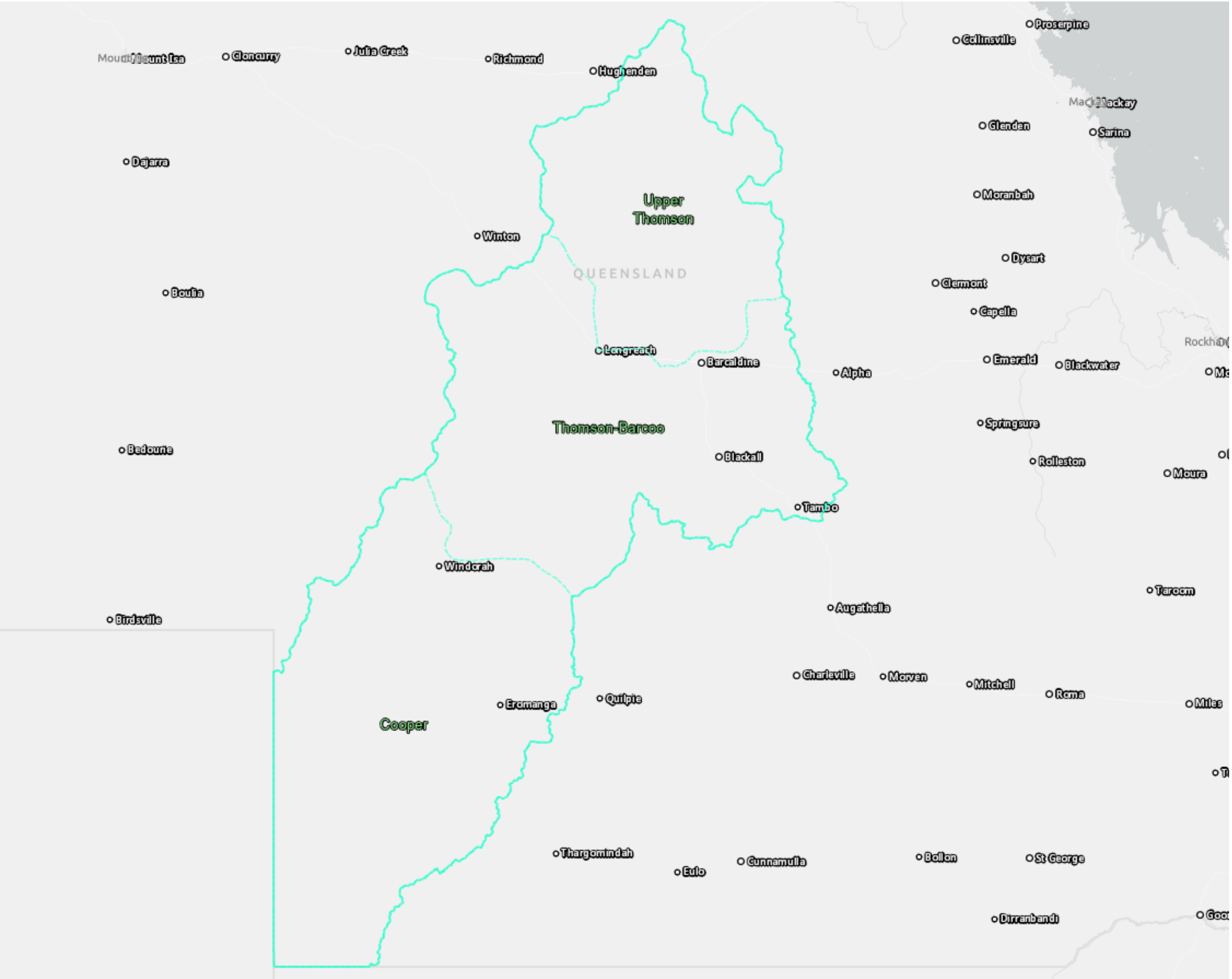

Figure 21: Cooper Creek Water Plan catchment area map.

8.2.2 Restrictions on New Water Licences

The Water Resource (Cooper Creek) Plan 2011 imposes certain restrictions on the issuance of new water licences in the Cooper Creek region. These restrictions are aimed at ensuring sustainable water management and balancing the needs of various stakeholders. The following key points highlight the restrictions on new water licences:

Unallocated Water Reserves: The Plan establishes specific volumes of unallocated water reserves for various purposes within the catchment area. These include an Indigenous reserve, a general reserve, a strategic reserve, and a town and community water reserve. The granting of water licences from these reserves is subject to the terms and conditions outlined in the Plan.

Purpose and Limitations: When applying for a water licence, the purpose for which the water will be used must be clearly stated. Restrictions may be imposed on the maximum stored volume, extraction rates, daily or annual volumetric limits, or mean annual volume. The chief executive has the authority to set additional conditions, including limits on water extraction and storage volume.

Indigenous Reserve: Water licences granted from the Indigenous reserve have specific conditions. These licences allow for seasonal assignment of water based on the seasonal water assignment rules specified in the resource operations plan. For project-based licences, the volume of water is granted only for the project's duration and must be returned to the Indigenous reserve upon completion or when it is no longer needed.

Strategic Reserve: Water licences granted from the strategic reserve are also project-based. The volume of water granted is limited to the project's lifespan and must be returned to the strategic reserve upon project completion.

The restrictions placed on new water licences in the Cooper Creek region are designed to achieve sustainable water resource management. These measures prioritize responsible allocation and utilization of water while taking into account the varied requirements and concerns of stakeholders within the catchment area.

8.2.3 Resource Utilisation

Table 16 provides information on resource utilization within the Cooper Creek Catchment Area. It compares the MAF of water within the water management area to the allocated volume of water specified in the water plan.

The allocation percentage of 0.29% for the Cooper Creek Basin highlights that only a small portion of the total available water has been allocated for consumptive use within the basin.

Table 16: Total surface water allocations as percentage of mean annual flow.

Water Management Area	Sub Catchment Area (km²)	Name of Reference Flow Gauging Station	Mean Annual Flow GS (ML)	Area Gauging Station (km²)	Area Ratio	MAF Water Management Area (ML)	Allocations as per Water Plan (ML)	Allocation percentage (%)
Cooper Creek	243,920	Thomson River at Stonehenge	2,075,210	87,810	2.78	5,764,520	16,751	0.29%

* Total allocations represent the existing allocations plus unallocated reserves.

8.3 Burdekin Basin Water Plan

The Water Plan (Burdekin Basin) 2007, commonly referred to as the "Plan," serves as a framework for managing water resources in the Burdekin Basin. The Plan, with its various purposes, defines water availability, facilitates sustainable water management practices, identifies future water requirements, establishes water allocations, promotes ecosystem restoration, and regulates the extraction of overland flow water. The Water Plan area is shown in Figure 22.

The Water Management Protocol provides additional detail to assist in implementation of the Plan. The protocol, which commenced on 6 December 2016 and was amended on 28 June 2019, defines the availability of water, establishes a sustainable framework for water management and usage, addresses future water requirements and regulates the taking of overland flow water.

The plan also introduces the concept of "existing overland flow works," which refers to works that were in existence before 17 January 2002 or started but not completed by that date and subsequently finished in accordance with the applicable moratorium notice. Reconfigured works, which do not increase the average annual volume of water taken compared to before their reconfiguration, are also considered existing overland flow works. The average annual volume of water taken by reconfigured works is determined based on the volume taken during a specific period.

The Burdekin Basin has been divided into seven sub-catchments for water planning purposes. Only the Belyando Suttor sub-catchment lies within the RAPAD region. Details of this sub-catchment are provided in Table 17 and Figure 23.

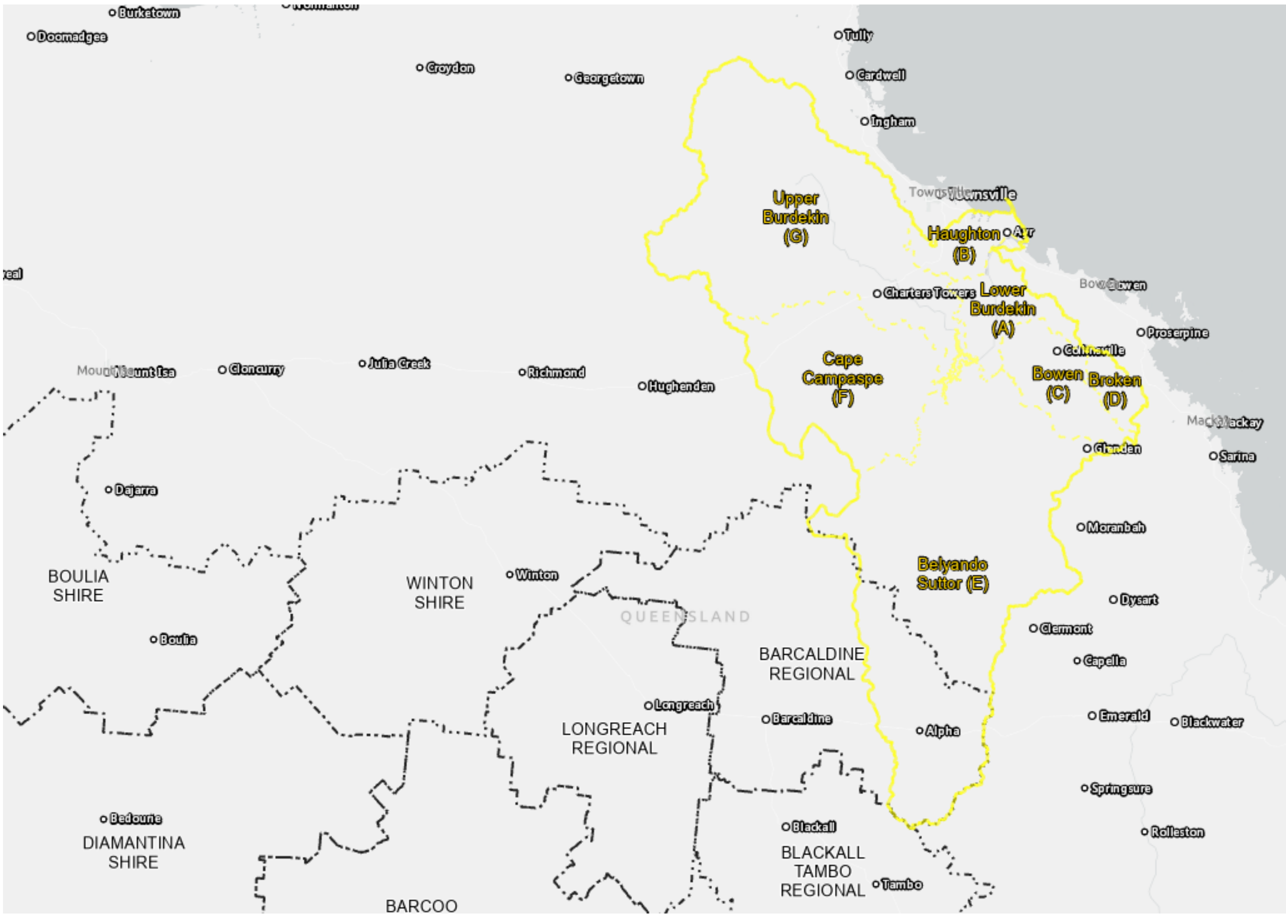

Figure 22: Burdekin Basin area map.

Table 17: Belyando Suttor information details.

Information	Details
Subcatchment Area	Belyando Suttor
Location	Central Queensland
Area	Approximately 44,000 square kilometres
Main Waterways	Belyando River and its tributaries
Land Use	Grazing and Agriculture
Towns/Communities	Suttor River, Belyando, Bogie
Water Management	Part of the Burdekin Basin
Measures Implemented	Water plans and allocation of water entitlements
Water Plan	Released in 2007, due for review in 2027
Objectives	Managing water resources, monitoring and managing groundwater and surface water resources, protecting environmental values of waterways.

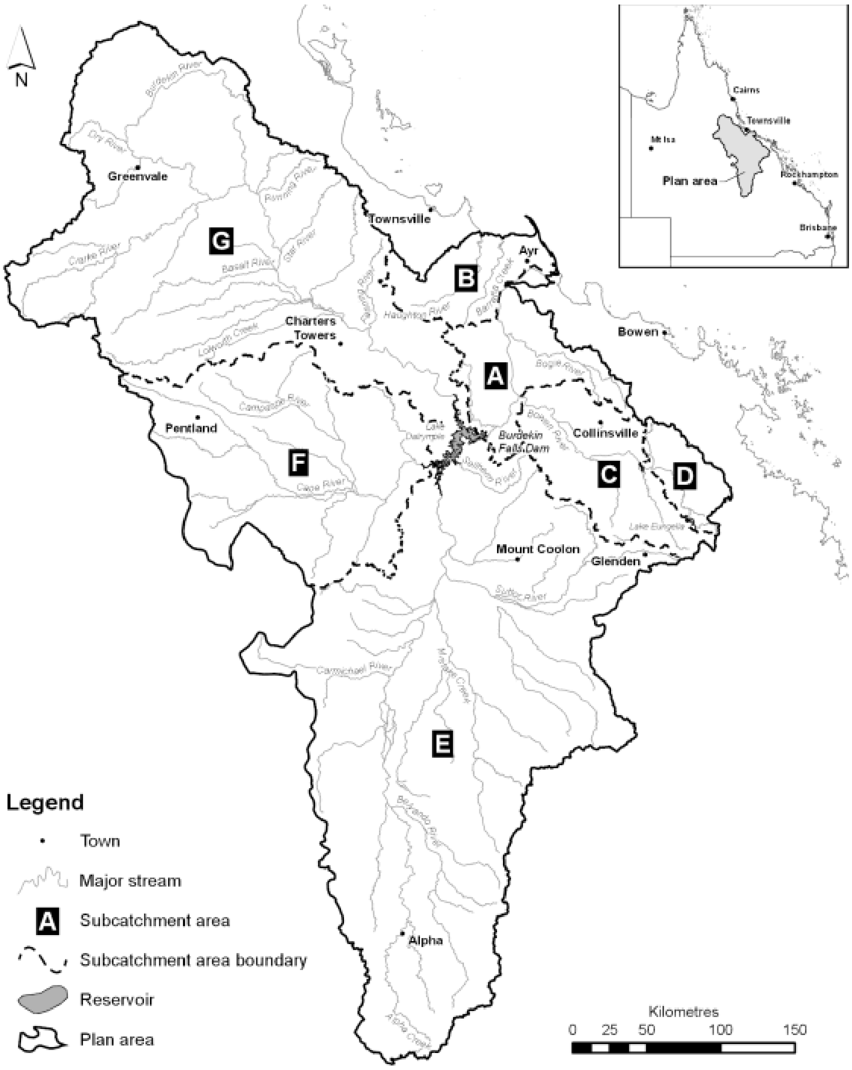

Figure 23: Sub catchment areas in the Burdekin Basin.

8.3.1 Current Allocations

8.3.1.1 Allocations in Plan

Existing surface water allocations for the Belyando Suttor sub-catchment amount to 98,225ML/a, whilst existing groundwater allocations amount to 6,200ML/a, refer to Table 18.

Table 18: Belyando Suttor allocated water.

Water Allocation	Volume (Megalitres per year)
Surface Water	98,225
Groundwater	6,200

8.3.1.2 Unallocated Water

The Plan includes unallocated reserves of 130,000ML/a for General use and 20,000 ML/a for Strategic use, refer to Table 19. Water is only available from the Strategic reserve via an approved application from the Queensland Government.

Table 19: Unallocated Reserves Belyando-Suttor.

Unallocated Water - Reserve Type	Sub-Catchment Area	Reserve Amount (ML/yr)
General	Belyando-Suttor	130,000
Strategic	Belyando-Suttor	20,000

8.3.2 Access to Unallocated Reserves

To take water from unallocated water reserves in the Burdekin Basin, certain considerations and requirements must be met. The process for making unallocated water available and dealing with it is outlined in Chapter 2 of the Water Plan (Burdekin Basin) 2007. The chief executive has the authority to maintain a register of the volume of unallocated water available.

When preparing and implementing a process to release unallocated water, the chief executive must consider several factors. These include the purpose for which the water is needed, the efficiency of existing and proposed water use practices, the extent of water taken under existing authorizations in the plan area, the availability of alternative water supplies, the impact on existing water users, potential adverse effects on groundwater flows, and the matters specified in Section 23(1)(a) and (b) of the Water Plan (Burdekin Basin) 2007. These considerations are not exhaustive, and the chief executive has discretion to consider additional factors.

For unallocated water submissions intended for irrigation, information demonstrating the potential suitability of the land for irrigation must be provided. This information should address factors such as the availability of land without remnant vegetation, the presence of ecological assets and environmental features, topography suitability, cultural heritage sites, and soil attributes. These factors help assess the suitability and constraints of the land for sustainable irrigation development.

The Burdekin Basin Water Management Protocol 2017 displays the total volumes of water held in the reserve for each sub catchment area.

8.3.3 Water Trading

In the Burdekin Water Plan, water trading is facilitated through a set of rules and procedures governing water allocations under a resource operations license. These rules ensure the effective management of water resources within the Burdekin Basin. The plan is divided into different parts, with Part 1 encompassing all allocations managed under a resource operations license. Parts 2 and 3 specifically address water supply schemes and have their own corresponding rules.

Division 1 of the plan focuses on the subdivision and amalgamation of water allocations. Subdivision refers to the division of an existing allocation into multiple new allocations, while amalgamation involves combining multiple allocations into a single allocation. Subdivision is permitted when the new allocations maintain the same volume and other attributes as the original allocation being divided. Similarly, amalgamation is allowed when the new allocation aligns with the combined attributes of the allocations being merged.

However, subdivision and amalgamation are prohibited if they do not meet the requirements specified in the rules. Division 2 of the plan introduces rules for changing water allocations, which are categorized as either permitted changes or assessed changes. Permitted changes include modifying the purpose of a water allocation, allowing transitions between 'any' and 'rural' purposes. Changes to the nominal location of an allocation are also permitted if they align with the existing location specified in the allocation.

Assessed changes cover specific scenarios, such as altering allocations designated as 'distribution loss' to 'any' or 'rural'. To request such a change, the allocation holder must submit an application to the chief executive along with a report demonstrating improved efficiency in water distribution within the associated system. The report should provide information on the expected reduction in distribution losses, the availability of sufficient volume to account for distribution losses, alignment with the objectives of the Water Plan, and any other relevant factors.

8.3.4 Resource Utilisation

Only a small portion of the Burdekin Basin lies within the RAPAD region, being the upper portion of the Belyando-Suttor sub-catchment. The flow in this region is best represented by a stream flow gauging station on the Suttor River at St Anns (ID: 120303A). The Belyando-Suttor sub-catchment has an estimated MAF of 1,605,081 ML and a total surface water (SW) allocation of 248,225 ML. This allocation represents approximately 15.5% of the MAF, refer to Table 20.

Table 20: Total surface water allocations as percentage of mean annual flow.

Water Management Area	Sub Catchment Area (km²)	Name of Reference Flow Gauging Station	Mean Annual Flow GS (ML)	Area Gauging Station (km²)	Area Ratio	MAF Water Management Area (ML)	Allocations as per Water Plan (ML)	Allocation percentage (%)
Belyando Suttor	53,508	Suttor River at St Anns	1,508,532	50,290	1.06	1,605,081	248,225	15.5%

* Total allocations represent the existing allocations plus unallocated reserves.

8.4 Great Artesian Basin (GAB)

The Great Artesian Basin is known for its significant underground water resources. It spans vast regions and is estimated to have an average depth of 1,000 meters. One of the main challenges associated with accessing this abundant water supply is the cost of extraction. The depth at which the water is located necessitates specialized drilling equipment and techniques, resulting in higher extraction costs. It is estimated that the cost per meter for extracting water from such depths is approximately AUD $1,000/metre.

Given the depth and associated costs of extraction, careful consideration and planning are required to ensure sustainable use of the water in the Great Artesian Basin. Proper management practices, including the implementation of efficient extraction methods and monitoring systems, are essential to balance the water demand with the available resources.

The Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017 is a comprehensive framework developed in Queensland, Australia, to effectively manage groundwater resources in the Queensland portion of the Great Artesian Basin (GAB) and other associated regional aquifers. This plan serves as a vital tool for ensuring the sustainable use and protection of groundwater, while also addressing the diverse water needs of communities and industries within the region. It establishes guidelines and regulations for water extraction, allocation, and trading, with a focus on securing water supply for current and future users and safeguarding the ecological health of springs and watercourses. Additionally, the plan integrates modern planning policies and considerations for the economic aspirations of Aboriginal people and Torres Strait Islanders. By promoting water efficiency, community engagement, and streamlined management practices, the Water Plan plays a crucial role in balancing water security, environmental sustainability, and socio-economic development in the Great Artesian Basin and surrounding areas.

Significant progress has been made in improving access and management of groundwater resources in the Great Artesian Basin (GAB). Policy enhancements and the implementation of water plans with inclusive planning strategies have contributed to a better understanding of groundwater users' rights and responsibilities, as well as the licensing of extraction across various sectors.

Each jurisdiction within the Basin governs water extraction in accordance with their own legislation, policies, and regulatory frameworks. These arrangements have advanced groundwater management, especially when community consultations have been conducted to develop effective management rules. However, further advancements are still necessary.

Several achievements have been accomplished since the first Strategic Management Plan (SMP). In Queensland, the introduction of the Water Plan (Great Artesian Basin and Other Regional Aquifers) in 2017 has played a significant role. This plan serves as a framework for managing groundwater in the Basin, ensuring a secure water supply for current and future users, and safeguarding the integrity of groundwater flows to springs and watercourses. The plan also defines the areas and conditions under which water can be extracted or made available, as well as the requirements for ongoing monitoring and reporting.

The revised plan in Queensland addresses the evolving water demand and modern planning policies. It incorporates new elements such as mandating the establishment of watertight seals for all uncontrolled bores and drains by 2027, allocating unallocated water reserves for the economic aspirations of Aboriginal people and Torres Strait Islanders, and simplifying water trading within the Basin. These measures promote improved water efficiency, cultural considerations, and streamlined water allocation processes.

Since 1989 the Queensland Government has invested $85 million in programs to cap and pipe stock and domestic bores. Together with landholders and the Australian Government the total investment is more than $234 million. To date this work has rehabilitated 750 bores and saved an estimated flow of 218,800 ML/a. This has resulted in increased groundwater pressures in the GAB. Under the Water Plan, landholders or other parties who fund work on behalf of the landholder to make a bore watertight are eligible for at least 30% of the water saved as a water licence.

8.4.1 Water Allocation

The granting of unallocated water reserves from the Great Artesian Basin (GAB) is governed by specific provisions outlined in the legislation. Unallocated water is held as reserves, including the general reserve, State reserve, and Aboriginal peoples and Torres Strait Islanders economic reserve. Unallocated water has been assigned to certain purposes. From the general reserve, unallocated water may be granted for any purpose. From the State reserve, it may be granted for coordinated projects, regionally significant projects, town water supply purposes for local governments, and electricity generation projects.

The Aboriginal peoples and Torres Strait Islanders economic reserve can be granted for helping Aboriginal persons or Torres Strait Islanders achieve their economic aspirations. The volume of unallocated water that may be granted from reserves is specified in schedule 4 of the legislation. The chief executive responsible for water management must consider various factors when dealing with unallocated water, including current and proposed water uses, availability of alternative water supplies, impacts on groundwater-dependent ecosystems and existing water licenses, among other relevant matters. The chief executive may require applicants for water licenses to conduct investigations, studies, or assessments on the potential impacts of water taking, and conditions may be imposed on granted licenses to address adverse effects and monitoring requirements. These provisions aim to ensure responsible and sustainable allocation of unallocated water within the GAB area.

8.4.1.1 Current Extractions

Growing recognition of the value of the water resources in the Basin has led to the implementation of improved management practices with the aim of ensuring sustainability and optimal utilization of water as part of a shift towards prioritizing the protection and preservation of the Basin's water resources contributing to the long-term viability and ecological health of the Great Artesian Basin. The allocation of water in the Great Artesian Basin (GAB) has undergone significant changes leading to reductions in extraction rates over time. Information on current extractions is provided in Table 21.

Table 21: Water Extractions in GAB area

Water User	Estimated Water Extraction (ML/yr)	Percentage of Basin Water Extraction	Annual Economic Value
Pastoral Industry	187,000	41%	$4 billion
Irrigated Agriculture	109,000	25%	$58 million
Mining, Intensive Stock, and Other Industries	57,000	12%	-
Gas/Petroleum Industry	87,000	19%	$2 billion (gas) / $6.3 billion (mining)
Towns	40,000	9%	-

Note: Economic value for the mining industry refers to annual economic value in mining, while economic value for the gas/petroleum industry refers to annual economic value in gas. The values for mining and gas/petroleum industries are not summed together as they are separate industries.

8.4.1.2 Unallocated Water

The GAB has been divided into various zones for management of water usage and unallocated reserves have been assigned to each of these zones. The unallocated reserves for the zones within the RAPAD region are provided in Table 22. Figure 24 provides a map of the Eromanga zones which lie within the RAPAD region.

Table 22: Unallocated Groundwater Reserves in the RAPAD Area.

Title	Groundwater Sub Area	Groundwater Unit	RAPAD AREA (Y/N)	Unallocated GW General Reserve ML	Unallocated GW Strategic Reserve ML	Unallocated GW Indigenous Reserve ML
Betts Creek beds		Betts Creek beds	Y	-	1500	45
Galilee Clematis	Galilee Clematis	Clematis	Y	455		
Eromanga	Various	Various	Y	1545	16400	190
Eromanga Precipice	Eromanga Precipice	Precipice	Y	365		

8.4.2 Water Management

The management of water in the GAB involves specific limitations and regulations to ensure responsible water usage. To take water from the GAB, individuals or entities must have proper authorization under a water license, water permit, seasonal water assignment notice, or specific sections of the Act (s 101).

Taking water for stock or domestic purposes (section 26) allows individuals to extract water from designated groundwater units and sub-areas. However, certain conditions must be met, including the use of a watertight delivery system, ensuring a cumulative drawdown for a groundwater-dependent ecosystem of less than 0.4m, and maintaining drawdown levels below the maximum limit at locations where other authorized water users operate.

Section 27 permits the taking or interference with water for the purpose of monitoring aquifers. In this case, water may be extracted using a controlled water bore, with a maximum volume of 2ML during a water year.

Section 28 allows for the taking or interference with water for projects benefiting Aboriginal peoples or Torres Strait Islanders or for prescribed activities outlined in the Water Regulation 2016. Similar to the previous sections, the maximum volume of water taken from a bore is 2ML during a water year, and drawdown levels must adhere to specific limits.

It is important to note that a water management protocol must be in place, allowing the chief executive to estimate and monitor cumulative drawdown and drawdown levels at specific locations to ensure compliance with the regulations.

8.4.2.1 Requirements for Water Extraction and Delivery Systems

Specific requirements and regulations are in place to help restore and maintain groundwater pressure. This section focuses on the key provisions related to controlling water bores and delivery systems.

A water bore is considered controlled if it falls under one of the following conditions: it is a sub artesian bore, an artesian bore with permanent headworks controlling water flow, or an artesian bore where water no longer naturally flows to the surface. On the other hand, a water bore is deemed to have a watertight delivery system if it meets certain criteria. This includes being controlled, distributing water through a pipeline to a trough, and minimizing water loss by maintaining the bore, pipeline, trough, and any associated cooling ponds or storage tanks.

For the taking of water for stock or domestic purposes using a water bore, a watertight delivery system is required. Individuals must not extract water from a bore without a watertight delivery system unless they hold a water license permitting such usage. Furthermore, bore owners are required to install a watertight delivery system for any water bore drilled after a specific commencement date.

If the chief executive becomes aware of a water bore that is not controlled or does not distribute water through a pipeline to a trough, certain actions are mandated. The licensee must be notified, and their water license must be amended under Section 33 to impose the necessary conditions.

Section 33 outlines the requirement to install a watertight delivery system for water bores covered by a water license. If a water bore did not have a watertight delivery system at the time of commencement or upon receiving a notice from the chief executive, the water license must be amended to include a condition specifying the deadline for installing a watertight delivery system.

By implementing these requirements for water extraction and delivery systems, efforts are made to restore and maintain groundwater pressure in a controlled and efficient manner, ensuring sustainable usage and minimizing water loss in the process.

8.4.2.2 Requirements for Taking Water for Purposes Other than Stock or Domestic Use: Ensuring Controlled and Responsible Water Extraction

This section describes requirements and responsibilities associated with taking water from a water bore for purposes other than stock or domestic use.

When a person holds a water license or permit for non-stock or non-domestic purposes, they must adhere to certain conditions. The water bore used for extraction must be controlled, meaning it is properly regulated and maintained. The aim is to minimize water loss and ensure that the extraction process is managed effectively. However, there are situations where a previously controlled water bore may no longer meet these requirements due to changes in groundwater pressure.

If this occurs, the person holding the license will be notified by the relevant authority. They will be informed that the water bore is no longer controlled and will be required to make amendments to their license accordingly. The amended license may allow them to continue using the uncontrolled bore, but it will also impose conditions. These conditions will include a timeframe within which the bore must be brought back under control, typically within 10 years. The license holder will need to provide written notice to the authority once the bore is once again controlled.

In the first year of holding a water license, the license holder has specific obligations related to bore control. If the license includes a condition requiring bore control, the holder must either notify the authority of their intention to comply with the condition within the first year or submit a bore management statement. The bore management statement outlines the holder's plans for controlling the bore and minimizing water loss by the specified deadline. The notice or statement must be provided in advance, ensuring transparency and accountability.

8.4.3 Amending Water Licences

The regulations governing water licenses and the process of amending them, particularly in cases where a watertight delivery system is required, are outlined below. The focus here is on instances where licensees seek amendments to sustain culturally or environmentally significant values that existed prior to the implementation of these regulations.

Before making decisions regarding the granting or amendment of water licenses, the chief executive must carefully consider any potential adverse impacts on groundwater pressure and levels at the border of Queensland and another state. This entails engaging in consultation with and considering information provided by the other state to inform the decision-making process.

When a water license contains a condition that mandates the installation of a watertight delivery system for a water bore, and a licensee applies to amend the license, certain requirements must be met. The licensee's application should identify the culturally or environmentally significant values that need to be sustained, specify the volume of water required to support these values, outline the intended water delivery method to minimize wastage, and provide supporting evidence. It is important to note that these requirements complement the general application criteria outlined in section 122(1) of the Act.

Upon meeting specific conditions, the chief executive is granted the authority to amend the water license. If it is determined that water taken from the bore without a watertight delivery system can sustain or contribute to sustaining culturally or environmentally significant values that existed prior to the regulations, the condition requiring the watertight delivery system may be modified or removed. The amended license should explicitly acknowledge the culturally or environmentally significant values that will be sustained by the water, and it should state that water may be taken for cultural or environmental purposes as long as these values persist.

Furthermore, the chief executive has the power to impose additional conditions on the amended license. These conditions may include limitations on the rate of water extraction from the bore and restrictions on the flow of water to specific locations where the culturally or environmentally significant values are present.

These provisions strike a delicate balance between water trading and the preservation of culturally or environmentally significant values. By allowing amendments to water licenses, valuable resources can be allocated for sustenance and preservation purposes, ensuring the continued appreciation and protection of our cultural and environmental heritage.

8.4.4 Water Trading

Water trading rules are outlined in the Great Artesian Basin and Other Regional Aquifers, Water Management Protocol. Key rules are provided below.

- Relocation is not permitted if there is a change in the purpose for which water is taken.
- Relocation can only occur if the original licence:
  - Is a declared metered licence under the Water Regulation 2016;
  - Is amended to require the take to be metered.
- Relocation can only occur if the proposed licence:
  - Is a declared metered licence under Water Regulation 2016;
  - Is granted with conditions requiring take to be metered.
- Relocation is not permitted from outside a zone into a zone.
- Relocation is permitted from one part of a zone to another part of the same zone.
- Relocation is permitted within the same Groundwater sub-area or to a permitted sub-area as defined in Attachment 6 of the Protocol.

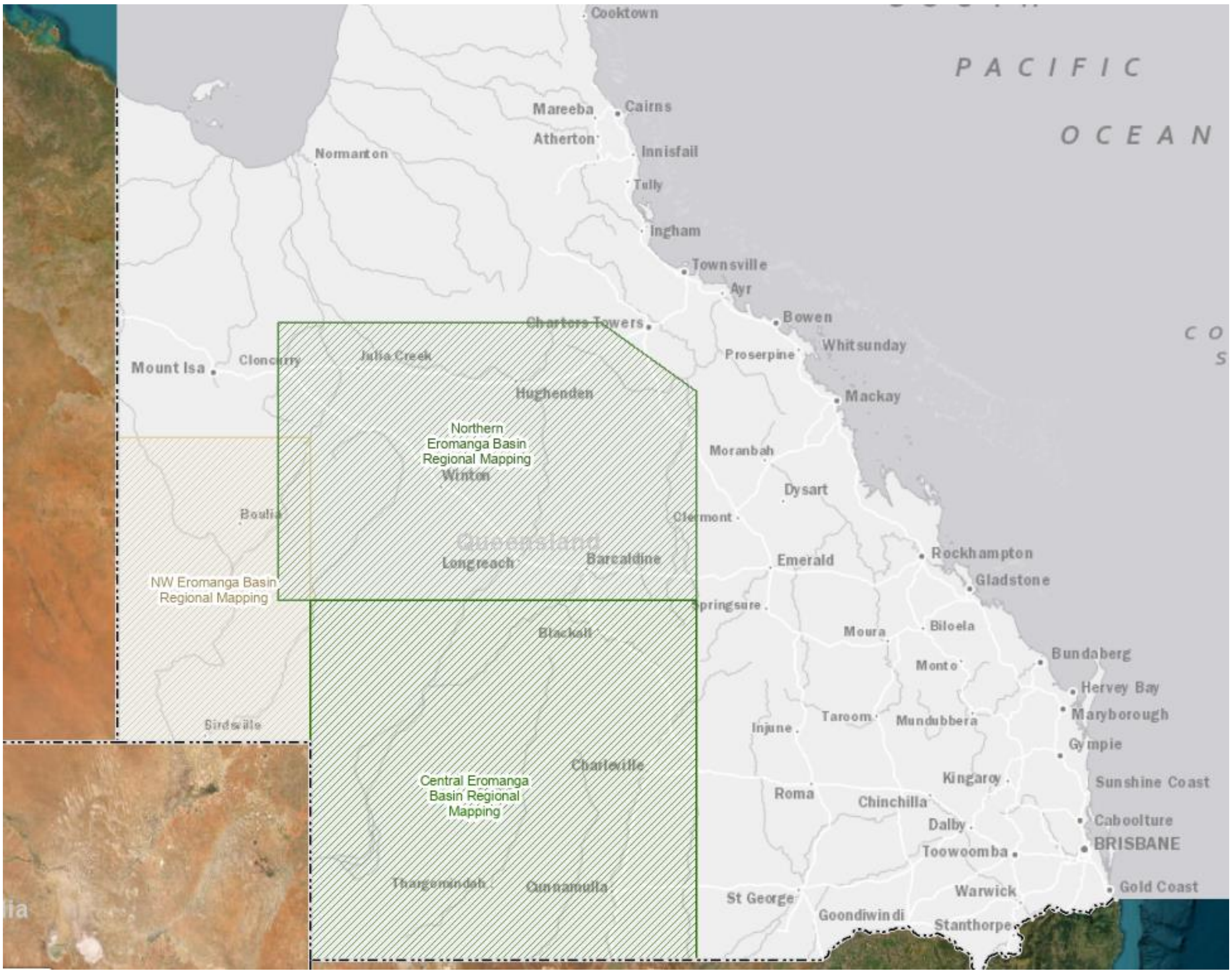

Figure 24: Eromanga Basin map area.

9. Comparisons to Other Catchment Areas

Table 23 provides information on the volume of surface water allocations in the RAPAD region relative to mean annual flows. The surface water allocations in the Georgina, Diamantina and Cooper Creek catchments are very small, at less than 1%. The Belyando Suttor sub-catchment in the Burdekin Basin has a higher percentage of surface water allocations at 6.1%. This compares to 19.8% for the full Burdekin Basin and 16.4% for the Fitzroy Basin.

The Low surface water allocations in the RAPAD region are due to multiple factors including the arid climate, low population densities and dominant landuses. The climate, irregular rainfalls and flows and sensitive environment render the region unsuitable for large scale intensive agricultural development.

Table 23: Comparation of Allocation Ratios

Water Management Plan	Water Management Area	Catchment Area (km²)	MAF (ML)	Surface Water Allocations as per Water Plan (ML) *	Allocation percentage (%)
RAPAD Region					
Georgina & Diamantina	Full Diamantina & Georgina	266,013	4,365,893	12,608	0.26%
Cooper Creek	Thomson	243,920	5,767,600	16,751	0.29%
Burdekin Basin	Belyando Suttor	53,508	1,605,100	98,225	6.12%
Other Areas					
Burdekin Basin	Full Burdekin Basin	133,600	8,523,000	1,689,489	19.8%
Fitzroy Basin	Full Fitzroy Basin	142,665	5,255,600	863,405	16.4%

* Represents the total amount of volume, including supplemented surface water, unsupplemented surface water, and unallocated surface water.

10. Conclusion

The water supply assessment has provided valuable information regarding the availability and utilization of water resources in the region. The assessment specifically focused on the catchment areas of Georgina and Diamantina, Cooper Creek, Burdekin Basin, and the Great Artesian Basin, aligning with existing water plans and resource plans.

The key findings of the assessment reveal the following:

- Current surface water licences in the Georgina and Diamantina plan area are negligible, whilst unallocated surface water reserves represent less than 1% of the total surface water flows.
- Current surface water licences combined with unallocated surface water reserves in the Cooper Creek plan area represent less than 1% of total surface water flows.
- Current surface water allocations in the Belyando-Suttor sub-catchment of the Burdekin Basin plan area represent approximately 6% of available surface water flows and unallocated reserves represent an additional 9%.
- Surface water extractions in the Belyando-Suttor sub-catchment of the Burdekin Basin plan area are much higher than those in the Georgina and Diamantina and Cooper Creek plan areas. This is because the Burdekin has larger and more reliable flow, and which has generated a greater level of development.
- Surface water extractions in the Georgina and Diamantina and Cooper Creek plan areas are negligible compared to groundwater extractions from the GAB, which is a larger and more reliable resource.
- There are unallocated surface water reserves of 13,500 ML in the Georgina Diamantine plan area which includes 1,500 ML for State Significant Projects and the remainder for “Any Use”.
- There are unallocated surface water reserves of 2,200 ML in the Cooper Creek catchment which are made up of 1,300 ML for projects of State or Regional significance, 500 ML for Town Water Supply, 200 ML for Indigenous uses and 200 ML for general but non-irrigation use.

- The largest opportunity for surface water development is in the Belyando-Suttor sub-catchment of the Burdekin Basin which has 130,000 ML of general reserves and 20,000 ML of strategic reserves.
- The GAB has 2,365 ML of unallocated general reserves and 17,900 ML of unallocated strategic reserves.
- There is also the potential to access 30% of the savings from capping existing bores in the GAB.

The key findings of the assessment indicate that while surface water allocations in certain catchment areas are limited, there are significant untapped reserves in other areas. Notably, surface water extractions in the Belyando-Suttor sub-catchment of the Burdekin Basin are comparatively higher due to the larger and more reliable flow, resulting in greater development. Additionally, groundwater extractions from the Great Artesian Basin (GAB) play a significant role, with substantial unallocated reserves available.

Opportunities for future water development include unallocated surface water reserves in the Georgina and Diamantina, and Cooper Creek catchments, as well as the substantial reserves in the Belyando-Suttor sub-catchment of the Burdekin Basin. Furthermore, the GAB presents substantial unallocated general and strategic reserves, along with the potential to access savings from capping existing bores.

Based on the assessment, untapped water resources have been identified that could support economic expansion within the region. It is crucial for RAPAD and stakeholders to recognize these opportunities and collaborate with the Queensland government, particularly the Department of Regional Development Manufacturing and Water (DRDMW), to address how best to secure water to meet emerging requirements.

In conclusion, the water supply assessment conducted to understand the water resources with the RAPAD in Central Western Queensland, provides insights into the availability and utilization of water resources and highlights the unique characteristics, challenges, and opportunities present in each catchment area. By capitalizing on available resources RAPAD can work towards implementing effective solutions that promote economic growth and ensure long-term water security for Central Western Queensland.

Appendix A

Streamflow Data

Appendix B

RAPAD Detailed Map

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WATER FOR ECONOMIC DEVELOPMENT – DEMAND ASSESSMENT

RAPAD

OCTOBER 2023

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EXECUTIVE SUMMARY

BACKGROUND

Central Western Queensland Remote Area Planning and Development (RAPAD) Board represents the region's local governments and is the peak regional economic development and advocacy body for the Central West Queensland region. Central to RAPAD's mission is facilitating growth and diversification of the region's economy and leading powerful advocacy to government to address the region's service and infrastructure needs.

To achieve this mission, RAPAD is developing a regional water strategy, which seeks to understand how water can be properly utilised to achieve transformation change in the region's economy, which can lead to long-term sustainability of the region's communities.

Combined with the strategy, an action plan is required to outline how the region can make meaningful progress towards realising the opportunity with clear roles and responsibilities for local government, the Queensland and Australian Governments (as a regulator and a funder of infrastructure) and private industry.

To deliver this strategy, RAPAD has engaged AEC Group Pty Ltd (AEC) to lead the stakeholder engagement, economic analysis (including demand assessment), strategy formation and action planning. AEC has engaged SMEC to deliver the water supply assessment.

REGIONAL ECONOMIC PROFILE

A regional economic profile was developed to focus on the economic indicators likely to drive demand for water across a range of use typologies. The following key insights were used to inform the potential drivers for future water demand in the RAPAD region:

- Population in the RAPAD region has been declining over time. Current Queensland Government population projections indicate continued population decline.
- The region's economic structure is principally geared towards agriculture (agricultural activity is 13 times more prominent in the RAPAD region than in Queensland on average). The only other industry with an economic specialisation in the region is public administration and safety and tourism.
- Nearly all of the value of the region's agricultural production is in livestock – with 94% attributed to the cattle industry, with 5% attributed to both wool and sheep and lambs and another 1% to other livestock. The RAPAD region produces 10% of Queensland's cattle and calves and 36% of Queensland's sheep and lambs.
- Agriculture is the largest export from the RAPAD region, accounting for 70% of the value of net exports ($423.7 M). The largest manufactured export from the region is meat products ($5.14 M).
- The RAPAD region imports considerable quantities of liquid fuels – approximately $28 million per year. Replacing these imports with locally supplied fuels (potentially green hydrogen) could deliver significant benefits.
- Tourism is a major growth industry in the RAPAD region, accounting for approximately 7% of GRP, with visitor nights growing across the region: 2.8% for Barcaldine – Blackall SA2, 5.3% for Far Central West SA2 and 4.5% for Longreach SA2.
- The RAPAD region also has considerable undeveloped natural resources that could support future economic transformation in the region, including:
    - Large areas of land (up to 67% of the region) that could be suitable for more intensive activity, such as improved pasture or cropping (both dryland and irrigated)
    - Multiple quality mineral (namely copper), coal and gas deposits
    - High quality geothermal resources, which can support future renewable electricity generation
    - Multiple locations with high quality wind, solar PV and concentrated solar, with capacity factors of 32%, 25% and 62% respectively. While most of these resources are not adjacent to the existing high voltage electricity network, they can be utilised to support local green hydrogen manufacturing to replace liquid fuels (principally in heavy vehicles).

CURRENT WATER USE

- The current uses for water in the RAPAD region include urban water consumption, agriculture and a range of industrial activities.
- Both surface water and groundwater are used to meet the region's water needs.
  - Groundwater resources (particularly in the Georgina Basin) are predominantly utilised for resource related activity. 22,836 ML of groundwater resource (65% of 35,329 ML total allocation) is used for mining and related industrial processes in the RAPAD region. 20% of groundwater resources are used for town water supply (7,183 ML).
  - Surface water resources are predominantly used to support irrigated agriculture, especially in the Burdekin (Belyando-Suttor) sub catchment. The Burdekin (Belyando-Suttor) sub catchment accounts for 78% of all surface water allocations in the RAPAD region (82,350 ML of 106,226 ML total allocation) and 81% of the allocated surface water in this sub-catchment is used for irrigation. 79% of the allocated surface water in the Cooper Creek basin is utilised for irrigation (14,089 ML of 17,768 ML total allocation).
- There are a number of water supply networks across the RAPAD region, supplying both reticulated water and receiving and treating waste water/ sewerage.
- Most communities in the RAPAD region utilise water for recreational purposes, principally in the form of town pools, but also in the provision of recreational lakes.
- In stream water storage in support of both town supply and irrigated agriculture does exist in the RAPAD region but is limited to the Cooper and Burdekin Basis. There is currently no in stream storages in the Georgina or Diamantina Basins.

FUTURE WATER DEMAND

Based on stakeholder engagement and economic analysis, a number of potential future water demands have been identified and quantified, the following activities are expected to be the key drivers for future demand for water:

- Regional opportunities include:
  - Urban development/growth = Nil expected
  - Improving drought preparedness = 2 GL (potentially utilising beneficial reuse of waste water)
  - Irrigated agriculture = 261.3 GL.
  - Green hydrogen for heavy transport = 40 ML – 189 ML (requiring beneficial reuse of waste water)
- Specific place-based opportunities include:
  - Blackall QWool Project = 550 ML
  - Barcaldine Renewable Energy Zone = 386 ML
  - Geothermal Electricity Generation = 0 ML (closed system)
  - Mineral mining and processing = 850 – 2,220 ML.
- A number of additional beneficial reuse opportunities have been identified, including town sewerage, industrial water uses and water from gas extraction.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Background

Central Western Queensland Remote Area Planning and Development (RAPAD) Board represents the region's local governments and is the peak regional economic development and advocacy body for the Central West Queensland region. Central to RAPAD's mission is facilitating growth and diversification of the region's economy and leading powerful advocacy to government to address the region's service and infrastructure needs.

To achieve this mission, RAPAD is developing a regional water strategy, which seeks to understand how water can be properly utilised to achieve transformation change in the region's economy, which can lead to long-term sustainability of the region's communities.

The formation of the strategy is to:

- Be informed by an analysis of both supply and demand opportunities
- Quantify the direct and indirect economic benefits of realising the opportunities (where adequate supply enables the opportunity to be achieved)
- Identify locally driven, bottom-up approaches to achieving the strategy outcomes
- Be verified through stakeholder engagement across the region.

Combined with the strategy, an action plan is required to outline how the region can make meaningful progress towards realising the opportunity with clear roles and responsibilities for local government, the Queensland and Australian Governments (as a regulator and a funder of infrastructure) and private industry.

To deliver this strategy, RAPAD has engaged AEC Group Pty Ltd (AEC) to lead the stakeholder engagement, economic analysis (including demand assessment), strategy formation and action planning. AEC has engaged SMEC to deliver the water supply assessment.

1.2 PURPOSE OF THIS REPORT

The purpose of this report is to present the drivers of future demand for water in the RAPAD region. This is achieved by identifying a number of drivers of future demand then quantifying the scale of demand associated with achieving these demand opportunities.

It is important to note that this report identifies demand unconstrained of any supply limitations. Presentation of demand with full consideration of supply limitations, as well as the potential economic outcomes supported by highest use of available water resources (and an assessment of the challenges relating to water in realising this demand), will be addressed in a future report (Regional Water Strategy).

1.3 APPROACH

The approach taken for this demand analysis involved the following elements.

- **Regional Economic Profile (Chapter 2):** Presents a regional economic profile of the RAPAD region, focusing on the economic indicators likely to drive demand for water across a range of use typologies. This chapter has been prepared to inform the potential drivers for future water demand (Chapter 4).
- **Current Water Use (Chapter 3):** Profiles the current drivers for water demand across the different catchments in the RAPAD region. This chapter also identifies and profiles the infrastructure used to support delivery of water to the ultimate customer.
- **Future Water Demand (Chapter 4):** Identifies and quantifies the future demand for water across a number of different demand drivers. This chapter also identifies a number of opportunities for beneficial reuse of waste water in the region.

2. REGIONAL ECONOMIC PROFILE

2.1 APPROACH

This chapter presents a regional economic profile of the RAPAD region, focusing on the economic indicators likely to drive demand for water across a range of use typologies. This chapter has been prepared to inform the potential drivers for future water demand (Chapter 4).

Key Points:

- Population in the RAPAD region has been declining over time. Current Queensland Government population projections indicate continued population decline.
- The region's economic structure is principally geared towards agriculture (agricultural activity is 13 times more prominent in the RAPAD region than in Queensland on average). The only other industry with an economic specialisation in the region is public administration and safety and tourism.
- Nearly all of the value of the region's agricultural production is in livestock – with 94% attributed to the cattle industry, with 5% attributed to both wool and sheep and lambs and another 1% to other livestock. The RAPAD region produces 10% of Queensland's cattle and calves and 36% of Queensland's sheep and lambs.
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- The RAPAD region also has considerable undeveloped natural resources that could support future economic transformation in the region, including:
  - Large areas of land (up to 67% of the region) that could be suitable for more intensive activity, such as improved pasture or cropping (both dryland and irrigated)
  - Multiple quality mineral (namely copper), coal and gas deposits
  - High quality geothermal resources which can support future renewable electricity generation
  - Multiple locations with high quality wind, solar PV and concentrated solar, with capacity factors of 32%, 25% and 62% respectively. While most of these resources are not adjacent to the existing high voltage electricity network, they can be utilised to support local green hydrogen manufacturing to replace liquid fuels (principally in heavy vehicles).

2.2 POPULATION

The table below shows the population of RAPAD LGAs and a number of key towns in the RAPAD region, and the historic and expected projected change in population over time. Only towns with a separate statistical area(s) (SA1 as defined by the ABS) are included.

Table 2.1. Historic and Projected Regional Population – RAPAD Region

LGA	2011	2016	2021	2026*	2031*
Barcaldine RC	3,292	2,909	2,863	2,736	2,639
Alpha	*363*	*300*	*264*	*228*	*196*
Barcaldine	*1,307*	*1,334*	*1,237*	*1,134*	*1,048*
Aramac	*300*	*260*	*221*	*192*	*167*
Blackall-Tambo SC	2,257	1,925	1,920	1,887	1,842
Blackall	*1,279*	*1,125*	*1,075*	*1,049*	*1,018*
Tambo	*352*	*336*	*315*	*302*	*287*
Longreach RC	4,296	3,727	3,693	3,486	3,311
Longreach	*3,145*	*2,735*	*2,738*	*2,568*	*2,424*
Winton SC	1,380	1,154	1,132	1,021	933
Winton	*1,007*	*869*	*779*	*681*	*603*
Boulia SC	496	439	474	456	443
• *Boulia*	*182*	*290*	*168*	*159*	*151*
Barcoo SC	363	282	317	292	277
Diamantina SC	310	302	287	268	262
Total RAPAD	**12,395**	**10,738**	**10,686**	**10,135**	**9,707**
RAPAD Growth %	**-**	**-2.8%**	**-0.1%**	**-1.1%**	**-0.9%**
QLD Growth %	**-**	**1.6%**	**1.5%**	**1.7%**	**1.6%**

Note: * projection based on QGSO Estimates for LGAs and ratio of existing SA1 population to total LGA
Source: AEC, ABS (2023, 2022 a), QGSO (2018).

2.3 CURRENT ECONOMIC STRUCTURE

Table 2.2 shows the economic structure of the RAPAD LGAs, how each sector has grown over the preceding 10 years and how the region's economic structure compares to Queensland. The economy in the RAPAD region is predominantly sustained by agriculture and public administration.

Table 2.2. Economic Structure – RAPAD Region ($M GRP)

Sector	2011-12	2021-22	% Change	% IVA	LQ
Agriculture, forestry and fishing	$693.6	$650.0	-6.3%	53.6%	13.0
Public administration and safety	$93.3	$92.6	-0.7%	7.6%	1.4
Construction	$179.3	$81.6	-54.5%	6.7%	0.9
Electricity, gas, water and waste services	$28.4	$27.3	-3.8%	2.3%	0.8
Arts and recreation services	$4.7	$7.3	55.8%	0.6%	0.8
Other services	$15.8	$17.2	9.2%	1.4%	0.8
Information media and telecommunications	$7.4	$10.8	45.6%	0.9%	0.7
Administrative and support services	$11.3	$27.7	144.3%	2.3%	0.7
Retail trade	$36.0	$33.3	-7.5%	2.7%	0.6
Accommodation and food services	$23.3	$17.3	-26.1%	1.4%	0.6
Transport, postal and warehousing	$46.1	$33.8	-26.6%	2.8%	0.6
Education and training	$50.6	$39.9	-21.1%	3.3%	0.6
Health care and social assistance	$68.1	$59.0	-13.3%	4.9%	0.6
Ownership of dwellings	$50.7	$48.3	-4.8%	n/a	0.5
Wholesale trade	$17.8	$16.0	-10.1%	1.3%	0.4

Sector	2011-12	2021-22	% Change	% IVA	LQ
Manufacturing	$19.1	$22.0	15.3%	1.8%	0.3
Financial and insurance services	$29.8	$22.7	-23.8%	1.9%	0.3
Rental, hiring and real estate services	$5.6	$9.8	74.9%	0.8%	0.3
Professional, scientific and technical services	$20.4	$20.8	1.9%	1.7%	0.3
Mining	$59.5	$22.8	-61.6%	1.9%	0.1
Gross Sector Value Add	*$1,460.8*	*$1,260.4*	-13.7%	-	-
Taxes less Subsidies	$110.5	$84.7	-23.4%	-	-
Gross Regional Product	**$1,571.3**	**$1,345.1**	**-14.4%**	**-**	**-**

Note: Location Quotient (LQ) is compared to Queensland. LQ > 1 indicates a specialisation.
Source: AEC

Agricultural industries in the RAPAD region are a dominant part of the regional economy. Table 2.3 and Table 2.4 provides an overview of the number of livestock across the RAPAD region and the value of agricultural production.

Table 2.3. Number of livestock (head)

LGA	Cattle and Calves	Sheep and Lambs
Barcaldine	355,270	178,031
Barcoo	114,498	37,213
Blackall-Tambo	195,692	98,064
Boulia	109,304	35,525
Diamantina	120,591	39,193
Longreach	85,083	330,740
Winton	102,751	33,395
Total RAPAD	**1,083,189**	**752,162**
Total Queensland	**10,605,366**	**2,079,829**
% of Queensland	**10.2%**	**36.2%**

Source: AEC

Table 2.4. Value of Agricultural Production by Commodity ($M)

LGA	Cattle & Calves	Sheep & Lambs	Other Livestock	Wool	Other Livestock Products	Broadacre Crops	Hay	Fruit and Nuts	Other	Total
Barcaldine	$195.1	$1.7	$2.0	$5.4	$0.0	$0.5	$0.4	$0.0	$0.0	$205.1
Barcoo	$62.9	$0.3	$0.0	$1.1	$0.0	$0.4	$0.3	$0.0	$0.0	$65.1
Blackall-Tambo	$107.5	$0.9	$1.1	$3.0	$0.0	$0.3	$0.2	$0.0	$0.0	$113.0
Boulia	$60.0	$0.3	$0.0	$1.1	$0.0	$0.4	$0.3	$0.0	$0.0	$62.1
Diamantina	$66.2	$0.3	$0.0	$1.2	$0.0	$0.4	$0.3	$0.0	$0.0	$68.5
Longreach	$47.5	$3.2	$2.0	$10.0	$0.0	$0.6	$0.0	$0.0	$0.0	$63.5
Winton	$56.4	$0.3	$0.0	$1.0	$0.0	$0.3	$0.3	$0.0	$0.0	$58.4
Total RAPAD	**$595.8**	**$7.0**	**$5.2**	**$22.8**	**$0.1**	**$2.8**	**$1.9**	**$0.0**	**$0.0**	**$635.7**
% of Total	**93.74%**	**1.04%**	**0.78%**	**3.44%**	**0.02%**	**0.44%**	**0.30%**	**0.00%**	**0.00%**	**100%**
Total QLD	**$5,902**	**$19**	**$1,015**	**$63**	**$571**	**$3,104**	**$147**	**$2,067**	**$1,664**	**$14,553**
% RAPAD of QLD	**10.1%**	**36.6%**	**0.5%**	**36.2%**	**0.0%**	**0.1%**	**1.3%**	**0.0%**	**0.0%**	**4.4%**

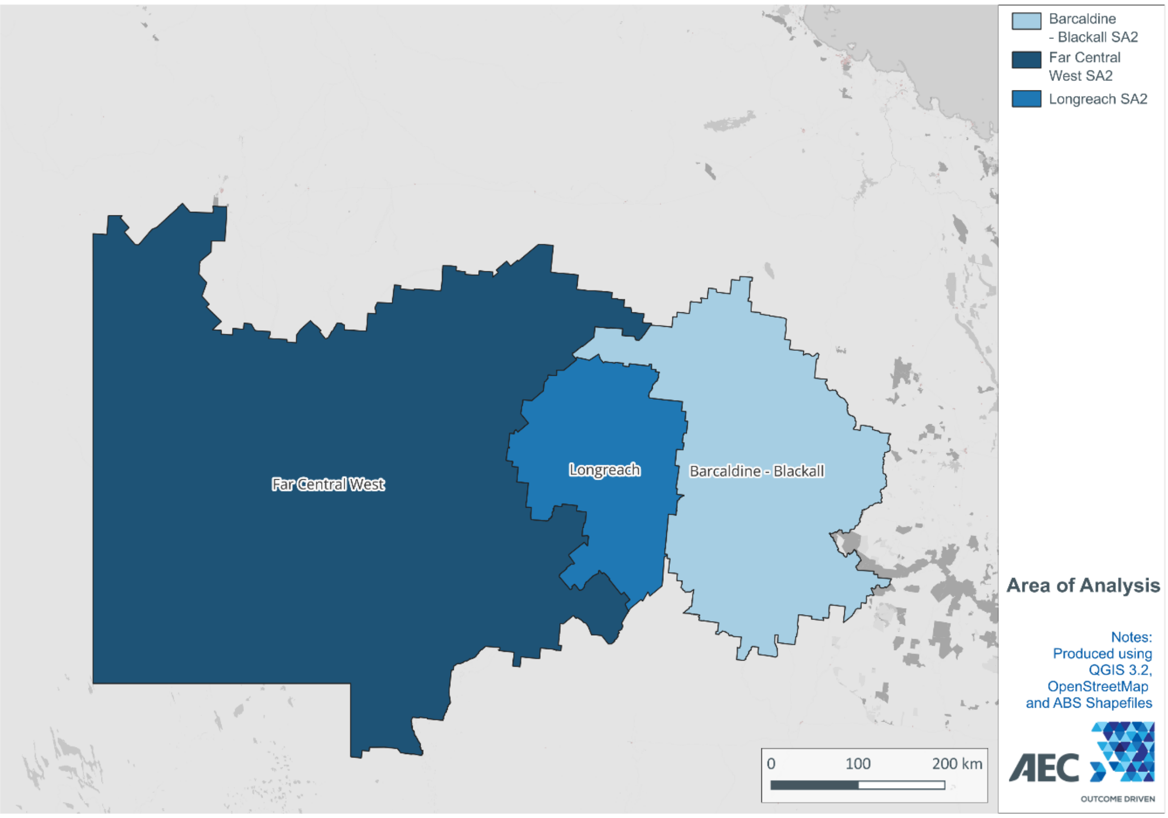
Source: ABS (2022 b).

2.4 TOURISM VISITATION

2.4.1 Tourism Catchment

The smallest area available on Tourism Research Australia (TRA) is Statistical Area 2 (SA2). The map of the RAPAD SA2 regions are provided in the figure below. Tourism visitation throughout section 2.4 refers to the below three SA2 catchment areas.

Figure 2.1. RAPAD SA2s



Source: AEC.

2.4.2 Visitors

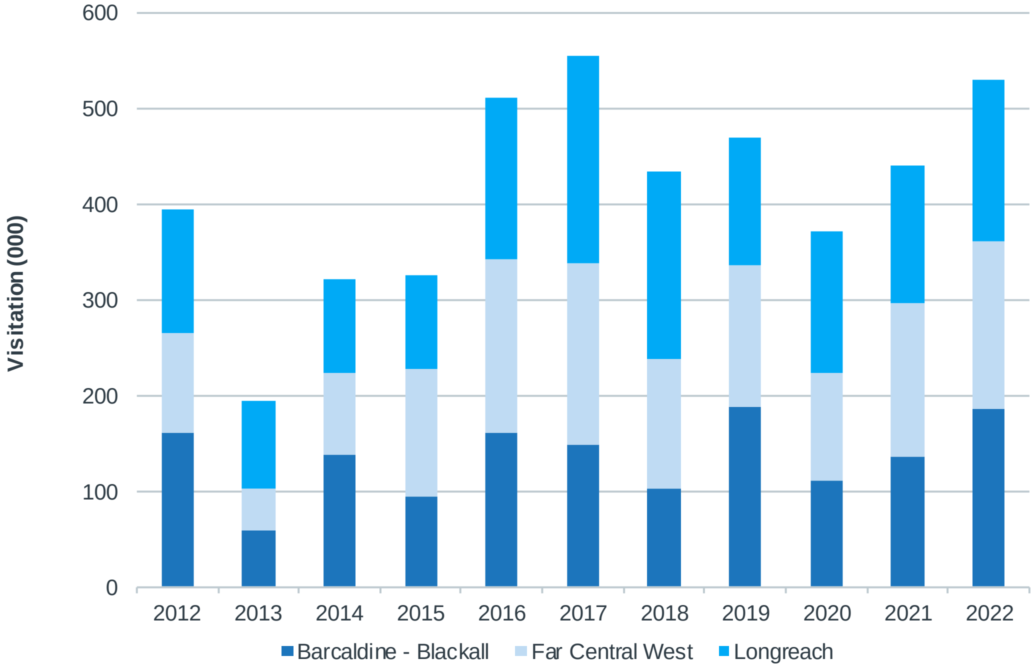
In 2022, total visitation to the RAPAD region was estimated to total 442,490 persons. The figure below does not total visitation to the entire RAPAD region as some visitors visit more than one Statistical Area 2 (SA2).

In 2022, visitation breakdown by SA2 was:

- Barcaldine – Blackall: 186,399 visitors including 54.6% day trip, 44.8% domestic overnight and 0.5% international.
- Far Central West: 175,930 visitors including 19.7% day trip, 79.5% domestic overnight and 0.8% international.
- Longreach: 167,881 visitors including 22.6% day trip, 76.6% domestic overnight and 0.8% international.

After the COVID-19 pandemic, visitation has bounced back and is higher than pre-pandemic levels.

Figure 2.2. Visitation (000), 2012 to 2022



Note: Totals in this figure will not sum to the total visitation for the RAPAD region as some visitors visit more than one SA2. To sum the visitation for Barcaldine – Blackall, Far Central West and Longreach for an estimate of the RAPAD region would double count some visitation.
Source: TRA (2023).

2.4.3 Visitor Nights

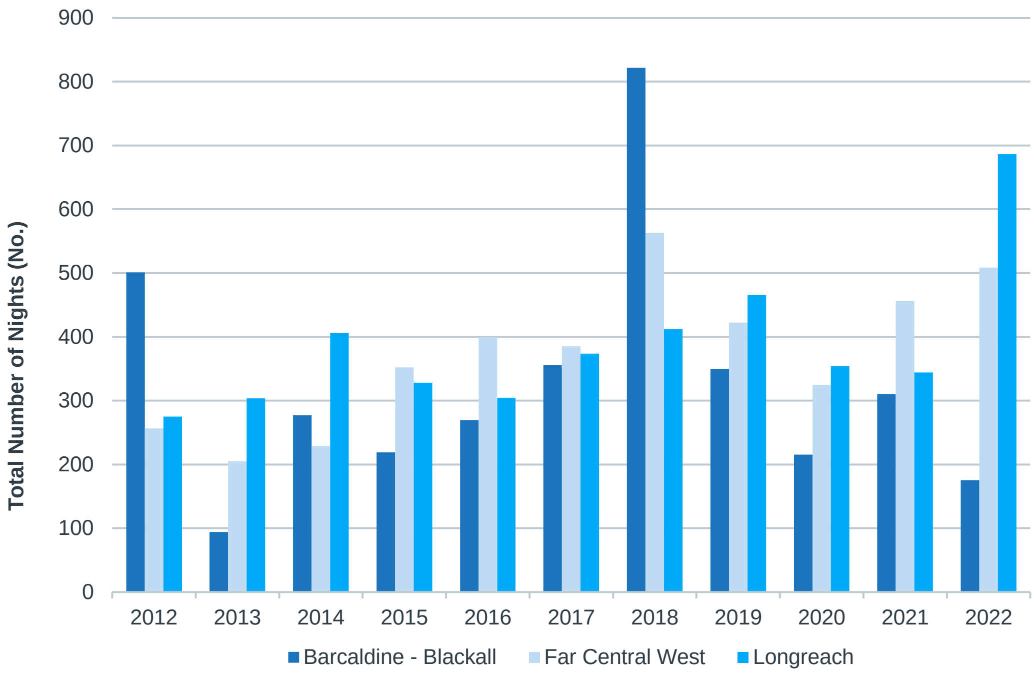
In 2022, the average length of stay for domestic overnight visitors in the RAPAD region totalled 5.0 nights. This was higher than 2019 when the average length of stay was estimated to total 4.0 nights.

A breakdown by region for 2022 includes:

- Barcaldine – Blackall: 2.0 nights
- Far Central West: 3.6 nights
- Longreach: 5.2 nights.

There is an abnormality in the dataset during 2018 when visitation declined but the number of domestic overnight nights significant increase. This spike was attributed to the Barcaldine – Blackall SA2, with the average number of nights for the year totalling 10.9.

Figure 2.3. Domestic Overnight, Total Number of Nights



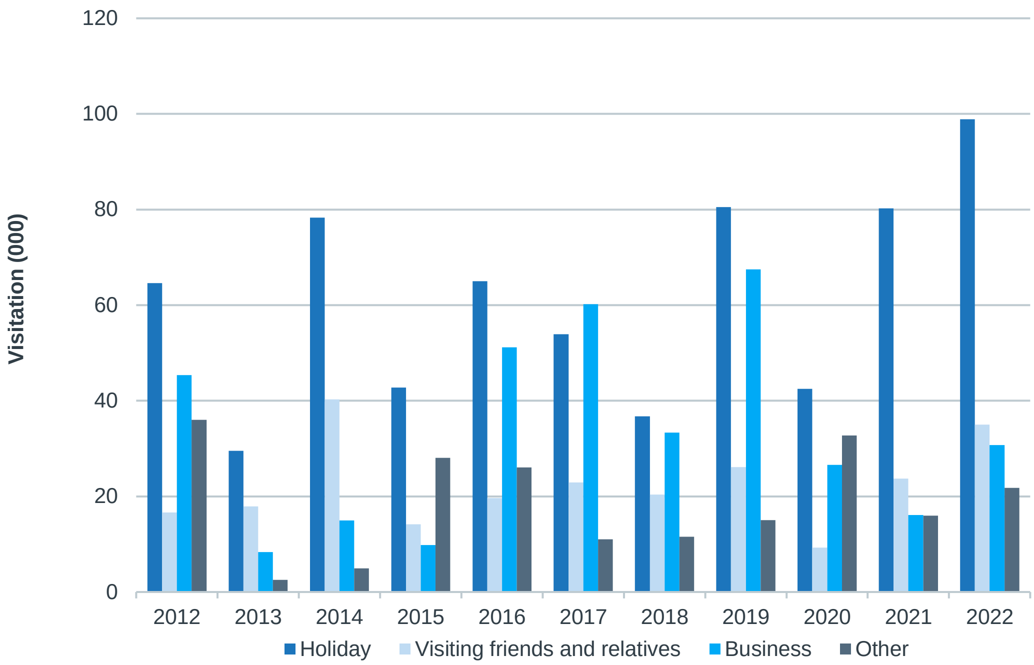
Source: TRA (2023).

2.4.4 Purpose of visit

Pre COVID-19, there was a higher proportion of business visitation, however, this has decreased after the pandemic, with holiday makers and those visiting friends and relatives increasing. A comparison of 2019 visitation by purpose and 2022 visitation by purpose is highlighted below:

- 2019: 42.6% holiday, 13.8% visiting friends and relatives, 35.7% business and 7.9% other
- 2022: 53.0% holiday, 18.8% visiting friends and relatives, 16.5% business, and 11.7% other.

Figure 2.4. Barcaldine – Blackall SA2, Purpose of Visit (2012 to 2022)

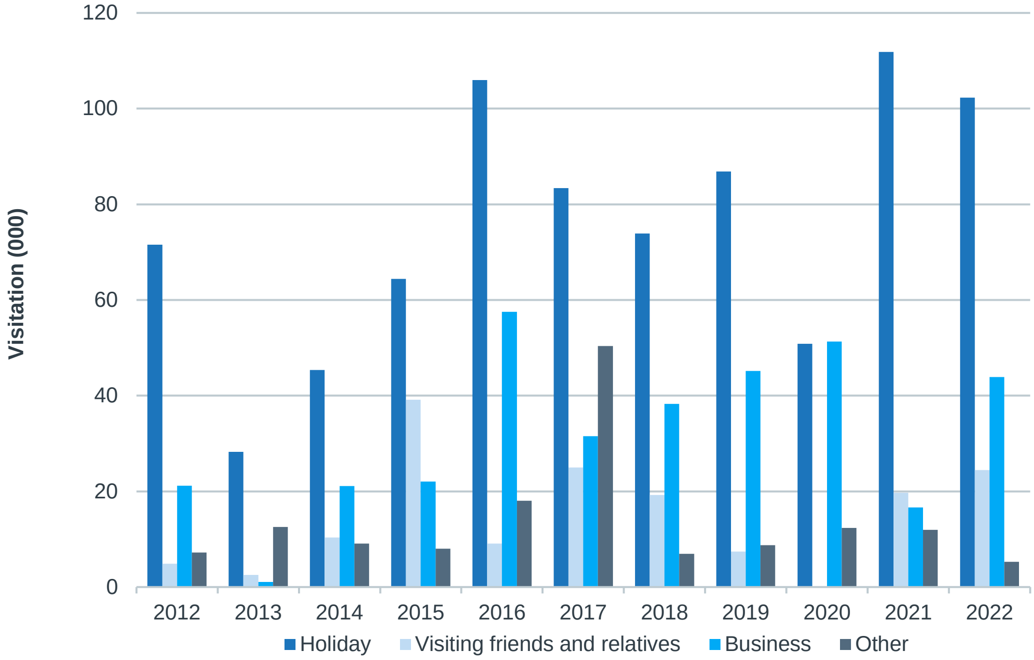


Note: Other includes other reason, no other reason, in transit, not stated-not asked, employment, education and not allocated.
Source: TRA (2023).

Holiday visitation is the highest proportion of visitation in the Far Central West SA2, accounting for 58.1% of total visitation in 2022. This was followed by business visitation (25.0%0 and visiting friends and relatives (13.9%).

When visitation dropped in 2020, business was the highest visitation by purpose (44.8%) followed by holiday (44.4%).

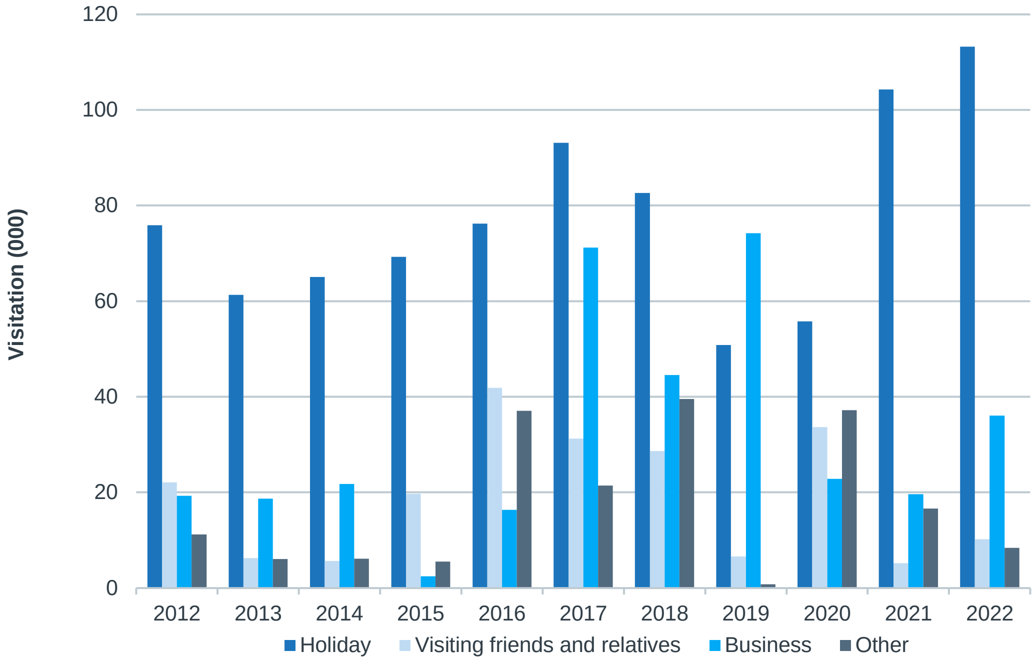
Figure 2.5. Far Central West SA2, Purpose of Visit (2012 to 2022)



Source: TRA (2023).

In 2022, the largest source of visitation by purpose was holiday, accounting for 67.5%. Prior to COVID-19, the largest source of visitation was business visitors, accounting for 56.0% of total visitation.

Figure 2.6. Longreach SA2, Purpose of Visit (2012 to 2022)

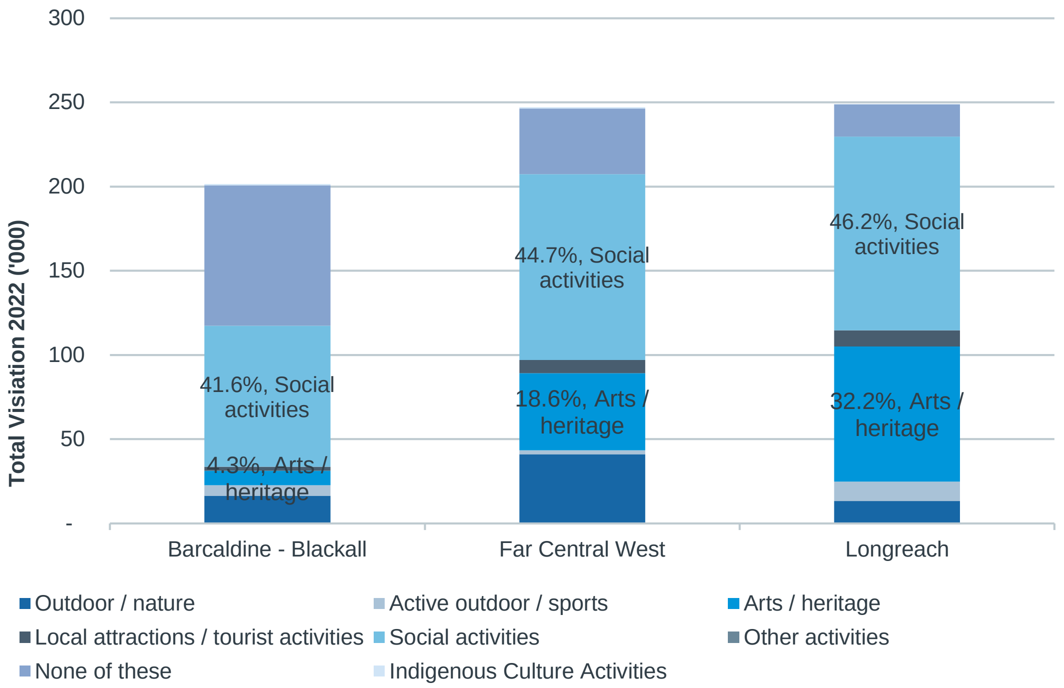


Source: TRA (2023).

2.4.5 Activities undertaken

Across each SA2 in 2022, the most popular activity undertaken was social activities, followed by arts and heritage.

Figure 2.7. Visitation by Activity, 2022



Source: TRA (2023).

2.4.6 Gross Regional Product

Historically tourism GRP in the RAPAD region grew year on year from 2012-13 to 2017-18, with total tourism GRP growing from $55.68 million to $1287.85 million. From 2018-19, tourism GRP has experienced decline from the effects of the COVID-19 pandemic.

In 2019-20, tourism accounted for 6.53% of total GRP, which is 16% higher than the Queensland average (represented by a LQ = 1.16).

Table 2.5. Tourism Gross Regional Product (Direct and Indirect) ($M)

Year	Barcaldine – Blackall SA2	Far Central West SA2	Longreach SA2	Total RAPAD Tourism	Total RAPAD GRP	RAPAD Tourism % of GRP	QLD Tourism % of GRP	Tourism GRP LQ
2008-09	$33.77	$29.36	$32.09	$95.22	$1,349.68	7.06%	6.01%	1.17
2009-10	$22.27	$28.90	$44.99	$96.16	$1,358.12	7.08%	5.76%	1.23
2010-11	$24.75	$24.85	$48.38	$97.98	$1,408.89	6.95%	5.64%	1.23
2011-12	$31.99	$22.85	$47.60	$102.44	$1,460.79	7.01%	6.10%	1.15
2012-13	$23.45	$15.44	$16.79	$55.68	$1,385.15	4.02%	6.32%	0.64
2013-14	$17.35	$16.96	$29.44	$63.74	$1,344.30	4.74%	6.07%	0.78
2014-15	$19.89	$21.49	$25.58	$66.96	$1,336.08	5.01%	6.00%	0.84
2015-16	$21.92	$30.53	$30.02	$82.46	$1,237.42	6.66%	6.35%	1.05
2016-17	$28.59	$41.14	$31.20	$100.93	$1,169.03	8.63%	6.32%	1.37
2017-18	$54.21	$35.74	$38.90	$128.85	$1,133.99	11.36%	6.78%	1.67
2018-19	$37.12	$39.34	$24.70	$101.16	$1,081.41	9.35%	6.97%	1.34
2019-20	$20.86	$21.80	$24.88	$67.54	$1,034.12	6.53%	5.64%	1.16

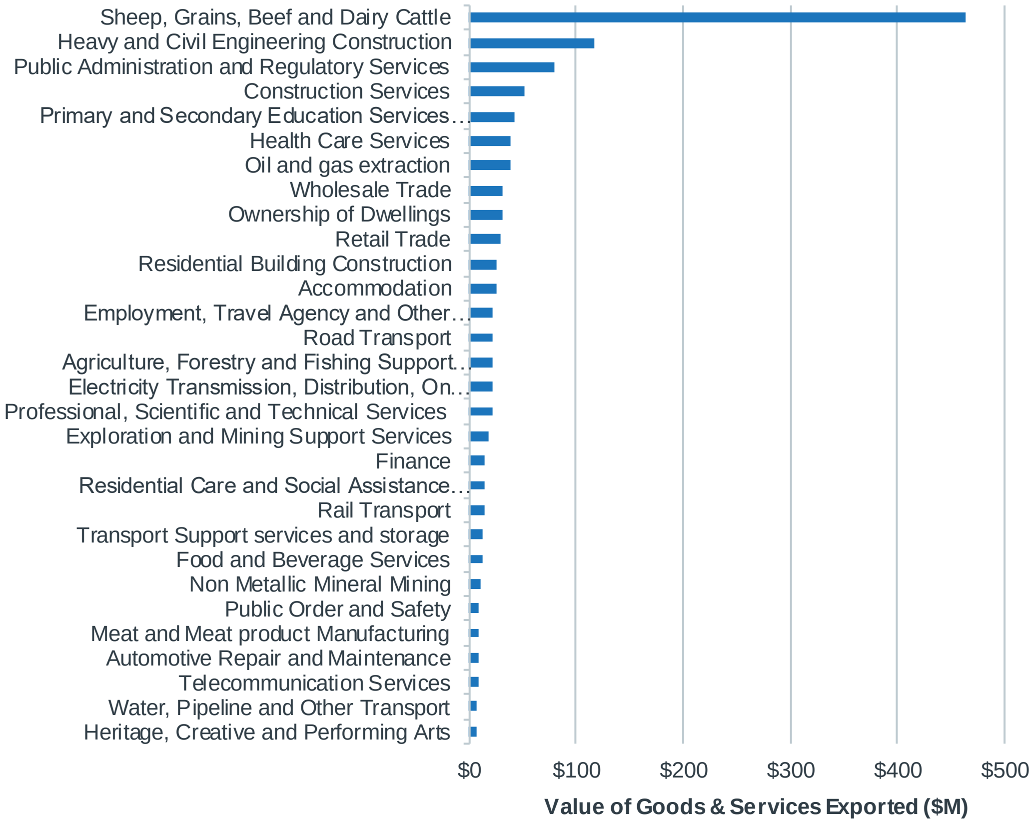
Note: A Location Quotient (LQ) represents the intensity of an activity, relative to the Queensland average. A LQ = 1 represents the same level of activity in the local region, relative to the Queensland average. A LQ = 2 represents twice as much activity in the local region, relative to the Queensland average.
Source: TRA (2021), AEC (unpublished).

2.5 NET EXPORTS

2.5.1 Regional Exports

The RAPAD region exported an estimated $1,290.8 million worth of goods and services in 2018-19. Of the total regional exports, sheep, grains, beef and dairy cattle accounted for 36.0% or $464.1 million. This was followed by heavy and civil engineering construction (9.0%) and public administration and regulatory services (6.2%).

Figure 2.8. Top 30 Exports from the RAPAD region, 2018-19

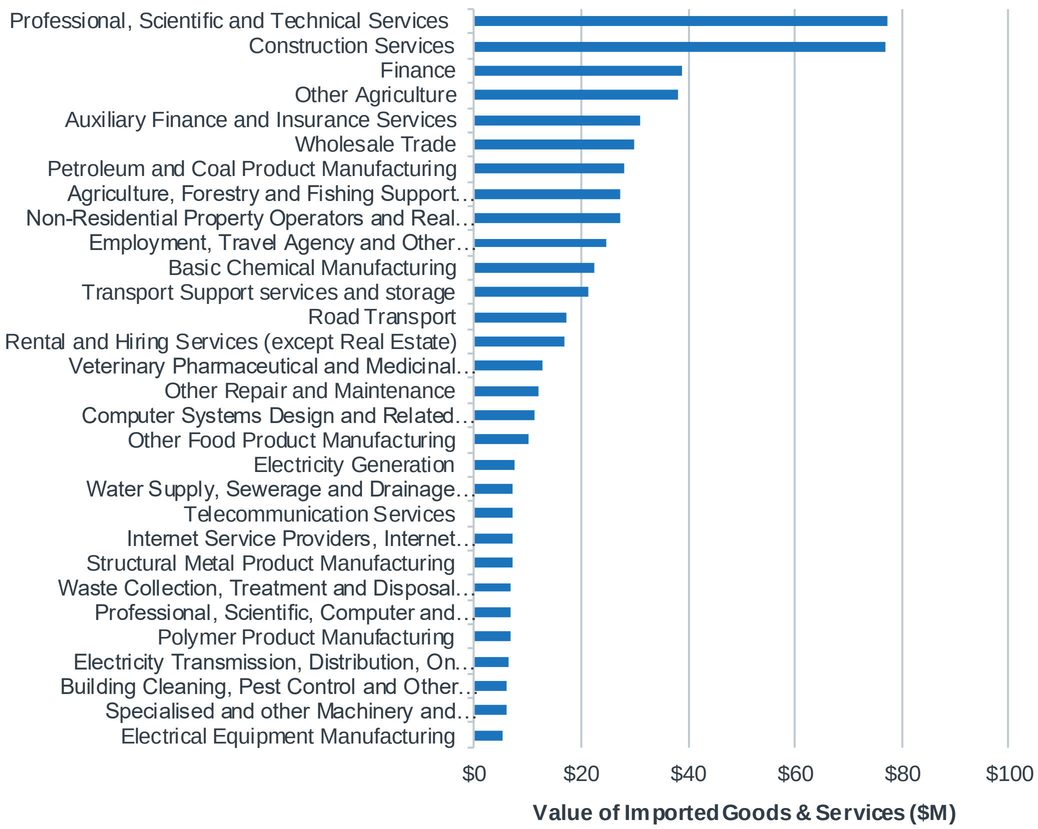


Source: ABS (2021), AEC.

2.5.2 Regional Imports

The RAPAD region imported an estimated $690.6 million worth of goods and services in 2018-19. Of the total regional imports, professional, scientific and technical services accounted for 11.2% or $77.3 million. This was followed by construction services (11.2%) and finance (5.6%).

Figure 2.9. Top 30 Imports from the RAPAD region, 2018-19



Source: ABS (2021), AEC.

2.5.3 Net Regional Exports

The largest regional net exports (imports subtracted from exports) are agricultural, forestry and fishing. This is followed by construction and public administration and safety.

Table 2.6. Net Regional Exports, 2018-19

Industry	Imports ($M)	Exports ($M)	Net Exports ($M)
Agriculture, forestry and fishing	$68.7	$492.5	$423.7
Construction	$79.4	$189.5	$110.1
Public administration and safety	$2.6	$87.9	$85.3
Mining	$3.0	$69.8	$66.8
Health care and social assistance	$0.8	$53.1	$52.3
Education and training	$1.0	$47.3	$46.3
Accommodation and food services	$5.0	$36.2	$31.2
Ownership of dwellings	$0.0	$30.0	$30.0
Retail trade	$2.3	$29.0	$26.7
Transport, postal and warehousing	$45.2	$66.1	$20.9
Arts and recreation services	$1.5	$7.4	$5.9
Wholesale trade	$30.0	$30.3	$0.3
Other services	$17.1	$17.1	-$0.1

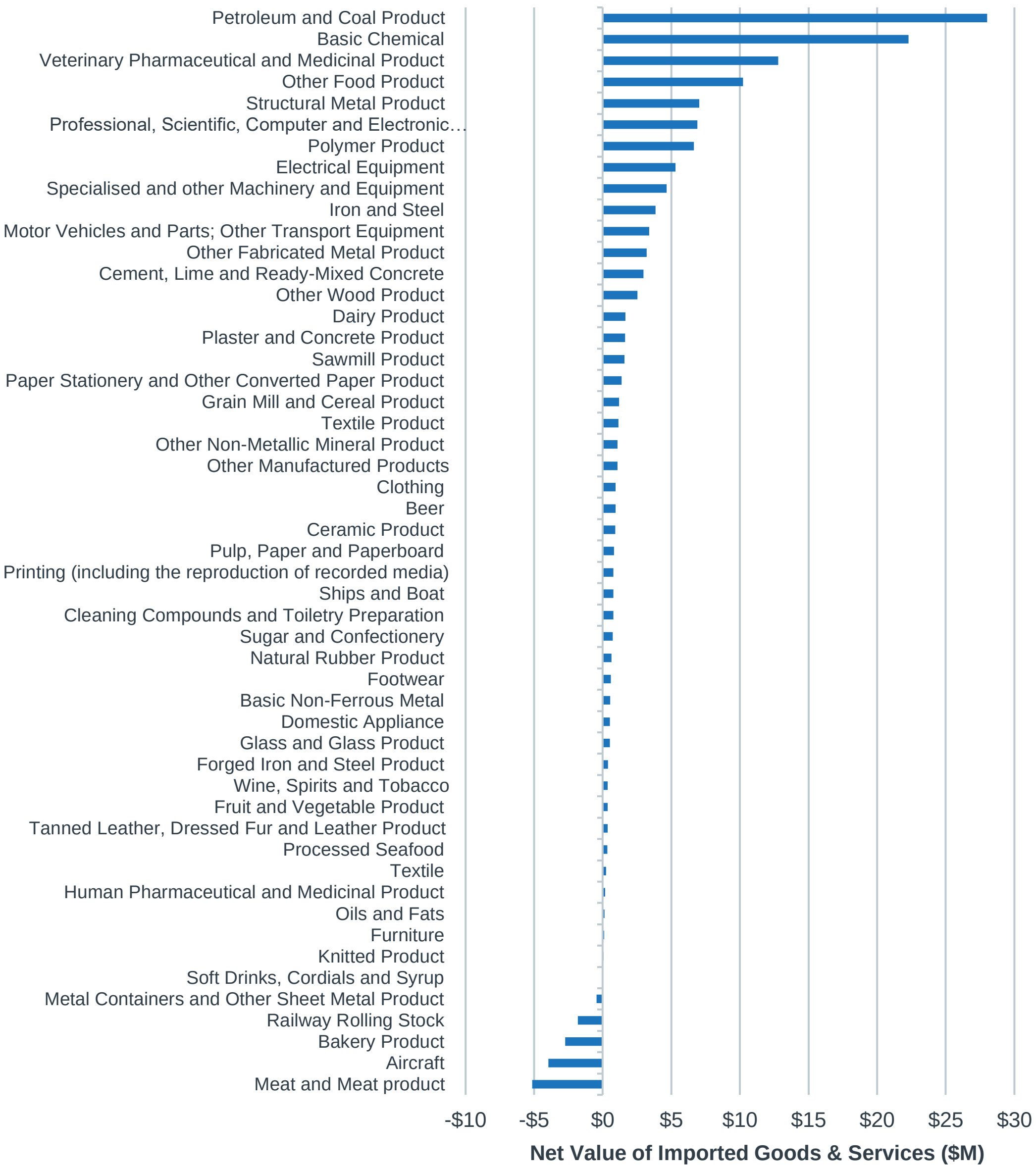
Industry	Imports ($M)	Exports ($M)	Net Exports ($M)
Information media and telecommunications	$18.9	$16.1	-$2.8
Electricity, gas, water and waste services	$28.3	$23.6	-$4.6
Administrative and support services	$31.0	$26.2	-$4.7
Rental, hiring and real estate services	$43.8	$7.1	-$36.7
Financial and insurance services	$72.8	$16.9	-$55.8
Professional, scientific and technical services	$88.6	$22.3	-$66.3
Manufacturing	$150.6	$22.1	-$128.5
Total	**$690.6**	**$1,290.8**	**$600.2**

Source: ABS (2021), AEC.

2.5.4 Net Regional Imports (Manufacturing)

The largest net imports of manufactured product into the RAPAD region are petroleum products (liquid fuels) and basic chemicals.

Figure 2.10. Net Imports of Manufactured Product to the RAPAD region, 2018-19



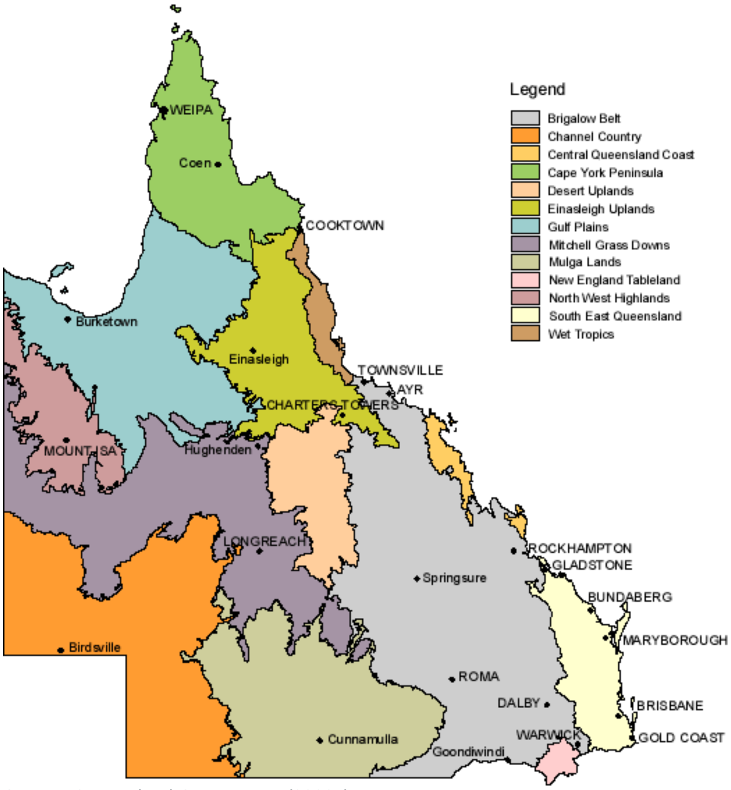
Source: ABS (2021), AEC.

2.6 NATURAL RESOURCE ASSESSMENT

2.6.1 Good Quality Agricultural Land

The terrestrial ecosystems present in the RAPAD region include a mixture of Tropical and Subtropical Grasslands, Savannas and Shrublands (predominantly the Mitchell Grass Downs and Desert Uplands), as well as Deserts and Xeric Shrublands (Channel Country) (CAPD, 2020).

Figure 2.11. Biogeographic Regions in Queensland



Source: Queensland Government (2023a)

Within these regional ecosystems, there are a number of different Land Zones, some with soils potentially sufficiently suitable to support a range of alternative agricultural activities (such as dryland or irrigated broadacre cropping and/or perennial orchard establishment). The dominant Land Zones in the region include (DSITIA, 2012):

- **Recent Quaternary Alluvial Systems:** Surrounding the major river systems in the south west of the RAPAD region are large areas of Quaternary alluvium and lacustrine deposits, which are considered mostly flat to gently undulating with active alluvial deposition in some part of the landscape. These soils are typically considered usually fertile.
- **Tertiary-early Quaternary clay plains:** Forming the majority of the central landscape in the RAPAD region and traditionally known as the Mitchell Grass Downs, these soils are constituted from the Mackunda, Winton and Glendower formation to form aeolian clays. These soils are considered to be highly fertile.
- **Tertiary-early Quaternary loamy and sandy plains and plateaus:** Forming the upper reaches of the Burdekin River basin in the north east of the RAPAD region are large areas of Late Tertiary and Quaternary colluvium and residual deposits, which typically form gently undulating plains, with clay soils. Cropping does occur in these zones, but is dependent on localised soil quality, which can be highly variable.
- **Quaternary inland dunefields:** Present in the far south west of the RAPAD region, these soils are large areas of deeply weathered and duricrusted land surfaces. These soils include those located in the inland dunefields on the far south west boundary of the RAPAD region. These soils have generally low fertility due to the highly weathered and leached soils.

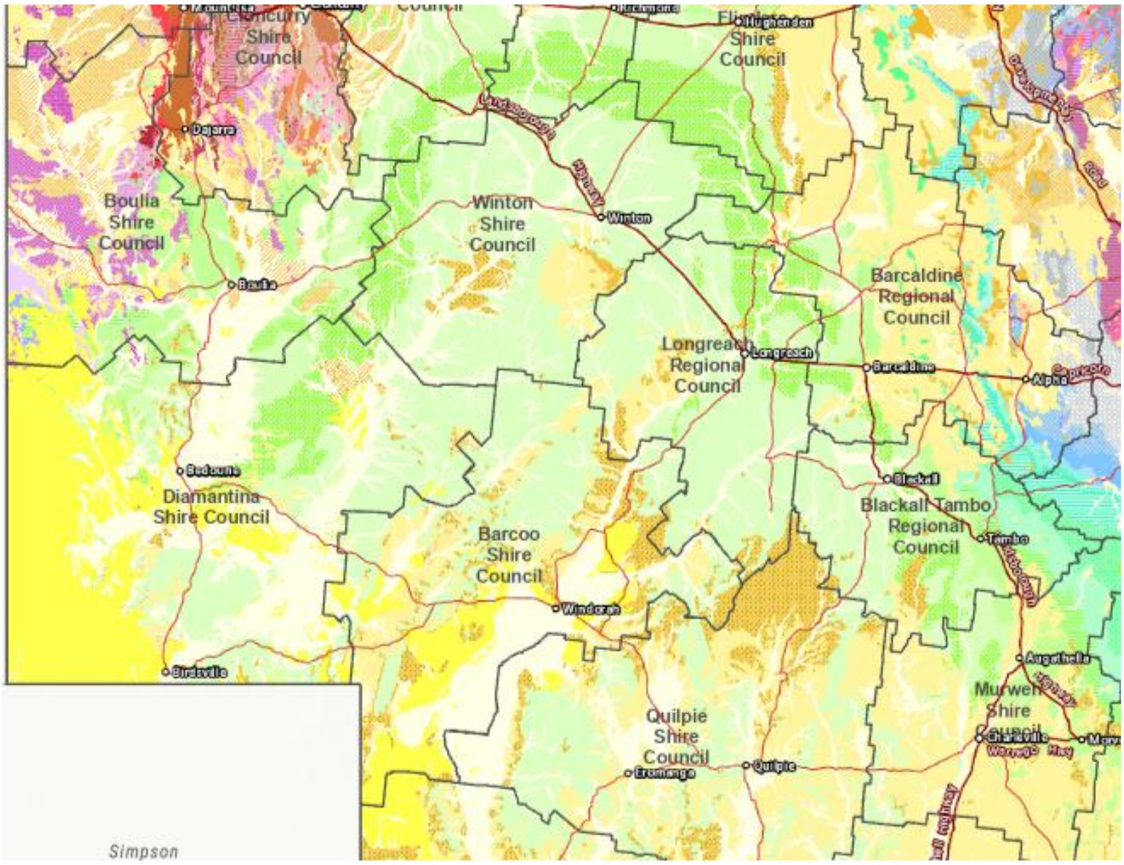
The distribution of these land types is included Table 2.7 and Figure 2.12 below.

Table 2.7. Land Zones in the RAPAD Region (ha)

LGA	Recent Quaternary Alluvial Systems	Tertiary-early Quaternary clay plains	Tertiary-early Quaternary loamy and sandy plains and plateaus	Other land types	Total	Potentially Suitable for Agriculture	% Potentially Suitable for Agriculture
Barcaldine	603,818	672,142	2,578,756	3,250,898	**5,338,239**	3,854,716	72%
Blackall-Tambo	294,251	1,142,233	375,592	1,517,825	**3,053,700**	1,812,076	59%
Longreach	529,917	2,855,444	316,683	3,172,127	**4,057,555**	3,702,044	91%
Winton	981,871	3,822,983	307,989	4,130,972	**5,380,870**	5,112,843	95%
Boulia	1,576,146	110,871	531,664	642,535	**6,094,359**	2,218,681	36%
Barcoo	1,678,388	1,856,161	970,452	2,826,613	**6,224,885**	4,505,001	72%
Diamantina	2,798,695	2,422,209	240,950	2,663,159	**9,466,092**	5,461,854	58%
Total RAPAD	**8,463,085**	**12,882,043**	**5,322,086**	**18,204,129**	**39,615,699**	**26,667,215**	**67%**

Source: Queensland Government (2023b).

Figure 2.12. Surface Geology of the RAPAD Region



Key:

- White: Recent Quaternary Alluvial Systems
- Green and dark green: Tertiary-early Quaternary clay plains
- Beige: Tertiary-early Quaternary loamy and sandy plains and plateaus
- Yellow: Quaternary inland dunefields.

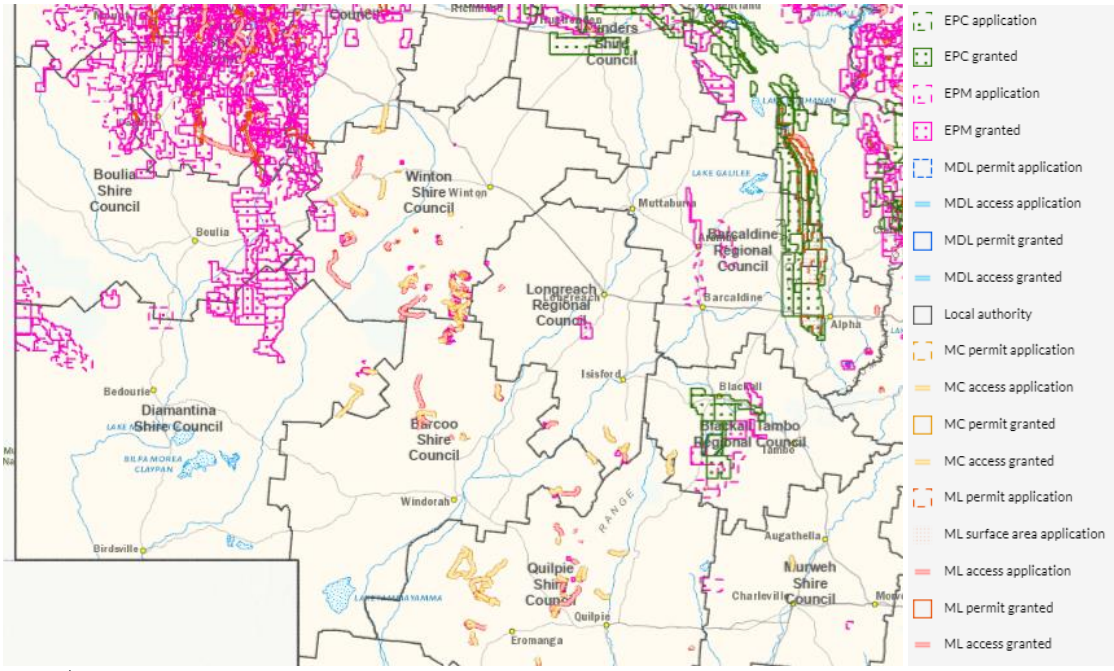
Source: Queensland Government (2023)

2.6.2 Mineral Resources

There is a total of 238 granted or applied permits in the RAPAD region for mineral exploration, which covers an area of 2.9 million hectares. Primary resources include coal (Barcaldine and Blackall-Tambo Regional Councils), Copper (Boulia and Diamantina Shire Councils) and Opals (Barcoo and Winton Shire Councils).

Figure 2.13 and Table 2.8 provides an overview of mineral exploration permits in the RAPAD region.

Figure 2.13. Mineral Resources Permits in the RAPAD Region



Note to key:
- EPC = Exploration Permit (Coal)
- EPM = Exploration Permit (Minerals)
- MDL = Mineral Development Licence
- MC = Mining Claim
- ML = Mining Lease

Source: GeoResGlobe (2023).

Table 2.8. Mineral Exploration Permits

Permit Type	# of Permits	Granted / Application	Notable Owners	Resource	Area (Ha)
Barcaldine					
MDL	3	Granted	• HANCOCK COAL PTY LTD • HANCOCK GALILEE PTY LTD • WARATAH COAL PTY LTD	Coal	72,805
MDL	1	Granted	• ALPHA RESOURCES PTY. LIMITED	OSH	1,905
EPM	5	Granted	• RENEGADE EXPLORATION (QLD) PTY LTD • ALPHA RESOURCES PTY. LIMITED • Others	AMOC	50,055
EPM	4	Application	• ACTIVEX LIMITED • RENEGADE EXPLORATION (QLD) PTY LTD	AMOC	108,083
Blackall Tambo					
MDL	1	Granted	• EAST ENERGY RESOURCES LIMITED	Coal	37,675
EPM	4	Granted	• ORIGIN ENERGY FUTURE FUELS PTY LTD • Others	AMOC	119,911
EPM	5	Granted	• MAXWELL, Brian William	AMOC	145,013
Longreach					
EPM	5	Granted	• GREENVALE MINING LTD	AMOC	28,093

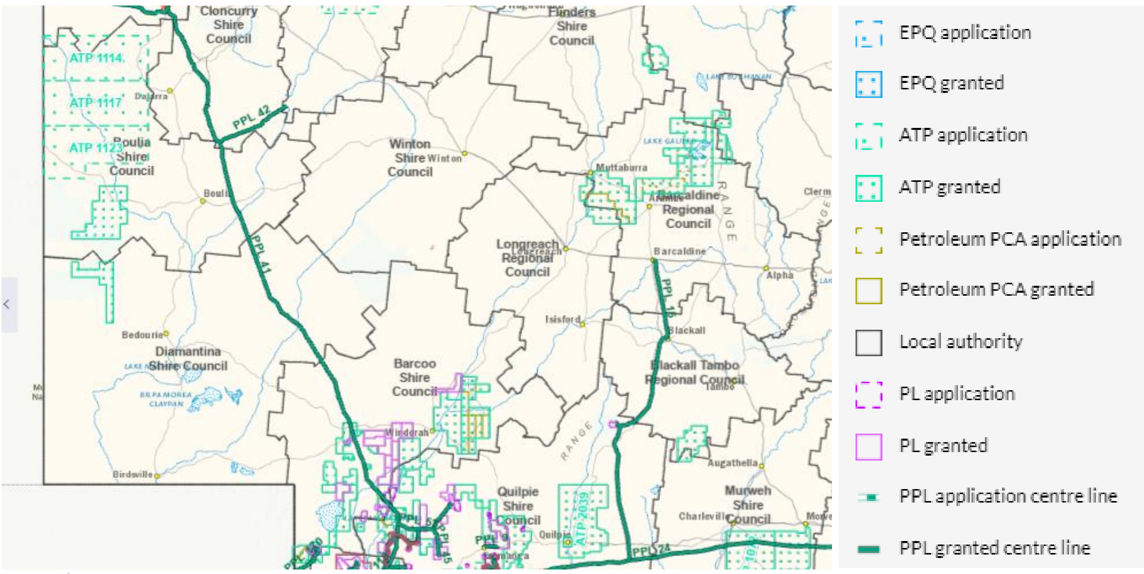
Permit Type	# of Permits	Granted / Application	Notable Owners	Resource	Area (Ha)
			• Others		
Winton					
EPM	34	Granted	• ANGLO AMERICAN EXPLORATION (AUSTRALIA)	AMOC	151,469
EPM	17	Granted	• Others	Opal	18,861
EPM	4	Application	• Others	AMOC	3,458
EPM	2	Application	• Others	Opal	2,525
Boulia					
EPM	67	Granted	• ANGLO AMERICAN EXPLORATION (AUSTRALIA) • Others	AMOC	722,481
EPM	26	Application	• RIO TINTO EXPLORATION PTY LIMITED • SANDFIRE RESOURCES LIMITED • Others	AMOC	509,001
Barcoo					
EPM	10	Granted	• Others	AMOC	9,392
EPM	4	Granted	• Others	Opal	3,763
EPM	1	Application	• RELIER PTY LTD	AMOC	1,253
EPM	1	Application	• ASHWOOD, Mark Ian	Opal	1,255
Diamantina					
EPM	23	Granted	• ANGLO AMERICAN EXPLORATION (AUSTRALIA) • HEATHGATE RESOURCES PTY LTD • Others	AMOC	422,585
EPM	21	Application	• RIO TINTO EXPLORATION PTY LIMITED • SANDFIRE RESOURCES LIMITED • Others	AMOC	510,840

Source: GeoResGlobe (2023).

2.6.3 Gas Resources

The RAPAD region currently 52 permits for petroleum exploration which covers an area of over 4 million hectares. Figure 2.14 and Table 2.9 provides an overview of petroleum exploration permits in the RAPAD region.

Figure 2.14. Gas Resources Permits in the RAPAD Region



Note to key:
- EPQ = Exploration Permit (Queensland)

- ATP = Authority to Prospect
- PCA = Potential Commercial Area
- PL = Production Licence
- PPL = Petroleum Pipeline Licence

Source: GeoResGlobe (2023).

Table 2.9. Gas Resource Permits

Permit Type	# of Permits	Granted / Application	Notable Owners	Resource	Area (Ha)
Barcaldine					
PCA	6	Granted	• CAPRICORN ENERGY PTY LTD • COMET RIDGE GALILEE PTY LTD	Petroleum	420,859
PCA	9	Application	• EUREKA PETROLEUM PTY LTD	Petroleum	205,515
Blackall Tambo					
ATP	1	Granted	• TOMORROW ENERGY CORPORATION	Coal Seam Gas, Petroleum, CONGAS	71,991
Longreach					
PCA	2	Granted	• CAPRICORN ENERGY PTY LTD	Petroleum	37,387
ATP	1	Granted	• CAPRICORN ENERGY PTY LTD	Petroleum	27,578
Boulia					
ATP	2	Granted	• MERLIN ENERGY PTY LTD	Petroleum, CONGAS, Oil	268,176
ATP	3	Application	• EUREKA PETROLEUM PTY LTD	Petroleum	1,958,946
Barcoo					
PCA	17	Granted	• ORIGIN ENERGY C5 PTY LIMITED • SANTOS QNT PTY. LTD.	Petroleum	273,871
ATP	10	Granted	• ORIGIN ENERGY C5 PTY LIMITED • SANTOS QNT PTY. LTD. • KEY COOPER BASIN PTY LTD • BRIDGEPORT ENERGY (QLD) PTY LIMITED	Petroleum, CONGAS, Shale Gas, Oil	674,138
Diamantina					
ATP	1	Granted	• MERLIN ENERGY PTY LTD	Petroleum, CONGAS, Oil	122,883

Source: GeoResGlobe (2023).

2.6.4 Renewable Energies

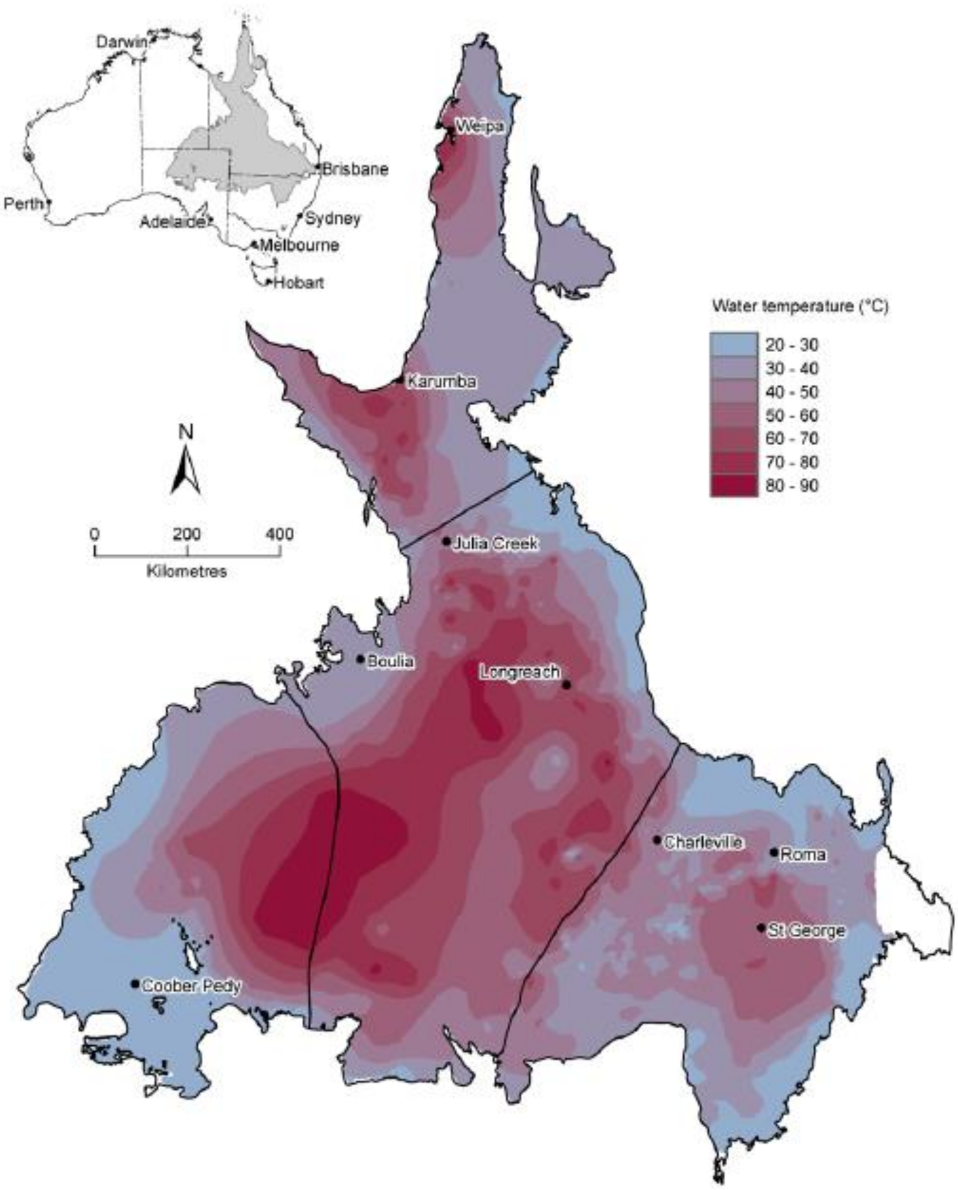
The RAPAD region has operational renewable energy production with opportunities to develop additional energy production due to its natural competitive advantages.

Geothermal

A correlation exists between the temperature of the groundwater in the aquifers and the depths of the aquifers. Shallow parts of the GAB, where aquifers are relatively close to the ground surface, such as near the recharge areas, contain relatively cool water, with temperatures only up to 40 °C. The regions of intermediate depths have temperatures between 40 and 60 °C and the deeper parts of the GAB show higher temperatures between 60 and 90 °C (CSIRO, 2012).

Figure 2.15 presents the geographical distribution of water temperature in the GAB.

Figure 2.15. Groundwater Temperatures in the Great Artesian Basin

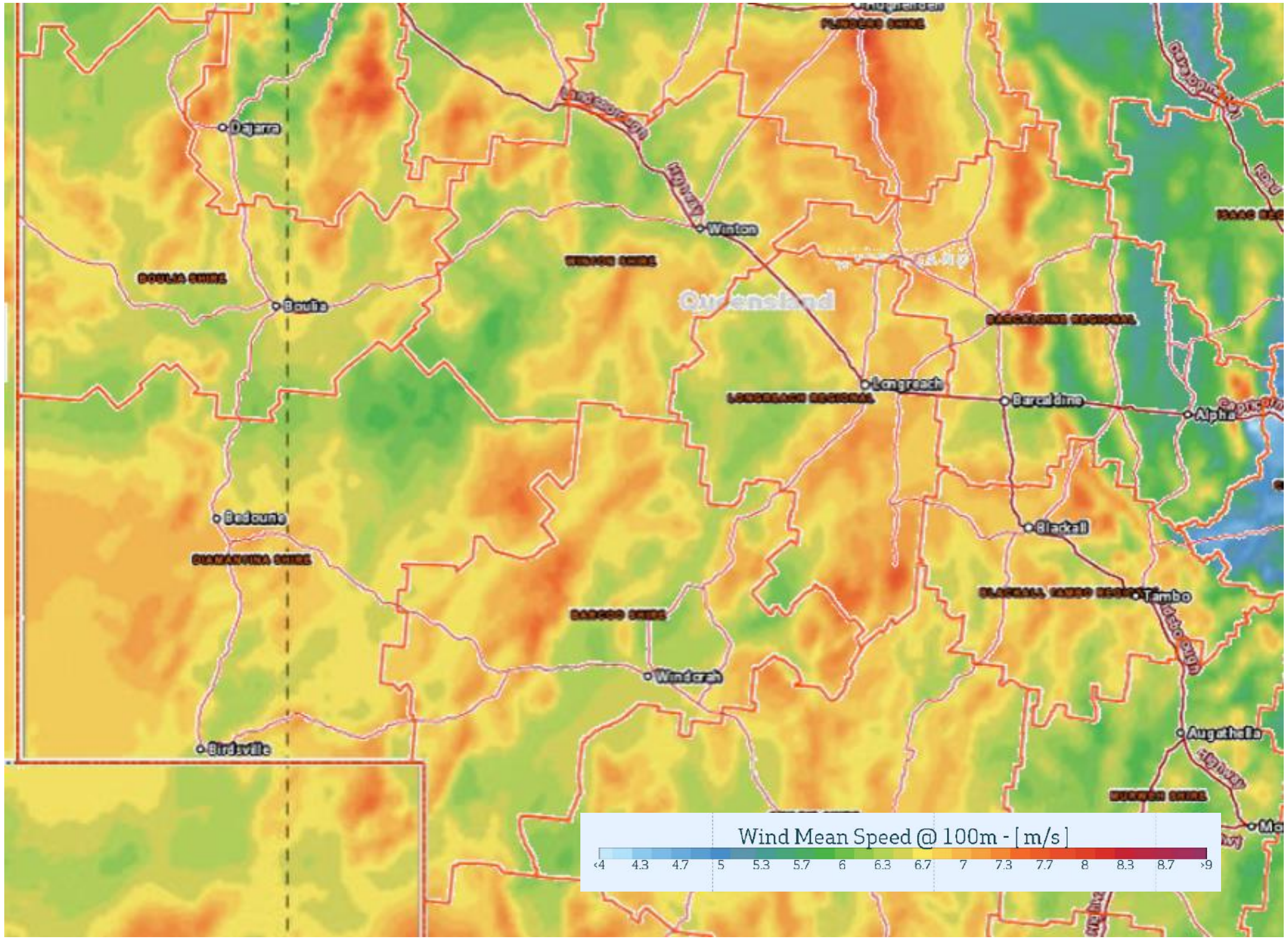


Source: CSIRO (2012)

Wind

The RAPAD region has a number of high quality resources (capacity factor of up to 32%), as outlined in the figure below. Notable resources include the Selwyn Range (Boulia Shire Council), the Great Dividing Range (Barcaldine and Blackall Regional Councils) and across Diamantina Shire. However, many of these locations are beyond the reaches of the high voltage transmission network.

Figure 2.16. Wind Resources in the RAPAD Region

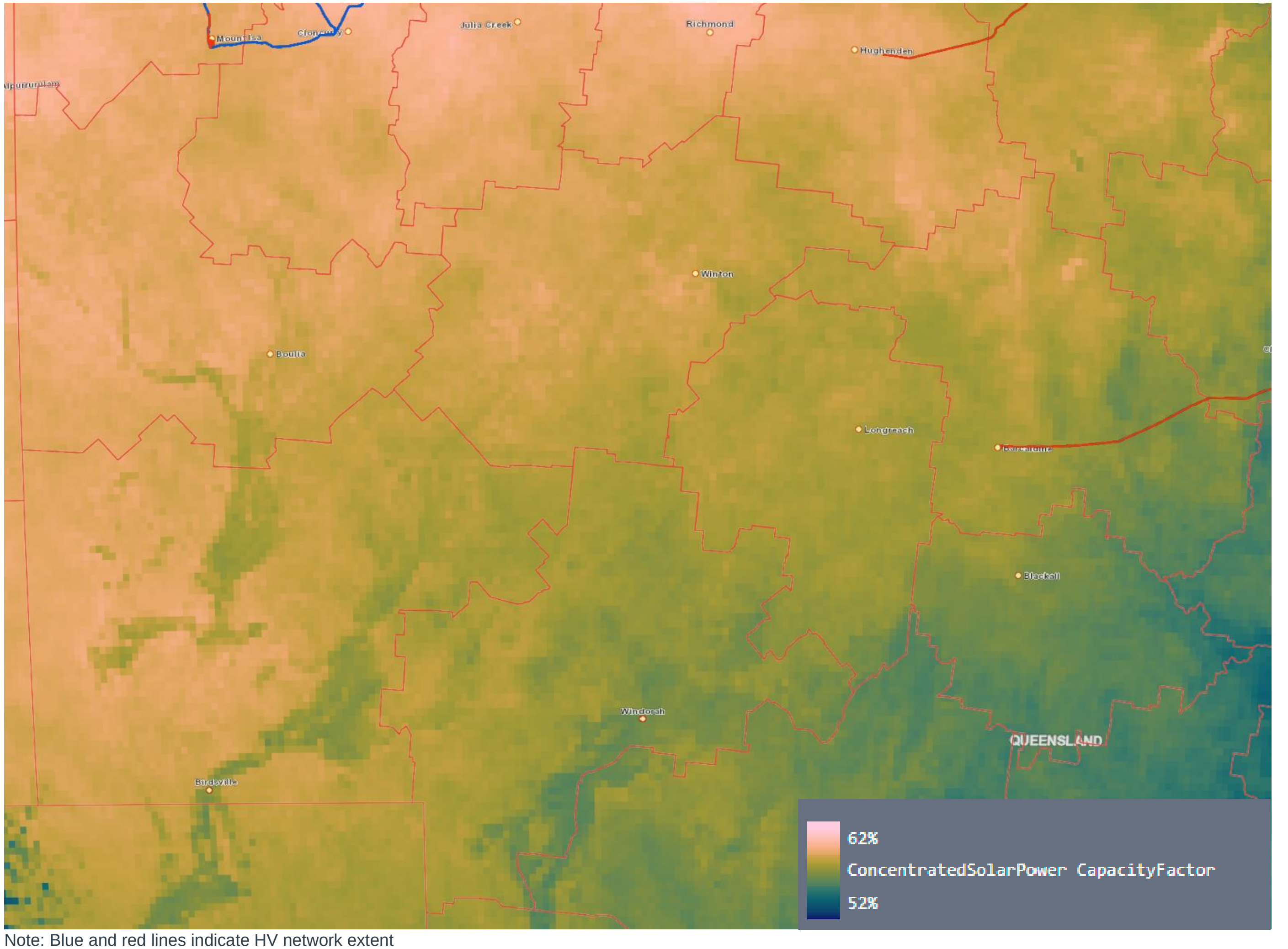


Source: Vortex (2022)

Solar

The RAPAD region has large areas of high-quality solar resources, particularly in the far western areas of the RAPAD region (Boulia, Diamantina and Winton Shires) where capacity factors reach up to 25% for solar PV and 62% for concentrated solar. However, these locations are not connected to the high voltage transmission network.

Figure 2.17. Solar Resources in the RAPAD Region



Note: Blue and red lines indicate HV network extent
Source: National Map (2023)

3. CURRENT WATER USE

3.1 APPROACH

This chapter identifies and profiles the current drivers for water demand across the different catchments in the RAPAD region. This chapter also identifies and profiles the infrastructure used to support delivery of water to the ultimate customer.

Key Points:

- The current uses for water in the RAPAD region include urban water consumption, agriculture and a range of industrial activities.
- Both surface water and groundwater are used to meet the region's water needs.
    - Groundwater resources (particularly in the Georgina Basin) are predominantly utilised for resource related activity. 22,836 ML of groundwater resource (65% of 35,329 ML total allocation) is used for mining and related industrial processes in the RAPAD region. 20% of groundwater resources are used for town water supply (7,183 ML).
    - Surface water resources are predominantly used to support irrigated agriculture, especially in the Burdekin (Belyando-Suttor) sub catchment. The Burdekin (Belyando-Suttor) sub catchment accounts for 78% of all surface water allocations in the RAPAD region (82,350 ML of 106,226 ML total allocation) and 81% of the surface water in this sub-catchment is used for irrigation.
- There are a number of water supply networks across the RAPAD region, supplying both reticulated water and receiving and treating waste water/sewerage.
- Most communities in the RAPAD region utilise water for recreational purposes, principally in the form of town pools, but also in the provision of recreational lakes.
- In stream water storage in support of both town supply and irrigated agriculture does exist in the RAPAD region but is limited to the Cooper and Burdekin Basis. There is currently no in stream storages in the Georgina or Diamantina Basins.

3.2 CURRENT USE TYPOLOGIES

In the RAPAD region, the common water uses typologies include:

- Urban water consumption, meeting a range of needs, including:
    - Residential and commercial water consumption for the local population
    - Water to support tourism visitation (particularly through accommodation providers)
    - Irrigation and maintenance of community parks, gardens and open spaces
    - Recreational uses, such as recreational dams and town pools and water parks.
- Agricultural uses, including:
    - Stock and domestic water consumption
    - Irrigated agriculture – both for fodder crops, broadacre crops and horticulture.
- Industrial activity, including:
    - Mineral mining and processing
    - Gas extraction
    - Non-mining manufacturing.

3.3 EXISTING WATER LICENCES

The following information has been derived from the Queensland Government's Water Entitlements Register (Queensland Government, 2023c).

Georgina Basin

Table 3.1 outlines the water allocations in the Georgina Basin (surface and groundwater – including GAB allocations).

Table 3.1. Water Allocations – Georgina Basin

License Type	Licenses	ML	% of total ML	Comment
Surface Water				
Town Water Supply	1	60	56%	• BOULIA SHIRE COUNCIL 60 ML
Industrial/mining	0	0	0%	
Irrigation	1	48	44%	
Construction	0	0	0%	
Stock & Domestic	0	N/A	0%	
Total	**2**	**108**	**100%**	
Groundwater				
Town Water Supply	5	556	2%	• BOULIA SHIRE COUNCIL 289 ML • MOUNT ISA CITY COUNCIL 195 ML • CLONCURRY SHIRE COUNCIL 76 ML
Industrial/mining	10	22,359	95%	• SOUTHERN CROSS FERTILISERS PTY LTD 16000 ML • SOUTH32 CANNINGTON PROPRIETARY LIMITED 2310 ML • CHINOVA RESOURCES OSBORNE PTY LTD 1445 ML • AUSTRAL RESOURCES LADY ANNIE PTY LTD 1344 ML • TREKELANO COPPER MINE 1000 ML • CHINOVA RESOURCES CLONCURRY MINES PTY LTD 260 ML
Irrigation	4	654	3%	
Construction	2	24	0%	
Stock & Domestic	65	N/A	0%	
Total	**86**	**23,593**	**100%**	

Source: Queensland Government (2023c)

Diamantina Basin

Table 3.2 below outlines the water allocations in the Diamantina Basin (surface and groundwater – including GAB allocations).

Table 3.2. Water Allocations – Diamantina Basin

License Type	Licenses	ML	% of total ML	Comment
Surface Water				
Town Water Supply	0	0	0%	
Industrial/mining	0	0	0%	
Irrigation	1	6,000	100%	
Construction	0	0	0%	
Stock & Domestic	0	N/A	0%	
Total	**1**	**6,000**	**100%**	
Groundwater				
Town Water Supply	5	1,658	67%	• DIAMANTINA SHIRE COUNCIL 493 ML • WINTON SHIRE COUNCIL 1165 ML
Industrial/mining	0	0	0%	
Irrigation	4	800	33%	
Construction	0	0	0%	
Stock & Domestic	107	N/A	0%	
Total	**116**	**2,458**	**100%**	

Source: Source: Queensland Government (2023c)

Cooper Creek Basin

Table 3.3 below outlines the water allocations in the Cooper Creek Basin (surface and groundwater – including GAB allocations).

Table 3.3. Water Allocations – Cooper Creek Basin

License Type	Licenses	ML	% of total ML	Comment
Surface Water				
Town Water Supply	8	3,679	20%	• LONGREACH REGIONAL COUNCIL 3070 ML • BARCOO SHIRE COUNCIL 541 ML • BARCALDINE REGIONAL COUNCIL 68 ML
Industrial/mining	0	0	0%	
Irrigation	34	14,089	78%	
Construction	0	0	0%	
Stock & Domestic	22	266	1%	
Total	**64**	**18,034**	**100%**	
Groundwater				
Town Water Supply	18	4,969	54%	• BARCALDINE REGIONAL COUNCIL 2195 ML • BLACKALL-TAMBO REGIONAL COUNCIL 1485 ML • LONGREACH REGIONAL COUNCIL 804 ML • FLINDERS SHIRE COUNCIL 305 ML • QUILPIE SHIRE COUNCIL 130 ML • BARCOO SHIRE COUNCIL 50 ML
Industrial/mining	5	478	5%	• SANTOS LIMITED 62.5 ML • SANTOS QNT PTY LTD 15 ML • ERGON ENERGY QUEENSLAND PTY LTD 400 ML
Irrigation	30	3,830	41%	
Construction	1	2	0%	
Stock & Domestic	765	N/A	0%	
Total	**819**	**9,279**	**100%**	

Source: Source: Queensland Government (2023c)

Burdekin Basin (Belyando Suttor)

Table 3.4 below outlines the water allocations in the Burdekin Basin (Belyando Suttor) (surface and groundwater – including GAB allocations).

Table 3.4. Water Allocations – Burdekin Basin (Belyando Suttor)

License Type	Licenses	ML	% of total ML	Comment
Surface Water				
Town Water Supply	0	0	0%	
Industrial/mining	5	15,280	19%	• ADANI INFRASTRUCTURE PTY LTD 12500 ML • SOLOMONS GOLD PTY LTD 1300 ML • STRAITS GOLD PTY LTD 1300 ML • MT COOLON GOLD MINES PTY LTD 150.9 ML • GOODLAND MINING PTY LTD 30 ML
Irrigation	23	67,070	81%	
Construction	0	0	0%	
Stock & Domestic	6	75	0%	
Total	**34**	**82,425**	**100%**	
Groundwater				
Town Water Supply	0	0	0	
Industrial/mining	0	0	0	
Irrigation	0	0	0	
Construction	0	0	0	
Stock & Domestic	6	0	100%	
Total	**6**	**6**	100%	

Source: Queensland Government (2023c)

3.4 EXISTING WATER INFRASTRUCTURE

Raw water supply

Table 3.5 and Source: Queensland Government (2023c)

Table 3.6 outlines the existing bores and in-stream water impoundments supporting town supply.

Table 3.5. Bores (Town Supply)

Asset Owner	Location	Water Source	Entitlement per year
Georgina Basin			
Boulia SC	Boulia	Longsight Sandstone	265
Boulia SC	Boulia	Burke River	60
Boulia SC	Marion Downs	Longsight Sandstone	4
Boulia SC	Urundangi	Austral Downs Limestone	20
Diamantina SC	Bedourie	Hooray Sandstone	150
Diamantina Basin			
Winton SC	Winton	Hutton Sandstone	1,000
Winton SC	Winton	Injune Creek Group	135
Winton SC	Corfield	Hutton Sandstone	30
Diamantina SC	Birdsville	Hooray Sandstone	343
Cooper Creek Basin			
Barcaldine RC	Jericho	Clematis Group	100
Barcaldine RC	Aramac	Hutton Sandstone	420
Barcaldine RC	Muttaburra	Hutton Sandstone	315
Barcaldine RC	Barcaldine	Hutton Sandstone	150
Barcaldine RC	Barcaldine	Hutton Sandstone	1210
Barcaldine RC	Jericho	Jordan Creek	68
Barcaldine RC	Alpha	Tertiary - Undefined	300
Barcoo SC	Windorah	Cooper Creek	150
Barcoo SC	Jundah	Thomson River	150
Barcoo SC	Windorah	Cooper Creek	141
Barcoo SC	Stonehenge	Thomson River	100
Barcoo SC	Jundah	Winton Formation	50
Blackall-Tambo RC	Blackall	Hutton Sandstone	1165
Blackall-Tambo RC	Tambo	Hutton Sandstone	170
Blackall-Tambo RC	Tambo	Precipice Sandstone	150
Longreach RC	Longreach	Hooray Sandstone	800
Longreach RC	Longreach	Thomson River	220
Longreach RC	Ifracombe	Collumpton Creek	770
Longreach RC	Isisford	Barcoo River	100
Longreach RC	Yaraka	Winton Formation	4
Burdekin Basin (Belyando Suttor)			
Nil	-	-	-

Source: Queensland Government (2023c)

Table 3.6. Water Impoundments (Town Supply)

Asset Owner	Water Source	Capacity (ML)
Georgina Basin		
Nil	-	-
Diamantina Basin		

Asset Owner	Water Source	Capacity (ML)
Nil	-	-
Cooper Creek Basin		
Longreach RC	Thomson River	3,300
Longreach RC	Thomson River	3,000
Longreach RC	Barcoo River	550
Longreach RC	Barcoo River	190
Barcoo SC	Thomson River	100
Barcoo SC	Cooper Creek	Not Stated
Burdekin Basin (Belyando Suttor)		
Nil		

Source: Queensland Government (2023c)

Water Reticulation

Table 3.7 outlines the volumes of water supplied for different uses from municipal reticulated water systems operated by local governments in the RAPAD region.

Table 3.7 Reticulated Water System Supply Volume (ML)

LGA	Location	Total	Residential	Commercial/ Industrial	Community uses
Georgina Basin					
Boulia SC	Boulia	NP	NP	NP	NP
Diamantina SC	Bedourie	245	NP	NP	NP
Diamantina Basin					
Winton SC	Winton	549	NP	NP	NP
Diamantina SC	Birdsville	100	NP	NP	NP
Cooper Creek Basin					
Barcaldine RC	Barcaldine	1,583	897	382	305
Barcaldine RC	Alpha	206	93	67	45
Barcaldine RC	Aramac	460	320	116	24
Barcaldine RC	Muttaburra	264	145	92	27
Blackall-Tambo	Blackall	246	169	71	5
Blackall-Tambo	Tambo	43	NP	NP	NP
Longreach RC	Longreach	1,653	1,264	236	153
Longreach RC	Ilfracombe	397	224	139	34
Longreach RC	Isisford	323	225	34	65

Notes:
- Based on an average of the past five years consumption data
- Numbers may not add due to rounding.
- NP = Not Provided

Source: RAPAD (2023), AEC

Sewer

Table 3.8 outlines the capacity of sewerage systems operated by local governments in the RAPAD region.

Table 3.8 Sewerage System Capacity

LGA	Location	Estimated Annual Throughput (ML)
Georgina Basin		
Boulia SC	Boulia	30.8
Diamantina SC	Bedourie	36.7
Diamantina Basin		
Winton SC	Winton	102.9
Diamantina SC	Birdsville	15.0

LGA	Location	Estimated Annual Throughput (ML)
Cooper Creek Basin		
Barcaldine RC	Barcaldine	240.5
Barcaldine RC	Alpha	30.8
Barcaldine RC	Aramac	63.0
Barcaldine RC	Muttaburra	39.6
Blackall-Tambo	Blackall	36.8
Blackall-Tambo	Tambo	6.4
Longreach RC	Longreach	260.8
Longreach RC	Ilfracombe	13.1
Longreach RC	Isisford	48.6

Source: RAPAD (2023), AEC

Recreational Assets

Within the RAPAD Region, there are a number of recreational water assets. These include:

- Recreational dams/impoundments:
    - Barcaldine Rec Park – 1.1 km long lake to Australian water ski standard
    - Tambo Dam
- Town pools:
    - Longreach Regional Council:
        - Longreach Memorial Pool
        - Ilfracombe Swimming Pool and Spa
        - Isisford Swimming Pool
    - Barcaldine Regional Council:
        - Barcaldine Swimming Pool Complex
        - Alpha War Memorial Swimming Pool
        - Jericho Swimming Pool
        - Aramac Aquatic Centre
        - Muttaburra Aquatic Centre
    - Blackall-Tambo Regional Council:
        - Blackall Aquatic Centre
        - Tambo Aquatic Centre
    - Winton Shire Council: Winton Swimming Pool
    - Barcoo Shire Council: Jundah Swimming Pool
    - Boulia Shire Council: Boulia Aquatic Centre
    - Diamantina Shire Council:
        - Birdsville Swimming Pool
        - Bedourie Aquatic Centre
    - Windorah (Baroo shire) is the only sizable community in the region without a town pool.

Irrigation (in-stream weirs)

A number of approvals exist for in-stream weirs to support irrigation activity in the Cooper Creek and Burdekin Basins, enabling 2,599 ML and 12,829 ML of in-stream storage, respectively.

Table 3.9 outlines the existing in-stream water impoundments used to support irrigation activity.

Table 3.9. Water Impoundments (Irrigation)

Asset Owner	Maximum Capacity (ML)	Water Source
Georgina Basin		
Nil	-	-
Diamantina Basin		
Nil	-	-
Cooper Creek Basin		
RAY MARGARET PEGLER; WENDY ALISON SHEEHAN; PETER DONALD SHEEHAN	682	Coonabilla Creek
ANDREW CHARLES JOHN LEEK AS TRUSTEE; DEBORAH CAROLINE LEEK AS TRUSTEE	500	Thomson River (Anabranch)
DEPARTMENT OF ENERGY AND WATER SUPPLY	420	Alice River
HURST PTY LTD AS TRUSTEE	180	Kyabra Creek
ANN SANDERSON; PETER ERNEST GEORGE SANDERSON	170	Macfarlane Creek
GILLIAN SUSAN RUSSELL; LINDSAY PATRICK RUSSELL	60	Macfarlane Creek
THE STATE OF QUEENSLAND (REPRESENTED BY THE DEPARTMENT OF AGRICULTURE AND FISHERIES)	54	Wellshot Creek
DENISE HILDA CAMERON	45	Slasher Creek
SHARON JEAN JONSSON; TREVOR NORMAN JONSSON	41	Unnamed Tributary of Torrens Creek
SHARON JEAN JONSSON; TREVOR NORMAN JONSSON	41	Unnamed Tributary of Torrens Creek
JESSE LOU TERRY; THOMAS GRAHAM TERRY	40	Maneroo Creek
PAUL JEFFREY SMITH AS TRUSTEE	35	Thomson River
ALAN WILLIAM KIRBY; CLARE MAJELLA KIRBY	30	Maneroo Creek
RICHARD ARTHUR JAMES	30	Jordan Creek
THE STATE OF QUEENSLAND (REPRESENTED BY THE DEPARTMENT OF AGRICULTURE AND FISHERIES)	30	Wellshot Creek
KIMBLE THOMAS; PETER FRANCIS THOMAS	27	Brutus Creek
FIONA ELIZABETH LUDGATE; TIMOTHY JAY LUDGATE	25	Barcoo River
MM & SJ DALEY	25	Katherine Creek
MURIEL ANN MACDONALD; HAMISH ANDREW MACDONALD; ANGUS MCINNES MACDONALD	25	Boree Creek
BRIGODOON CATTLE COMPANY PTY LTD AS TRUSTEE	20	Thunda Creek
DUNCAN BRUCE EMMOTT	20	Thomson River
BENJAMIN JAMES BANKS; MEGAN LOUISE MOHR	15	Thornleigh Creek
MATTHEW WILLIAM BACK; TESSA ANN BACK	15	Top HUT Creek
AUSTRALIAN STOCKMAN'S HALL OF FAME AND OUTBACK HERITAGE CENTRE	10	Watyakan Creek
BENJAMIN JAMES BANKS; MEGAN LOUISE MOHR	10	Toorina Creek
BRIGODOON CATTLE COMPANY PTY LTD AS TRUSTEE	10	Thunda Creek
TOP PLAIN PASTORAL CO PTY LTD AS TRUSTEE	10	Jordan Creek
BENJAMIN JAMES BANKS; MEGAN LOUISE MOHR	8	Toorina Creek
RAY MARGARET PEGLER; WENDY ALISON SHEEHAN; PETER DONALD SHEEHAN	8	Unnamed Tributary of Mcintyre Creek
LEONNIE KAY HARRINGTON; LOCH HARRINGTON	5	Skeleton Creek
BRIGODOON CATTLE COMPANY PTY LTD AS TRUSTEE	4	Thunda Creek
BRIGODOON CATTLE COMPANY PTY LTD AS TRUSTEE	4	Thunda Creek
Burdekin Basin (Belyando Suttor)		
BRUCE DURRELL PETER WERNER; SALLYANNE WERNER	4,000	Pelican Lagoon
BD MULCAHY PTY LTD AS TRUSTEE	3,000	West Logan Creek
NEW TWIN HILLS PASTORAL COMPANY PTY LTD AS TRUSTEE	2,500	Pelican Lagoon

Asset Owner	Maximum Capacity (ML)	Water Source
WILLIAM RAYMOND GILLHAM	1,850	Suttor Creek
JOHN EDWARD KENNY; CLAVER WILLIAM KENNY	370	Belyando River Anabranch
LEIGH PATRICIA SULLIVAN; JOHN CHARLES SULLIVAN	350	Police Creek
DUDDY FARMING PTY LTD	200	Diamond Creek
KALANG PASTORAL COMPANY CQ PTY LTD AS TRUSTEE	100	Mistake Creek
GREGORY ERIC ASHTON; CLAVER WILLIAM KENNY; JOHN EDWARD KENNY; G & D ASHTON TRADING PTY LTD AS TRUSTEE	100	Suttor River
MATTHEW DOUGLAS PETER WERNER; TELEATHA COLLEEN MAE WERNER	90	Logan Creek
FRANKFIELD PASTORAL COMPANY CQ PTY LTD TRUSTEE AS TRUSTEE	80	Mistake Creek
FRANKFIELD PASTORAL COMPANY CQ PTY LTD TRUSTEE AS TRUSTEE	80	Mistake Creek
BARBARA FAY CATTELL; COLIN VICTOR CATTELL	45	Unnamed Tributary of Diamond Creek
GRAHAM JOHN HEELAN; KRISTY PATRICIA HEELAN	20	Eaglefield Creek
WILLIAM GEORGE DENNIS; THOMAS JOHN DENNIS	18	Fox Creek
RUSSELL HENRY ROSTRON; WAYNE THOMAS CEDRIC ROSTRON	11	Belyando River (Longreach Channel)
JOHN EDWARD KENNY; CLAVER WILLIAM KENNY	10	Unnamed Tributary of Grahame Creek
ANNA JACQUELINE APPLETON; KRISTINE MARGARET APPLETON; LOID STEPHEN GILES APPLETON; RICHARD FREDERICK JOHN APPLETON; WILLIAM DALE APPLETON; ZAVIERA LOUSIE APPLETON	5	Belyando River

Source: Queensland Government (2023c)

4. FUTURE WATER DEMAND

4.1 APPROACH

This chapter identifies future demand for water across a number of different demand drivers and quantifies the order of magnitude of this future demand through benchmarking potential future use to existing activities in similar locations.

Based on stakeholder engagement and economic analysis, the following activities are expected to be the key drivers for future demand for water:

- Urban development/growth
- Agricultural development
- Industrial uses of water
- Energy generation.

It is important to note that this analysis assumes unconstrained supply of water to realise the opportunity. Presentation of demand with full consideration of supply limitations, as well as the potential economic outcomes supported by highest use of available water resources, will be addressed in a future report.

Key findings:

A number of potential future water demands have been identified and quantified.

- Regional opportunities include:
  - Urban development/growth = Nil expected
  - Improving drought preparedness = 540,000 ML (potentially utilising beneficial reuse of waste water)
  - Irrigated agriculture = 121.3 GL
  - Green hydrogen for heavy transport = 40 ML – 189 ML (requiring beneficial reuse of waste water).
- Specific place-based opportunities include:
  - Blackall QWool Project = 550 ML
  - Barcaldine Renewable Energy Zone = 386 ML
  - Geothermal Electricity Generation = 0 ML (closed system)
  - Mineral mining and processing = 850 – 2,220 ML (no-coal) and 3,500 – 6,000 ML (coal).
- A number of additional beneficial reuse opportunities have been identified, including town sewerage, industrial water use and water from gas extraction.

4.2 URBAN DEVELOPMENT/ GROWTH

Supply of potable water is an essential precondition of urban development and a key demand on water resources. Future urban demand for additional water can expect to come from a range of different uses.

Natural Population Increase

Natural increase in the population of existing communities would traditionally be a driver for additional water consumption, where incremental growth in population drives incremental increases in residential and commercial water demand.

However, in the RAPAD region, most communities have a stable or declining population, indicating that future demand for reticulated water from local residents is not expected to increase beyond current levels.

Tourism Visitation

In addition to the local residents, reticulated water supplies must be sufficient to support seasonal tourist demands.

Tourism is a key driver for the regional economy The RAPAD region attracts considerable numbers of tourists each year. Ensuring reticulated water supplies can meet future demands from tourists (particularly though accommodation providers) is an important consideration in future water planning.

Public Amenity

Maintaining well-presented parks and gardens is key driver of a town's perceived liveability and visitability, especially in communities that are prone to drought. In the arid conditions experienced in the RAPAD region, permanent irrigation of community parks and gardens is an essential requirement.

Induced Growth

Beyond natural increase, future demand for urban water supply can be induced through the realisation of a regional economic development opportunity, which drives a step-change in the region's labour force. Such an increase in the regional labour force would have a corresponding impact on population, which would drive demand for both residential and commercial water supply (considering the additional business activity from additional local spend).

4.3 AGRICULTURAL DEVELOPMENT

Agriculture is a major user of water resources. Future agricultural demand for additional water can expect to come from both improving drought preparedness and developing irrigated agriculture.

Improving Drought Preparedness

Existing graziers in the RAPAD region have an opportunity to improve their resilience to drought through the production and storage of fodder crops, which can be used to feed livestock during times of low or no rainfall.

Emergency feeding rates of 1.5 kg of feed per head per day for cattle (Future Beef, 2011) and 0.5 kg of feed per day per head of sheep (Agriculture Victoria, 2018). Hay yield is estimated to be 5 t/ha (ABS, 2023) and require up to 14 ML/ha (DNRM, 1984) of water used in the production of feed. The total theoretical maximum demand from this activity is calculated in Table 4.1 below.

Table 4.1. Theoretical Maximum Demand – Improving Drought Preparedness

LGA	Livestock – cattle (head)	Livestock – sheep and lambs (head)	Estimated stored feed requirement (tonnes)	Total Water Demand (ML)
Barcaldine	355,270	178,031	227,001	635,603
Blackall-Tambo	114,498	37,213	69,479	194,541
Longreach	195,692	98,064	125,038	350,106
Winton	109,304	35,525	66,327	185,716
Boulia	120,591	39,193	73,176	204,893

LGA	Livestock – cattle (head)	Livestock – sheep and lambs (head)	Estimated stored feed requirement (tonnes)	Total Water Demand (ML)
Barcoo	85,083	330,740	106,943	299,440
Diamantina	102,751	33,395	62,351	174,583
Total RAPAD	**1,083,189**	**752,162**	**730,315**	**2,044,882**

Source: AEC

Irrigated Agriculture

The RAPAD region has large areas of soils that could be suitable for irrigated agricultural production. Potential irrigation typologies in the region could include:

- Improved pasture and feed for cattle, to enable either earlier turnoff or finishing
- Broadacre cropping, such as cotton or cereal crops (wheat, maize, rice, barley, oats, rye and sorghum)
- Irrigated horticulture, both annual and perennial.

Realising the above opportunity would require and require up to 14 ML/ha (DNRM, 1984) of water applied to the irrigation area. The total theoretical maximum demand from this activity is calculated in Table 4.2 below.

Table 4.2. Theoretical Maximum Demand – Irrigated Agriculture

LGA	Potentially suitable land (ha)	Total Water Demand (ML)
Barcaldine	2,698,301	37,776,214
Blackall-Tambo	1,268,453	17,758,342
Longreach	2,591,431	36,280,034
Winton	3,578,990	50,105,860
Boulia	1,553,077	21,743,078
Barcoo	3,153,501	44,149,014
Diamantina	3,823,298	53,526,172
Total RAPAD	**18,667,051**	**261,338,714**

Note:
- 6.5 ML/ha used to calculate total water demand.
- 30% of potentially suitable land was assumed to be non-developable (considering infrastructure requirements and environmental protections)

Source: AEC

4.4 INDUSTRIAL USES OF WATER

Water is a key input into several industrial processes. Industrial use of water is most likely to occur in those sectors that value-add to existing sectors and replace imports, such as meat processing, wool scouring, mineral processing and metal manufacturing (particularly in the concentration process) as well as the production of construction materials (particularly in concrete production).

Wool Scouring

Water is a key input into the wool scouring process. Based on estimates of the QWool project in Blackall, total water demand is expected to be 550 ML per annum.

It is important to note that wool scouring also produces comparable volumes of effluent water that must be treated before being recycled.

Mining and Mineral Processing

Water is used in mineral mining and early-stage ore processing is primarily used to improve the economic recovery of resource by removing extraneous material (tailings). Mineral is recovered from the ore using traditional grinding and flotation methods in a concentrator (to remove extraneous matter from the ore).

While the order of magnitude volumes of water required for mineral processing is dependent on individual sites and mine production processes and volumes, a potential range of 850 ML to 2,200 ML per non-coal mine per year and 3,500 to 6,000 ML per coal mine per year could be considered based on an assessment of key resource projects in North West Queensland and the Bowen Basin.

Table 4.3. Theoretical Maximum Demand – Mine and Mineral Processing Facility

Allocation Holder	Basin	Total Water Allocation (ML)
Non-Coal Resources		
SOUTHERN CROSS FERTILISERS PTY LTD	Georgina Basin	16,000
SOUTH32 CANNINGTON PROPRIETARY LIMITED	Georgina Basin	2,210
AUSTRAL RESOURCES LADY ANNIE PTY LTD	Georgina Basin	1,344
TREKELANO COPPER MINE	Georgina Basin	1,000
CENTURY MINING LIMITED	Nicholson Basin	820
NORANDA PACIFIC; PARADISE PHOSPHATE LIMITED	Nicholson Basin	950
CHINOVA RESOURCES OSBORNE PTY LTD	Georgina Basin	1,312
STRAITS GOLD PTY LTD	Burdekin Basin	1,300
SOLOMONS GOLD PTY LTD	Burdekin Basin	1,300
CHEETHAM SALT LIMITED	Fitzroy Basin	20,000
Coal Resources		
ADANI INFRASTRUCTURE PTY LTD	Burdekin Basin	12,500
BHP MITSUI COAL PTY LTD	Fitzroy Basin	3,534
GS COAL PTY LTD	Fitzroy Basin	6,250
PEABODY (BOWEN) PTY LTD	Fitzroy Basin	1,700
KESTREL COAL RESOURCES PTY LTD; MITSUI KESTREL COAL INVESTMENT PTY LIMITED	Fitzroy Basin	4,510
MPC LENTON PTY LTD; NEW LENTON COAL PTY LTD	Fitzroy Basin	1,500

Source: Queensland Government (2023c)

Barcaldine Renewable Energy Zone (BREZ)

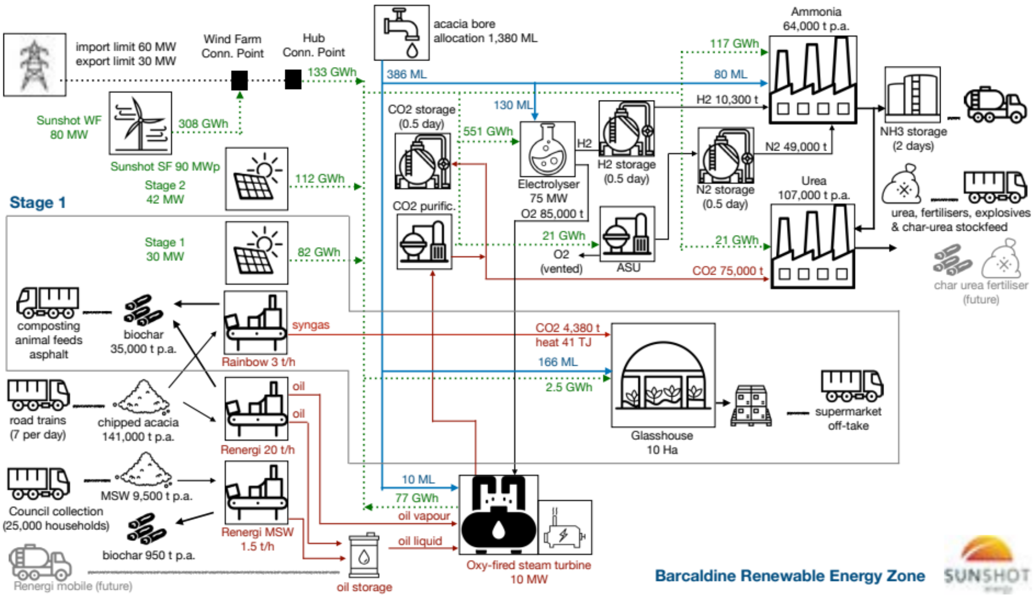
The Barcaldine Renewable Energy Industrial Zone (BREZ) is a prototype industrial precinct that can support zero emissions business development in regional Australia. The proposed industrial zone seeks to provide tenants with an all-service site including long extendable leases and reliable and globally cost competitive green electricity and bio-chemical inputs (Sunshot Industries, 2021). Importantly, the BREZ project has a local market by replacing basic chemical imports into the region.

A number of anchor tenants (and their water demands) have been identified, including:

- 10 ha of intensive horticultural glasshouse (166 ML water demand)
- 75 MW Hydrogen electrolyser (130 ML water demand)
- 10 MW Steam Turbine (10 ML water demand)
- 64,000 t pa Ammonia production (80 ML water demand)

A detailed overview of the BREZ operations have been included in Figure 4.1 below.

Figure 4.1. Key Aspects of BREZ Operations



Source: Sunshot Industries (2021)

4.5 ENERGY PRODUCTION

The growth in alternative, low/lower carbon energy is expected to drive demand for water.

Green Hydrogen Production

Located along the freight route between Darwin and Toowoomba (connecting to Brisbane/Sydney), the RAPAD region covers a large area of the national freight route (covering 700 km, 20% of the distance from Darwin to Toowoomba) and local fuelling infrastructure plays a key role in the freight task. The RAPAD region also generates considerable road freight through the movement of cattle to eastern processors.

An emerging area of focus for the road freight industry is the opportunity to decarbonise transport operations, which are a key CO2 emissions source. Road transportation accounts for 20% of Australia's Greenhouse Gas Emissions (GHGs) (DCCEEW, 2022). The likely opportunity to decarbonise road transportation is through diesel replacement with green hydrogen fuel cells, principally as a in long-haul transport. It is important to note that production of green hydrogen requires use of recycled/non-potable water from renewable sources, as well as renewable energy.

Approximately 70,810 heavy vehicle movements occur along the Landsborough Highway in the RAPAD region annually– based on a 194 average daily movement (QTLC, 2015). Assuming these heavy vehicle movements pass through the RAPAD region throughout the year, consuming around eight kg of hydrogen per 100 kilometres (McKinsey, 2022), the heavy vehicle transport fleet would require 3.9 million kilograms of hydrogen annually to travel along the 700 km of highway through the region and 18.6 million kilograms of hydrogen annually to travel along the length of the Darwin to Toowoomba freight route.

Assuming 10 L of water is needed to produce 1 kg of hydrogen, 39.65 ML of recycled water would be required for annual heavy vehicle movement travel within the RAPAD region and 186.94 ML for the length of the Darwin to Toowoomba route.

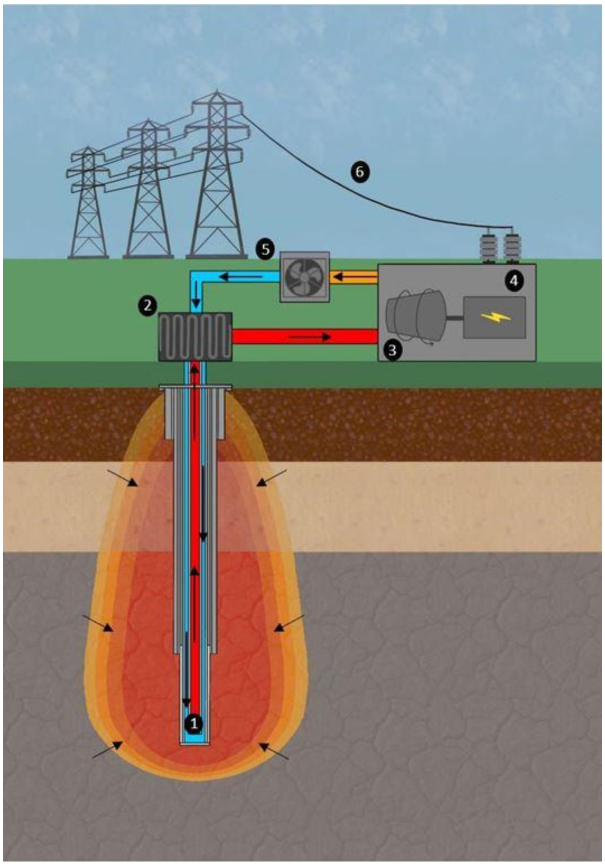
Assuming ranges of up to 500 km (McKinsey, 2022), at least two refuelling stations would be required in the region.

Geothermal Electricity Generation

The high temperatures of the artesian groundwater in the Great Artesian Basin (GAB) represents a potential geothermal resource, where the water can be used to generate electricity from a conventional steam turbine.

A prospective geothermal project in the RAPAD region is the Greenvale Energy Ltd, where an Exploration Permit for Minerals or Coal (EPM) has been granted to develop to produce 24/7 baseload renewable energy with no groundwater usage – where extracted water is returned to the GAB after passing through the heat exchanger (IQ, 2023), as outlined in Figure 4.2.

Figure 4.2. Geothermal Electricity Generation



Note:
- Fluid is circulated through the system (blue) down to the heat exchanger (1) where temperatures at the bottom of the well results in the conduction of thermal energy (red), which is returned to the surface heat exchanger (2).
- This energy expands into the ORC turbine (3), internally turning the generator to produce electricity (4). The hot fluid is then directed to the coolers (5), condensing into a cooler state and returning to the surface heat exchanger (2), where the well circulation reheats it. Power is sent to the substation (6) for transmission to the end user.

Source: IQ (2023)

4.6 BENEFICIAL REUSE OF WATER

Different activities in the RAPAD region produce water, which if treated could provide beneficial re-use opportunities. These activities include:

- Town sewerage – As outlined in Chapter 3, a number of towns in the RAPAD region have a reticulated sewerage system. In most cases, the treated water is disposed back into the adjacent watercourse, which is often upstream of another town's raw water supply. Alternative beneficial reuse opportunities are possible and could include application in town beautification, irrigated agriculture (including fodder crops for cattle) or in the production of energy (such as green hydrogen or electricity through anaerobic digestion and use of biogas).

  Expansion of reticulated sewerage in the region may not only improve the liveability and development potential of the benefited communities, but it may also expand the opportunity for beneficial reuse of water.

- Industrial waste water – Similar to town sewerage, water intensive industrial activities have opportunities to re-use water, either recycled into their industrial processes or in complementary activities (such as in production of fodder to support an abattoir).

  Gas affected water – As outlined in Chapter 2, the RAPAD region has a number of approved coal seam gas development licenses. Unlike conventional gas (where a licence exists in the Barcoo Shire), coal seam gas production incurs considerable water withdrawal, which can be treated and beneficially reused. The total volume of water that is expected to be extracted from potential gas projects in the RAPAD region is currently unknown.

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