

# **Minister's Performance Assessment Report**

**Water Plan (Gulf) 2007**

**May 2018**

This publication has been compiled by Coastal Catchments of Water Policy, Department of Natural Resources, Mines and Energy.

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## **Minister's foreword**

I am pleased to publish this report which shows that the Gulf water plan and the implementation of its strategies have been effective in advancing the sustainable management of the Gulf's precious water resources.

The plan expires on 1 September 2018 but I am proposing extend the life of the plan until 1 September 2028 as permitted under the *Water Act 2000*. I formed this view based on an assessment of the performance of the Gulf water plan which indicates that the plan strategies are achieving the desired outcomes. With potential risks to water users and the environment assessed as low, there are expected to be no adverse impacts on water entitlement holders or natural ecosystems in the plan area if the life of the plan is extended. Further there remains significant opportunity through unallocated reserves and water trading to meet additional water demands.

This extension of the plan does not close any doors as a review or amendment of the plan can be undertaken at any time should risks in the catchment change or significant new water demands emerge that cannot be addressed under the current plan.

I encourage anyone with an interest in the management of the Gulf's water resources to read this report and provide a submission on the water management issues that are important to you and your community. A form is provided in Appendix 1 of this report to assist you in making a submission.

Community feedback plays a vital role in ensuring that the management of Queensland's water resources continues to meet the needs of existing users, future development and the environment. I will carefully consider all submissions before I make a final decision regarding the extension to the expiry of this plan.

**Hon Dr Anthony Lynham MP**

Minister for Natural Resources, Mines and Energy

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## Executive summary

This report provides an overview of the implementation of the Water Plan (Gulf) 2007 (the plan) and summarises amendments and assessments undertaken from the commencement of the plan in 2007.

An assessment of the performance of the plan against its outcomes is summarised in Table 1. It indicates that the plan strategies are achieving the desired outcomes as follows:

- the plan outcomes align with the *Water Act 2000* (Water Act) requirements for advancing the sustainable management of Queensland's water resources
- information on entitlements, water use and authorisations in the plan area indicates that there is no significant increase in demand in the plan area
- the findings of research and monitoring indicate that the implementation of the plan is achieving the plan's outcomes
- the plan objectives and strategies continue to provide security of entitlements for water users and provide water for the environment
- potential risks to water users and the environment have been classified as low risk and can be effectively managed under current arrangements
- no non-compliance under a water entitlement or other authorisation has been identified in the plan area.

**Table 1: Summary of performance assessment for the plan**

Key considerations	Comment
<b>What amendments, if any, have been made to the plan since its commencement;</b>	There were some amendments made to the plan to establish Indigenous reserves of unallocated water, allow licences in the Flinders and Gilbert rivers to be seasonally and permanently transferred and provide for additional general reserves.
<b>Water entitlement and usage summary</b>	Metered data indicates that use of supplemented water is less than 24% and 75% of entitlements for the Julius Dam and Moondarra Dam water supply schemes respectively. The metered use of un-supplemented water is below 1% of entitlement. A summary of water entitlements and usage is presented in Section 6.
<b>Research and monitoring findings</b>	Considerable monitoring and research has been completed in the plan area since the commencement of the plan, and is presented in Section 9. This information has been used to support the preliminary evaluation of the plan presented in this report. There are some knowledge gaps identified in the monitoring but this can be addressed in future monitoring and research programs.
<b>Is implementation of the plan effective?</b>	The plan continues to provide for economic, social, and environmental outcomes. Previous reports prepared about the plan did not highlight any significant issues with the implementation of the plan.
<b>Is the plan achieving its outcomes?</b>	The plan's outcomes are being achieved.  The plan has set maximum unallocated water reserves and set flow thresholds for water take to maintain flood flows for the environment.
<b>Have any risks been identified to the plan outcomes?</b>	The potential risks to water users and the environment have been classified as low risk and can be effectively managed under current arrangements.

Key considerations	Comment
	The Mount Isa urban water supply has been classified as medium risk due to Mount Isa's reliance on Moondarra Dam, but this risk can be managed by using the allocation held by council in Julius Dam which has a low usage. This was the case when the level at Lake Moondarra was low in 2014, but supply from Julius Dam was not required as Lake Moondarra received significant inflows in early 2015. Mount Isa's population is not anticipated to rise significantly during the next 10 years
<b>Has there been any noncompliance?</b>	There were no matters of noncompliance identified.

There are no additional demands for water identified that cannot be met from within the current plan.

Importantly, a review or amendment of the plan can be implemented at any time should risks in the catchment change or significant new water demands emerge. Furthermore an assessment report on the plan will be done every five years to address the on-going sustainable management of the water resource. With potential risks to water users and the environment assessed as low, there are expected to be no adverse impacts on water entitlement holders or natural ecosystems in the plan area resulting from extending the life of the plan to 1 September 2028.

## 1 Purpose and structure of the report

Section 49 of the Water Act requires the Minister to prepare reports for each water plan to ensure the implementation and effectiveness of each plan is regularly reviewed and evaluated as part of an adaptive management cycle of planning, implementation, monitoring and reporting. The Water Regulation 2016 (Water Regulation) requires these reports to be prepared at five year intervals and address a range of matters relevant to the ongoing sustainable management of Queensland's water resources.

This report provides an overview of the implementation of the plan and summarises amendments and assessments undertaken from the commencement of the plan in 2007 to the present, including:

- The risk assessment undertaken using the plan outcomes measured against best available information on the catchment and is presented as Appendix 2.
- Long-term hydrological models were used during the development of the water plan to better understand water use, availability and security. These hydrological models have been assessed against the latest understanding of climate and use trends to improve our knowledge on these matters. The summary of this report is shown in Appendix 3.
- Water plans are adaptive and amendments are made to them as necessary to advance the sustainable management of Queensland's water resources. A list of the amendments are discussed in section 5 and details are provided in Appendix 4.
- Water for consumptive use is accessed through authorisations and these are presented in section 6 and detailed in Appendix 5.
- Water planning for the Gulf has identified reserves of unallocated water which were set aside for future use over the initial 10-year life of the plan and are discussed in section 7 and recorded in Appendix 6.

- Under sections 93 to 103 of the Water Act, water may be taken for certain uses without an authorisation and this is reported on in Appendix 7.
- Monitoring forms part of the adaptive management cycle of the water plans to ensure that the plans are meeting their stated ecological outcomes. A summary of the Environmental Flow Assessment Program (EFAP) and other monitoring programs in the Gulf catchment are shown in Appendix 8.

## **2 Plan area**

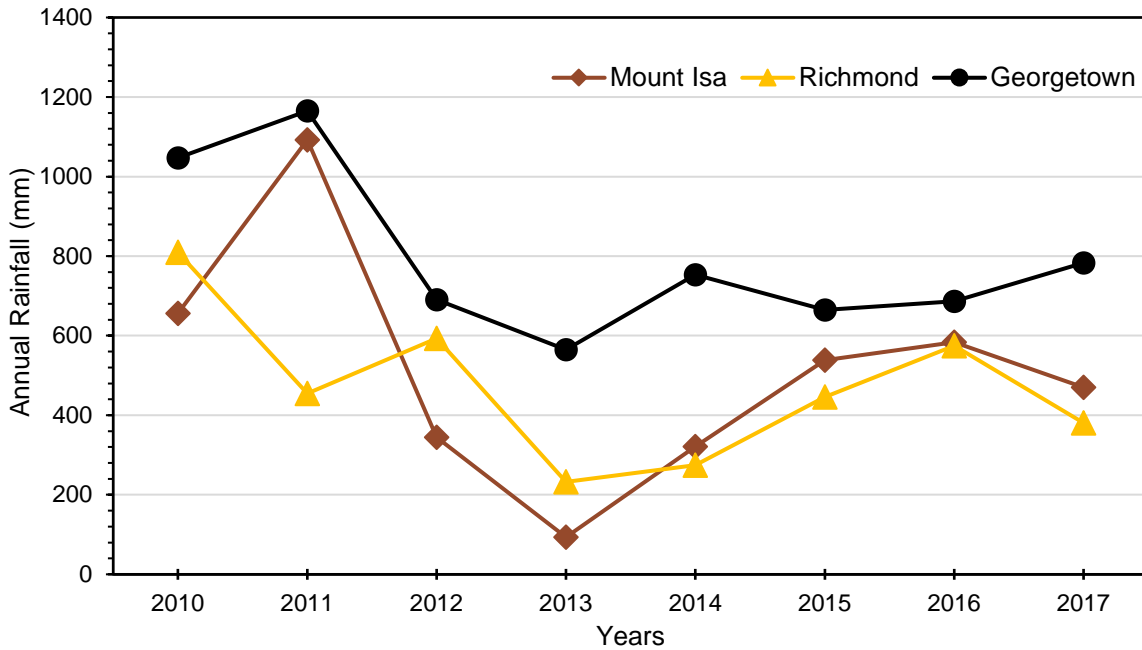
The Gulf Plan area drains into the Gulf of Carpentaria and covers approximately 315,000 km<sup>2</sup> in Queensland. It is comprised of the Staaten, Gilbert, Norman, Flinders, Leichardt and Nicholson rivers, Settlement Creek and the Morning Inlet catchments (Figure 1). These eight catchments account for about 15 percent of the total state water run-off.

Rainfall in this region is predominantly monsoonal and experiences tropical cyclones, one as recent as March 2018 (Tropical Cyclone Nora). Figure 2 shows the rainfall patterns for Mount Isa, Richmond and Georgetown over an eight year period (2010-2017). Mount Isa and Georgetown received over 1000 mm of annual rainfall in 2011 but Richmond received only about 450 mm. A dry year was experienced in 2013 across the three towns, with Mount Isa registering an annual total of only 93 mm.



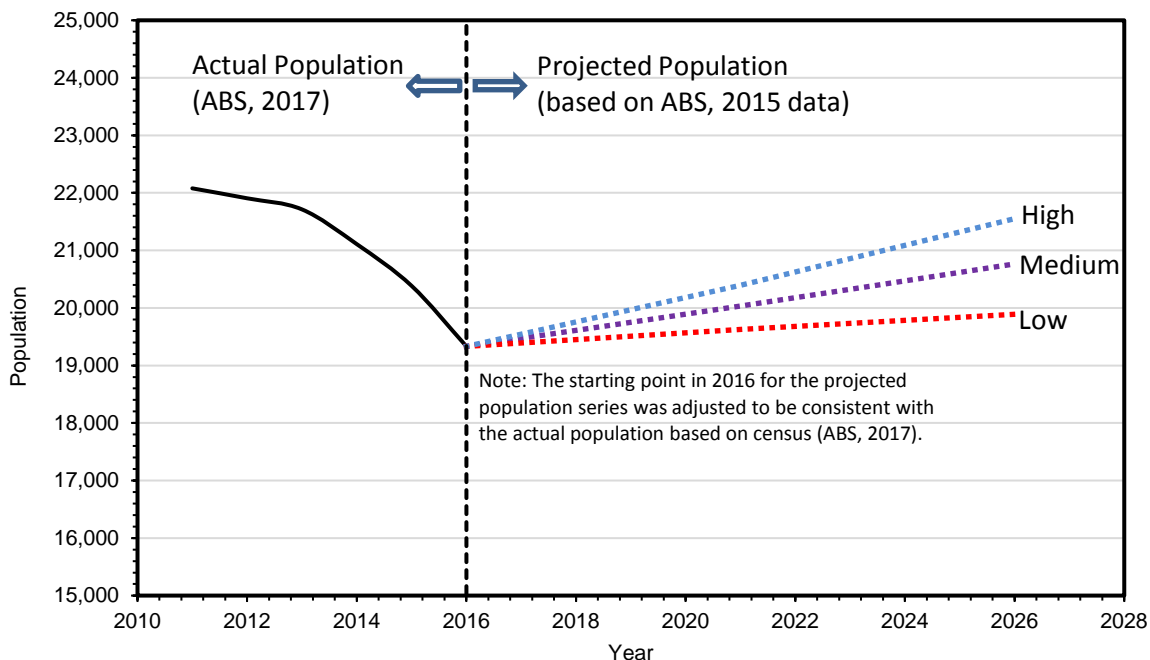


Figure 1: Gulf water plan area showing towns and catchments



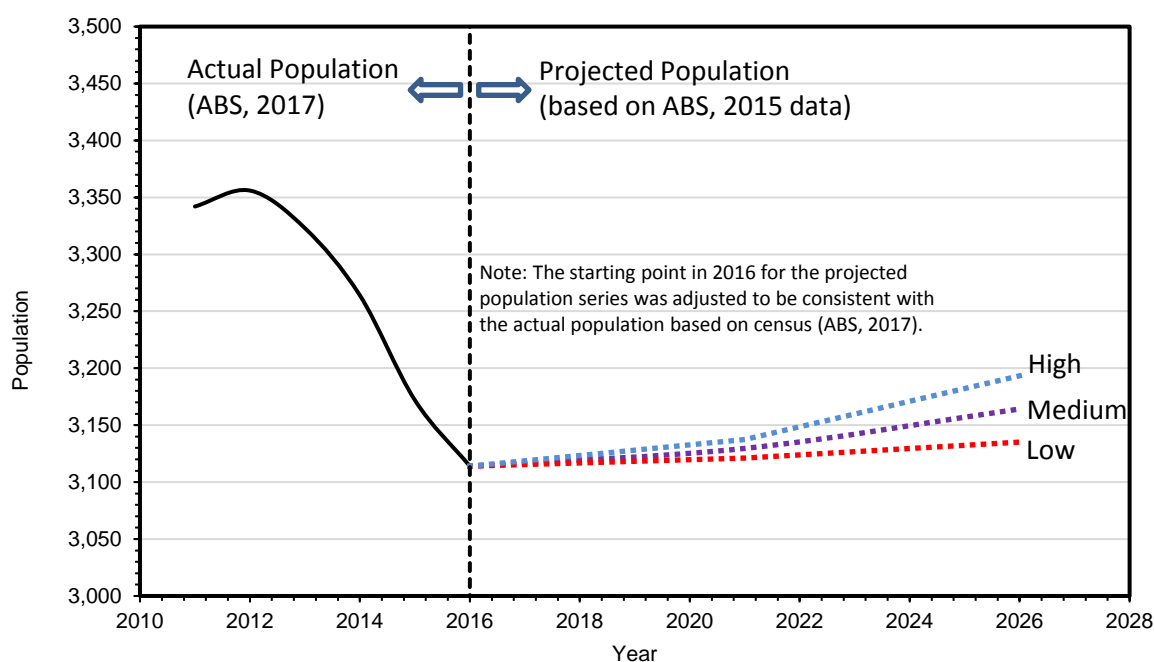
**Figure 2: Rainfall for Mount Isa, Richmond and Georgetown (showing 2010-2017)**

The population trends for Mount Isa and Cloncurry have generally been in decline since 2011 to 2016 based on data from the Australian Bureau of Statistics (ABS) (refer Figures 3 and 4). There was about 12% decrease in the population of Mount Isa between the 2011 and the 2016 census (ABS, 2017). Similarly about 7% reduction in the population of Cloncurry was registered between the 2011 and 2016 census (ABS, 2017).



**Figure 3: Mount Isa - actual and projected population trends**

Figures 3 and 4 show the projected population for three growth scenarios from 2016 to 2026. Based on the medium series, the population of Mount Isa is projected to be about 21,000 in 2026 while the population of Cloncurry is projected to be about 3,170 people. Depending upon the future developments in the area, the total population is likely to remain below the 2012 level over the next eight years for both towns.



**Figure 4: Cloncurry - actual and projected population trends**

The major uses of water in the plan area are mines around Mount Isa, pockets of localised irrigated agriculture, tourism, commercial and recreational fishing. The mining industry has been the primary driver for regional employment and economic growth. This has flow-on effects in the local economy, other regional areas and the state's economy.

### 3 Advancing the sustainable management of Queensland's water resources

The water plan establishes a system for the allocation and use of water resources in the basin for the economic, physical and social wellbeing of the people of Queensland through the provision of:

- water allocations that provide certainty for water users to promote economic development
- strategies to implement rules to ensure security for town water supplies and essential services
- outcomes and objectives to advance the sustainable health of ecosystems, water quality, water-dependent ecological processes and biological diversity
- specific economic and social outcomes to enable Aboriginal peoples and Torres Strait Islanders in stated areas to achieve their economic aspirations
- consideration of the water related cultural values of Aboriginal peoples and Torres Strait Islanders in the plan area when making a decision under the plan.

## 4 Assessment of the effectiveness of plan implementation

An assessment was undertaken to inform the decision making process regarding the plan extension. This included a review of the plan outcomes and effectiveness of the strategies in the plan to meet the outcomes. A risk assessment was undertaken which considered the demand for water over the past 10 years, changes in the catchment over the life of the plan, and identification of emerging water demands. Any issues that had arisen over the life of the plan were assessed and mitigation strategies proposed where appropriate.

Under this assessment framework, the level of risk, along with other factors, such as a plan's continuing balance of economic, social and environmental outcomes, determines the most appropriate course of action. The risk assessment was undertaken using the plan outcomes measured against best available information on the catchment and the resulting table is presented as Appendix 2.

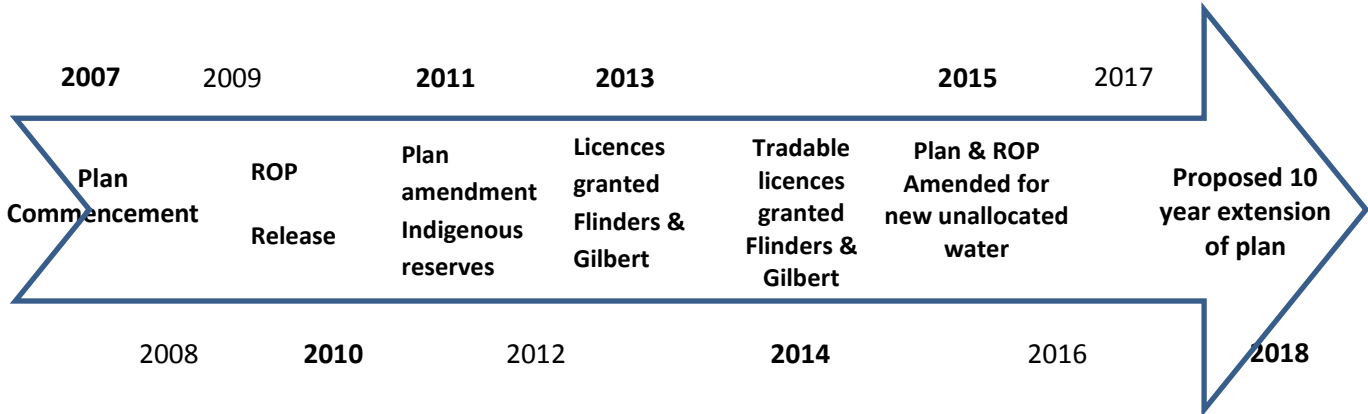
The plan's outcomes are effectively implemented by the regulation of the take of water, the release of unallocated water reserves the conversion of unsupplemented water entitlements to tradeable volumetric entitlements and of supplemented water entitlements to tradeable water allocations. This includes the associated water sharing rules and water allocation change rules, and specific ecological outcomes in the water plan were implemented by the inclusion of environmental management rules for water supply infrastructure requiring environmental flow releases and waterhole management.

The plan's outcomes were implemented by the release of the Gulf Resource Operations Plan (ROP) in September 2010, as well as other specific actions required by the water plan. Key achievements in implementing the water plan include:

- The creation of ten supplemented water entitlements to tradeable water allocations in the Julius Dam and Moondarra Dam water supply schemes, and implementation of associated seasonal and permanent water trading provisions.
- The granting of resource operations licences for supplemented water supply schemes detailing the water sharing and infrastructure operating rules to ensure a reliable and secure water supply.
- The implementation of specific water plan provisions for granting additional entitlements to take water, ensure that the long-term interests of existing entitlement holders and the environment are protected.
- The release of unallocated water to the public and local governments.

## 5 Plan amendments and implementation since commencement

A number of amendments have been made to the water plan since it commenced including consequential amendments to reflect administrative changes relating to the Water Act an outline is shown in Figure 5 and more detail is presented in Appendix 4.



**Figure 5 Water planning milestones for the Gulf Water Plan**

Amendments to the Water Act and the Water Regulation commenced on 6 December 2016. These amendments change the way water planning is delivered across the state, including the planning documents. These new or expanded water planning documents which replace the previous water resource plans and resource operations plans provide greater flexibility to amend operational documents and allow water service providers to manage their schemes more efficiently and effectively, the new documents include:

## 6 Water entitlements and use

Water users have access to water, taken under a water entitlement (e.g. water licence or allocation) or under a statutory authorisation through the Water Act (e.g. prescribed activities, permits or stock and domestic use).

Supplemented water in the Leichardt River catchment is provided from the Moondarra Dam and Julius Dam water supply schemes. All Julius Dam water allocations are high priority while all Moondarra Dam water allocations are medium priority. There are six supplemented water allocations in Julius Dam and four water allocations within the Moondarra Dam water supply scheme.

A summary of the announced allocations and scheme water use is provided in Table 2 and detailed in Appendix 5. It shows that supplemented water use has been low during the life of the plan. Over the last seven water years from 2010-2017, the use ranges from 3.7% to 23.9% of the entitlement for Julius Dam Water Supply Scheme. For the Moondarra Dam Water Supply Scheme, the use over the last seven water years is higher at 43.1% to 74.1%.

**Table 2: Supplemented water entitlements and use for the water supply schemes**

Water Supply Scheme	Water Year	Water Entitlement (ML)	Water Extracted (ML)	Percentage of Water Entitlement Extracted
Julius Dam	2016-17	48,850	1,815.41	3.7
	2015-16	48,850	5,072	10.4
	2014-15	48,850	11,037	22.6
	2013-14	48,850	11,666.8	23.9
	2012-13	48,850	8,676.06	17.8
	2011-12	48,850	8,037.97	16.5
	2010-11	48,850	7,922.32	16.2
Moondarra Dam	2016-17	26,300	13,957	53.1
	2015-16	26,300	14,733	56.0
	2014-15	26,300	16,966	64.5
	2013-14	26,300	11,334	43.1
	2012-13	26,300	19,487	74.1
	2011-12	26,300	18,037	68.6
	2010-11	26,300	17,540	66.7

Moondarra Dam was at a low water level in 2013 and the announced allocation for the Moondarra Dam Water Supply Scheme was only set at 9% at start of the water year (1 July 2014). However the dam received significant inflows and the scheme announced allocation was increased to 100% in February 2015. During this drought period, Julius Dam was capable of supplying water to Mount Isa, if needed.

The overall low level of use indicates that the demand for water is not high and current water needs can be met within existing entitlements.

The unsupplemented water entitlements within the plan area amount to a combined annual volume of 291 926 ML (Table 3). The Gilbert River catchment has been metered recently and the use for the water year 2016/17 was 240.54 ML. This represents a low use of only about 0.7% of the total licence entitlement issued of 34 972 ML. The rest of the catchments are yet to be metered as they are not metered entitlement areas or users have not activated their take.

**Table 3: Unsupplemented water entitlements**

Catchment	Unsupplemented Entitlement (ML)		Total Unsupplemented Entitlement (ML)
	Groundwater	Surface Water	
Gregory-Nicholson	1,943.0	6,222.0	8,165
Settlement Creek	0	0	0
Leichhardt River	129.6	20,521.4	20,651
Flinders River	12,346.0	212,512.0	224,858
Norman River	180.0	3,100.0	3,280
Gilbert River	13.0	34,959.0	34,972
Staaten River	0	0.0	0
<b>Total</b>			<b>291,926</b>

Note: The entitlements are current as at 9 April 2018.

## 7 Unallocated water

The plan established general, Indigenous and strategic reserves of unallocated water, which were set aside to meet future water requirements over the initial 10-year life of the plan. The details of the initial unallocated water reserves are shown in Appendix 6 (Table 7).

Water from the general reserves in the Flinders River and Gilbert River catchments was made available for sale by tender in 2012. The entire 80 000 ML in the Flinders Rivers catchment was allocated and 14 220 ML in the Gilbert Rivers catchment was allocated.

In 2013, water from the strategic reserves in the Flinders River and Norman River catchments, Gilbert and Nicholson River subcatchment was made available by way of granting for a particular purpose. This resulted in 1450 ML, 1000 ML, 700 ML and 116 ML being granted to the Flinders Shire, Carpentaria Shire, Cloncurry Shire and Burke Shire councils respectively for town water supply. Also in 2014, the entire 2500 ML strategic reserve for Lake Corella was also granted in accordance with the Gulf ROP.

Amendments to the water plan in 2015 resulted in several changes to unallocated water reserves across the plan area. Strategic reserve volumes were amended to reflect the volumes remaining after granting water entitlements for particular purposes (e.g. town water supply), and the general reserves in the Flinders River and Gilbert River catchments were increased as a result of the findings from the Flinders and Gilbert Resource Assessments undertaken by the CSIRO. The details of the amended unallocated water reserves are shown Appendix 6 (Table 8).

Following the 2015 water plan amendments, the general reserves for the Flinders and Gilbert were increased by 239 650 ML and 467 000 ML respectively. The increased general reserve in the Flinders River catchment was again made available for sale by tender, as well as the general reserves in the Gregory River, Lower Leichhardt River subcatchments, Nicholson and Norman catchments. From the Flinders River catchment general reserve, 92 500 ML was allocated, leaving 147 150 in reserve. The entire 2500 ML in the Gregory River subcatchment was allocated, and 5000 ML of the 15 000 ML available in the Lower Leichhardt River subcatchment was also allocated. There was no water from the general reserves allocated in the Nicholson River and Norman River catchments.

In 2017, the Etheridge Shire Council was granted 500 ML and 1360 ML from the strategic reserve for Forsayth and Georgetown water supplies respectively from the Delaney River.

A third release of unallocated water from general reserves is currently underway by way of fixed price sale, with a total of 92 500 ML made available. This total comprises of up to 7500 ML from one reach of the Cloncurry River in the Flinders River catchment, and up to 85 000 ML from two reaches of the Gilbert River catchment.

## 8 Statutory authorisations (Water Act s93-103)

The take of water under statutory authorisations provided by the Water Act is not required to be measured. A qualitative assessment of broad trends in consumptive water use behaviour will identify risks that these statutory authorisations pose to existing water users' rights or the environment. A summary of this assessment is presented in Appendix 7, and is based on the best available information.

From the assessments, there is no identified increase in the water take for authorisations allowed under the Water Act for activities such as fire-fighting, stock, domestic, constructing authorities, and prescribed activities.

## **9 Environmental Flows Assessment Program and other research and monitoring**

The Queensland Government through the Environmental Flows Assessment Program (EFAP) undertakes ecological monitoring to assess the ecological performance of each water plan in meeting its stated ecological outcomes. The EFAP is supported by other research programs and reports. Among these other programs and research are those that show the freshwater flow dependence of northern Queensland marine fisheries of the Gulf of Carpentaria such as banana prawns and barramundi. Research shows that the growth rates of these species are enhanced by freshwater flows, enhanced growth rates lead to greater recruitment success and survival of young and consequently, to greater commercial catches. The abundance of many other species which become prey for fisheries species are also dependent on freshwater flows, such that, reduced flows may affect fisheries.

Research shows that floodplain food sources also contributed over 30% of the diet of barramundi collected in the recreational fishery of the during the dry season. Other research shows the relationship between flow and floodplain contribution to riverine food webs and assessed potential risks from proposed future water resource development scenarios on in the water plan.

The environmental impact assessment (Appendix 2, Table 5) highlights measures to minimise the potential impact to the banana prawn and barramundi fisheries by the requirement of flow conditions that protect peak flows during January to March. A summary of the EFAP and other monitoring programs and reports in the Gulf catchment are shown in Appendix 8.

The Northern Australia Environmental Resources Hub which is funded through the Commonwealth Government's National Environmental Science Program (NESP), is undertaking a number of projects for Northern Australia that include projects that will improve our understanding of environmental water needs in the Gulf and Mitchell regions of Queensland. This includes projects being undertaken directly in Gulf and Mitchell river catchments and through projects in other catchments that will provide findings that are relevant and transferable to the Gulf and Mitchell areas. Of particular importance for the Gulf is the Hub's work in building a better understanding between the links between Gulf rivers and coastal productivity. This work builds further on CSIRO's work that informed the Gulf Water Plan amendment of 2014. It will focus on better quantifying how flows from major rivers can affect the health and productivity of floodplains and coastal areas, including ecological assets such as banana prawns, barramundi, migratory shorebirds.

## **10 Noncompliance**

In the Moondarra Dam water supply scheme, there were no compliance issues identified for the operation of Moondarra Dam under the ROP, including operating in accordance with the water sharing rules. All monitoring and reporting provisions were met from July 2010 to June 2017.

In the Julius Dam water supply scheme, there were no compliance issues identified with the operation of Julius Dam under the ROP, including operating in accordance with the water sharing rules. Monitoring and reporting provisions were met from July 2010 to June 2017. At times there were operational difficulties, for example during flooding; where an operational report was submitted to explain why particular requirements such as missed water quality sampling, could not be met at that time.

For the other catchments of the plan, there were no matters of noncompliance identified.



## 11 Potential future developments

There are a number of proposed developments in the area such as the Queensland North West Minerals Province, and the proposed Cave Hill dam site, Etheridge Irrigation Scheme, Hughenden Irrigation Project and Three Rivers Irrigation Project.

The Queensland North West Mineral Province, around Mount Isa and Cloncurry, is one of the world's richest mineral-producing region. It contains the majority of Queensland's mineral resources and holds about 75% of the state's base metal mineral endowment including copper, lead and zinc as well as major silver, phosphate deposits and rare earth potential. The Province has faced some economic challenges with a number of the older and larger mining operations being closed in recent years as a result of lower commodity prices. However with global commodity prices starting to improve, there is an opportunity to support the mining industry into the future. A strategic blueprint for the region has been prepared to foster further exploration, project investment and development opportunities for long term economic growth. The outcome of this work may impact on the water demand for the Gulf plan.

A potential dam site at Cave Hill on the Cloncurry River is proposed to augment the water supply for the Cloncurry township, mining and to develop an irrigated agriculture precinct. A feasibility study is being undertaken with funding from the National Water Infrastructure Development Fund.

The Gilbert River Irrigation Project is located in the Gilbert River catchment. It is proposed by the Etheridge Shire Council and involves the establishment of the Gilbert River Agricultural Precinct. The project includes a proposed Green Hills dam.

The Hughenden Irrigation Project has been proposed on the Flinders River, involving the construction of a dam. The Flinders Shire Council has a trial to grow grapes as a pilot project for the area.

An irrigation project (Three Rivers Project) was proposed in 2015 by Stanbroke on the Flinders River, south of Normanton. The project was declared then as a Coordinated Project and an Environment Protection and Biodiversity Conservation controlled action. The proposal is based on cotton production and is seeking additional water.

There are other proposals in the Gulf such as the pumped hydro project at the Kidston mine site in the upper Gilbert River catchment using the existing Kidston Dam and associated water licence.

Most of these proposed developments are in their early stages of investigations. Depending upon the progress and the certainty of such proposed developments, the Gulf plan can accommodate a number of new water demands. Additionally the plan can be reviewed or amended at any time in future should the risks in the catchment change or significant new demands are confirmed that cannot be met under the current plan.

## 12 Recommendations and proposed plan extension

This report presents information and assessments that will be used as part of the decision making process. In summary:

- the plan outcomes align with Water Act requirements for advancing the sustainable management of Queensland's water resources
- information on entitlements, water use and authorisations in the plan area indicates that there is no significant increase in demand in the plan area
- the findings of research and monitoring indicate that the implementation of the plan is achieving the plan's outcomes
- the assessment indicates plan objectives and strategies continue to provide security of entitlements for water users and provide water for the environment
- potential risks to water users and the environment have been classified as low risk and can be effectively managed under current arrangements
- no noncompliance matters were identified.

Taking into consideration all the matters above, and that the plan may be amended at any time if it is no longer advancing the sustainable management of water, the Minister is proposing to extend the life of the plan for the maximum period of 10 years to 1 September 2028.

Submissions on the proposal to postpone the expiry of the plan are invited and will be considered as part of the decision making process.

## 13 How to make a submission

Any entity may make a submission about the proposal to postpone the expiry of the plan. Submissions must:

- a) be in writing and signed by each person who made the submission or an authorised officer (such as the executive officer or secretary of a committee), unless the submission is electronic, in which case no signature is required
- b) state the name and address of each person who made the submission
- c) state the grounds of the submission and the facts and circumstances relied on in support of the grounds
- d) be received on or before **5pm, Friday 22 June 2018**.

To make a written submission, you are encouraged to use the submission form in Appendix 1 and complete the steps in the checklist below to ensure your submission is properly made. Only properly made submissions will be considered by the chief executive in postponing the expiry of the plan.

Submissions can be made by:

**Email:** [WRPGulf@dnrme.qld.gov.au](mailto:WRPGulf@dnrme.qld.gov.au)

**Post:** Chief Executive  
Attention: Sandra Turchet, Project Officer  
Gulf Water Plan  
Department of Natural Resources, Mines and Energy  
28 Peters Street  
Mareeba QLD 4880

**Online:** Get involved [www.getinvolved.qld.gov.au](http://www.getinvolved.qld.gov.au)

### Further information

For further information on lodging a submission, enquiries should be directed to:

- Shannon Dempster, Water Planning Manager on (07) 4222 5538
- Email: [WRPGulf@dnrme.qld.gov.au](mailto:WRPGulf@dnrme.qld.gov.au)

Alternatively, information can be viewed or downloaded via the department's website at [www.dnrme.qld.gov.au](http://www.dnrme.qld.gov.au) ([Search for Gulf](#))

### Submissions checklist

Please use the following checklist to ensure that you have made a proper submission:

- The name and address of each person making the submission has been specified on the submission form.
- Each person or authorised representative making the submission has signed the submission form.
- The grounds of the submission and the facts and circumstances relied on to support those grounds have been stated.
- Any additional information has been attached and the submission form states the number of additional pages attached.

Ensure your submission form is lodged by **5pm, Friday 22 June 2018**(allow enough time for receipt before the closing date for submissions).

# Appendix 1: Submission form

<b>Office Use Only</b>
Submission No:.....

Surname (Mr/Mrs/Ms/Dr/Other)

First Name	
Address	
Postcode	Fax No.
Organisation	
Position	
Phone No.	Mobile
Email	
Signature 1	Date
Signature 2*	Date

\*if necessary, e.g. for an organisation

Which interest group do you primarily represent? (You may tick more than one box)

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> Irrigator (surface water)        | <input type="checkbox"/> Riparian landholder                           | <input type="checkbox"/> Research/academic               |
| <input type="checkbox"/> Irrigator (groundwater)          | <input type="checkbox"/> Horticultural interests                       | <input type="checkbox"/> Tourism industry                |
| <input type="checkbox"/> Dryland farmer                   | <input type="checkbox"/> Local government                              | <input type="checkbox"/> Commercial fisher               |
| <input type="checkbox"/> Grazier                          | <input type="checkbox"/> Stock and domestic water user                 | <input type="checkbox"/> Recreational fisher             |
| <input type="checkbox"/> Mining industry                  | <input type="checkbox"/> Environmental interests                       | <input type="checkbox"/> Small business                  |
| <input type="checkbox"/> Water service provider           | <input type="checkbox"/> Commerce/development                          | <input type="checkbox"/> NRM Board/Catchment             |
| <input type="checkbox"/> Community group (please specify) | <input type="checkbox"/> Aboriginal peoples or Torres Strait Islanders | <input type="checkbox"/> Industry group (please specify) |
| .....   |  | .....  |
| <input type="checkbox"/> Other (please specify).....      |  |  |



## Appendix 2: Risk assessment of plan outcomes

**Table 4: Socio-Economic Outcomes**

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan (ROP) management rules that provide for outcome	Qualitative risk ranking and Preliminary assessment of outcome
13 Economic Outcomes			
(a) provision for the continued use of all water entitlements and other authorisations to take or interfere with water;	The plan itself does not limit or restrict existing users, or the taking of water under statutory authorisations.	The ROP provides for the following: <ul style="list-style-type: none"> <li>• metering</li> <li>• permanent transfer rules</li> <li>• granting and amending water licences to take overland flow water</li> <li>• dealing with water licence applications.</li> </ul>	Low Risk.  This outcome is being achieved. The plan provides ongoing access to water under existing and new water entitlements.
(b)(i) water for the supply of urban water for Mount Isa City; and  (ii) water to support growth in the mining industry in north-west Queensland	The plan defines the water allocation security objectives for supplemented take from Lake Moondarra and Julius Dam.  The plan provides for unallocated water reserves.	The ROP provides for the following: <ul style="list-style-type: none"> <li>• water allocation change rules</li> <li>• seasonal water assignment rules</li> <li>• dealing with unallocated water</li> <li>• water sharing rules including critical water supply arrangements</li> <li>• permanent transfer rules.</li> </ul>	Medium Risk.  This outcome is being achieved. Mount Isa city access its water from the Moondarra Dam water supply scheme. An alternative supply from the Julius Dam water supply scheme is available if required. The population at Mount Isa is not likely to increase significantly over next 10 years.
(c) availability of water to support growth in industries dependent on water in the plan area;	The plan provides for unallocated water reserves.	The ROP provides for the following: <ul style="list-style-type: none"> <li>• dealing with unallocated water</li> <li>• water allocation change rules</li> <li>• seasonal water assignment rules</li> <li>• dealing with unallocated water</li> <li>• water sharing rules including critical water supply arrangements</li> <li>• permanent transfer rules.</li> </ul>	Low Risk.  This outcome is being achieved. The Plan provides ongoing access to water under existing and new water entitlements.
(d) provision for the taking of water in Lake Mary Kathleen;	The plan provides for 1,100 ML of strategic unallocated reserves.	The ROP provides a process for dealing with unallocated water.	Low Risk.  This outcome is being achieved. The Plan provides ongoing access to water under existing and new water entitlements.
(e) availability of water in the following areas to support growth in irrigated agriculture—  (i) Gilbert River catchment area; (ii) Flinders River catchment area; (iii) Nicholson River catchment area; (iv) Lower Leichhardt River subcatchment area;	The plan provides for unallocated water reserves.	The ROP provides a process for dealing with unallocated water and permanent transfer rules.	Low Risk.  This outcome is being achieved. The Plan provides ongoing access to water under existing and new water entitlements.

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan (ROP) management rules that provide for outcome	Qualitative risk ranking and Preliminary assessment of outcome
<p>(f) Availability of water to help Aboriginal peoples and Torres Strait Islanders:</p> <p>(i) Cape York Peninsula Region area;</p> <p>(ii) Flinders River catchment area;</p> <p>(iii) Gilbert River catchment area;</p> <p>(iv) Morning Inlet catchment area;</p> <p>(v) Settlement Creek catchment area;</p> <p>(vi) Staaten River catchment area;</p> <p>(vii) Gregory River subcatchment area;</p>	<p>The plan establishes Indigenous reserves of unallocated water.</p>	<p>The ROP provides a process for dealing with unallocated water and seasonal water assignment rules.</p>	<p>Low Risk.</p> <p>This outcome is being achieved.</p> <p>The Plan provides ongoing access to water under existing and new water entitlements.</p>
<p>(g) encouragement of continual improvement in the efficient use of water;</p>	<p>The plan provides a framework for specifying and converting area-based water licences to volumetric water licences, including consideration for efficient irrigation in plan area.</p> <p>In dealing with unallocated water, the plan requires the chief executive to consider the efficiency of present and proposed uses of water.</p>	<p>The ROP provides for the following:</p> <ul style="list-style-type: none"> <li>• scheme licence holder monitoring of water take</li> <li>• metering</li> <li>• water allocation change rules</li> <li>• seasonal water assignment rules</li> <li>• permanent transfer rules.</li> </ul>	<p>Low Risk.</p> <p>This outcome is being achieved.</p> <p>The Plan provides ongoing access to water under existing and new water entitlements.</p>
<p>(h) support of tourism in the plan area, including, for example, by protecting flows that support the natural aesthetics of watercourses and their surroundings;</p>	<p>The plan outlines the volumes of unallocated water that may be accessed as well as providing for the environment through setting of Environmental Flow Objectives (EFOs).</p> <p>The plan also limits the level of interference to flow through either diversion structures or excavation of the stream bed. Furthermore, there are limitations possible for new licences that restrict the level of drawdown of waterholes.</p> <p>Groundwater and overland flow are managed.</p>	<p>The ROP outlines the process for the granting of unallocated water.</p> <p>The ROP also establishes annual volumetric limits in water management areas as well as setting flow conditions for the seasonal assignment of water.</p> <p>The ROP outlines the process for granting overland flow water.</p>	<p>Low Risk.</p> <p>This outcome is currently being achieved.</p> <p>The plan provides the framework for the management of the water resource. The volume of unallocated water, the restrictions on the access conditions for the unallocated water and by establishment of EFOs provide for this outcome.</p>
<p>(i) support of commercial fishing in the Gulf of Carpentaria, including, for example, by protecting flood flows that may deliver nutrients and water to estuarine and marine environments to stimulate growth and movement of native aquatic animals, including fish, prawns and crabs.</p>	<p>The plan outlines the volumes of unallocated water that may be accessed as well as providing for the environment through setting of EFOs.</p>	<p>The ROP outlines the process for the granting of unallocated water.</p>	<p>Low Risk.</p> <p>This outcome is currently being achieved.</p> <p>The plan has set maximum unallocated water reserves and licences that are granted from unallocated water as water harvesting entitlements. These require high flow thresholds to ensure peak flows support fisheries productivity and lower flow thresholds support downstream users and environmental needs such as waterholes as refugia. EFOs in the plan dictate these thresholds and provide protection to the overall flow regime and wet season flows.</p>

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan (ROP) management rules that provide for outcome	Qualitative risk ranking and Preliminary assessment of outcome
<b>14 Social outcomes</b>			
14(a)(i) support of population growth in towns and communities dependant on water in the plan area; (ii) Aboriginal peoples and Torres Strait Islanders: (A) Cape York Peninsula Region area; (B) Flinders River catchment area; (C) Gilbert River catchment area; (D) Morning Inlet catchment area; (E) Settlement Creek catchment area; (F) Staaten River catchment area; (G) Gregory River subcatchment area;	(i) The plan allows for strategic reserves of unallocated water  (ii) The plan provides for continued use of water entitlements in the plan area, and establishing Indigenous reserves of unallocated water	The ROP provides for the following: <ul style="list-style-type: none"> <li>• dealing with unallocated water</li> <li>• water allocation change rules</li> <li>• seasonal water assignment rules</li> <li>• dealing with unallocated water</li> <li>• water sharing rules including critical water supply arrangements</li> <li>• permanent transfer rules</li> </ul>	Low Risk.  This outcome is being achieved. The Plan provides ongoing access to water under existing and new water entitlements.
(b) support of water-related cultural values of Aboriginal and Torres Strait Islanders in the plan area;	Water related cultural values are supported by an unallocated water release process assessment criteria that considers cultural heritage. EFOs support water features that have cultural value.	The ROP provides the following: <ul style="list-style-type: none"> <li>• process for dealing with unallocated water including consideration of cultural values</li> <li>• operating and environmental management rules e.g. waterhole management at provide for both the environmental and cultural values of waterholes</li> </ul>	Low Risk.  This outcome is being achieved.
(c) promotion of a cooperative approach between the State and relevant Northern Territory government agencies to water resource management;	The plan specifies a cooperative approach between State and Northern Territory.	The ROP provides for chief executive data collection and assessment	Low Risk.  This outcome is being achieved.
(d) maintenance of flows – aesthetic, cultural and recreational values.	The plan identifies performance indicators and provides for the maintenance of flows for aesthetic, cultural and recreational values through EFOs.	The ROP provides for the following: <ul style="list-style-type: none"> <li>• operating and environmental management rules (e.g. rules for operation of infrastructure, minimum stream flow requirements)</li> <li>• environmental flows</li> <li>• chief executive data collection and assessment</li> </ul>	Low Risk.  This outcome is being achieved. The Plan provides ongoing access to water under existing and new water entitlements.

Note: The Resource Operations Plan (ROP) will transition to the various statutory instruments such as the water management protocol, resource operations licence and associated operations manual in the future.



**Table 5: Environmental Outcomes**

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and Preliminary assessment of outcome
<b>15. (1) Each of the following is an ecological outcome for water in the plan area—</b>					
<p>(a) maintenance of the natural variability of flows that support the habitats of native plants and animals and migratory birds in watercourses, floodplains, wetlands, lakes and springs;</p>	<p>The plan identifies performance indicators and provides for the maintenance of flows through EFOs</p>	<p>The ROP outlines the process for the granting of unallocated water.</p> <p>The ROP also establishes annual volumetric limits, maximum rates of take, as well as setting flow conditions.</p> <p>The ROP outlines the process for managing overland flow.</p>	<ul style="list-style-type: none"> <li>• Floodplain vegetation</li> <li>• Floodplain wetlands</li> <li>• Fluvial geomorphology and river forming processes</li> <li>• Southern Mitchell Aggregation/Southeast Karumba Plain Aggregation</li> <li>• Brackish estuarine habitat</li> <li>• Waterholes</li> <li>• Riffles</li> <li>• Stable flow spawning fish</li> </ul>	<p>DSITIA (2014) reviewed possible impacts on the cues for migratory fish species if unallocated water reserves in the Gilbert and Flinders rivers were increased. The report only assessed the provision of flow requirements, not barrier impacts (i.e. a dam).</p> <p>Jardine et al. (2013) found that during the dry season, barramundi and other predators in the Flinders River gain most of their carbon from plants and microbes attached to logs and rocks in the waterhole.</p> <p>Plants and microbes in waterholes is influenced by water clarity – driven by groundwater input (Waltham et al. 2013) as well as inundation frequency and duration on floodplains (DSITIA 2014).</p>	<p>Low Risk.</p> <p>This outcome is currently being achieved. The plan has set maximum unallocated water reserves. Water licences are granted from general reserves with flow thresholds derived from EFO's that aim to provide protection to the overall flow regime. For example first flush and peak flows are protected and low flow thresholds protect waterholes as refugia.</p>
<p>(b) provision for the continued capability of a part of a river system to be connected to another part, including by maintaining flood flows that—</p> <p>(i) allow for the movement of native aquatic animals between riverine, floodplain, wetland, estuarine and marine environments; and</p> <p>(ii) deliver nutrients and organic matter throughout the plan area to support natural processes such as breeding, growth and migration in riverine, floodplain, wetland, estuarine and marine environments; and</p> <p>(iii) deliver water and sediment throughout the plan area to support river-forming</p>	<p>The plan outlines the volumes of unallocated water that may be accessed as well as providing for the environment through setting of EFOs.</p> <p>The plan also limits the level of interference to flow through either diversion structures or excavation of the stream bed.</p>	<p>The ROP outlines the process for the granting of unallocated water.</p> <p>The ROP also establishes annual volumetric limits, maximum rates of take, as well as setting flow conditions.</p> <p>The ROP outlines the process for managing overland flow.</p>	<ul style="list-style-type: none"> <li>• Floodplain vegetation</li> <li>• Floodplain wetlands</li> <li>• Fluvial geomorphology and river forming processes</li> <li>• Southern Mitchell Aggregation/Southeast Karumba Plain Aggregation</li> <li>• Brackish estuarine habitat</li> <li>• Riffles</li> <li>• Migratory aquatic biota</li> <li>• Freshwater turtles</li> </ul>	<p>Refer to (a) above.</p>	<p>Low Risk.</p> <p>This outcome is currently being achieved. The plan has set maximum unallocated water reserves. Water licences are granted from general reserves with flow thresholds which are derived from EFO's that aim to provide protection to the overall flow regime. For example first flush and peak flows are protected and low flow thresholds protect waterholes as refugia.</p>

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and Preliminary assessment of outcome
processes;					
(c) minimisation of changes to natural variability in water levels to support natural ecological processes, including the maintenance of refugia associated with waterholes and lakes;	<p>The plan has implemented groundwater management areas as well as declaring groundwater within 1 kilometre of prescribed watercourses to be water in the watercourse.</p> <p>Performance indicators and EFOs are established.</p> <p>Instream interference is limited.</p> <p>Overland flow is managed by the plan.</p> <p>The plan allows for restrictions to be placed on new licences in unsupplemented reaches regarding the take of water from waterholes or lakes.</p>	<p>The ROP outlines rules for trading water licences within volumetric limits and zones, and imposing flow conditions on licences either established through trading or granted from unallocated water.</p>	<ul style="list-style-type: none"> <li>• Floodplain vegetation</li> <li>• Floodplain wetlands</li> <li>• Fluvial geomorphology and river forming processes</li> <li>• Southern Mitchell Aggregation/Southeast Karumba Plain Aggregation</li> <li>• Brackish estuarine habitat</li> <li>• Riffles</li> <li>• Migratory aquatic biota</li> <li>• Freshwater turtles</li> <li>• Waterholes as refugia</li> </ul>	<p>The majority of waterholes sampled in the Flinders and Gilbert River catchments were found to have a low likelihood of groundwater input to provide for persistence (Jolly et al. 2013). However, more waterholes in the Gilbert River catchment were found to act as refugia during the dry season due to more persistent flows (McJannet et al. 2013). These more persistent flows are important to refresh waterholes in this area, with the result that these waterholes are generally clearer.</p> <p>Waterhole clarity is a key driver for ecosystem processes so any changes to the level of baseflow input into the waterholes may affect the clarity and resultant ecosystem processes (Waltham et al. 2013).</p>	<p>Low Risk.</p> <p>This outcome is being achieved. The plan manages overland flow, groundwater and surface water and there are specific minimum environmental flows set by EFOs. Water licences are granted from general reserves with flow thresholds which are derived from EFO's. Water licence trade assessments consider EFOs and establish flow conditions.</p>
(d) maintenance of the permanence of water in naturally perennially flowing watercourses and in river bed sands that provide water to support native plants and animals, particularly during dry seasons;	<p>Groundwater within 1 kilometre of prescribed watercourses is declared to be managed as water in the watercourse.</p> <p>The plan established maximum volumes for unallocated water reserves.</p> <p>There is a requirement for considering the availability of water in the bed sands when deciding water sharing rules.</p> <p>There are monitoring</p>	<p>The ROP outlines maximum annual volumetric limits for water extraction in Water Management Zones that limits the maximum take of water. Water may be transferred in these zones but only up to this maximum limit.</p> <p>The ROP also outlines the need for chief executive data collection and assessment.</p> <p>All entitlements that</p>	<ul style="list-style-type: none"> <li>• Riffles</li> <li>• Migratory aquatic biota</li> <li>• Freshwater turtles</li> <li>• Waterholes as refugia</li> <li>• GDEs</li> </ul>	<p>Permanence of perennial streams: The only extensive perennial watercourses known in the Gulf water plan area are Lawn Hill Creek and Gregory River (Australian Government 2011). Groundwater discharge from the Georgina Basin limestones maintain baseflow in this area. Streamflow monitoring has shown that the Gregory River at Gregory and Riversleigh has been permanent since the commencement of the plan.</p> <p>Bed sands: DSITIA (2014) conducted a risk assessment to riparian plant species potentially affected by water extraction from the Gilbert River bed sands. Under the full utilisation of</p>	<p>Low Risk.</p> <p>This outcome is partially being achieved. The plan manages specific areas to provide for ecological outcomes for perennial streams. However, no monitoring data is available to assess the impact of water take on bed sand ecosystems. Metered use of entitlements within the bed sand management area is low compared to maximum annual volumetric limits.</p>

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and Preliminary assessment of outcome
	requirements as part of the plan. Instream interference is limited.	actively take water are metered. The ROP outlines maximum annual volumetric limits for water extraction in Water Management Zones that limits the maximum take of water. Water may be transferred in these zones but only up to this maximum limit.		entitlements, the bed sands were drawn down past the root zone (2.5 m) for a total of 4.5% of the total simulation period, suggesting a low risk to adult trees. However, it is known that Melaleuca seedlings may be more sensitive to drawdown.	
(e) the promotion of improved understanding of the matters affecting flow-related health of ecosystems in the plan area;	There are monitoring and reporting requirements in the plan. The minister reports on matters affecting the environment and water users in the Ministers report on the plan.	The performance of the plan will be assessed using monitoring to determine if outcomes are being achieved.	<ul style="list-style-type: none"> <li>• all</li> </ul>	<p>The details of departmental monitoring and other monitoring conducted within the plan area have been summarised in this report (Appendix 8) and are used as a tool to assess the achievement of the ecological outcomes.</p> <p>There have been a number of studies conducted to determine the potential impact of further allocation of water resources in the area – the information from these and other studies have also been summarised.</p>	<p>Low Risk.</p> <p>The outcome is being achieved. There has been only limited specific ecological and water monitoring associated with plan strategies and ROP rules within the plan area to this time. While unallocated water releases has increased the water entitlement volumes for Gulf entitlements, these licences are yet to be developed. Three new surface water and additional groundwater monitoring stations were installed. Data has been collected on an ongoing basis to provide additional flow and water level recordings as well as to better manage flow thresholds for licences granted. There has been substantial ecological monitoring program information available and a number of programs are continuing to provide additional and transferrable information.</p>
(f) maintenance of water in the bed sands of the Gilbert River between AMTD 317km and AMTD 263km— (i) to provide aquatic habitat for native aquatic plants and animals, particularly during dry seasons; and	Groundwater within 1 kilometre of prescribed watercourses is declared to be managed as water in the watercourse. The plan established unallocated water	The ROP outlines maximum annual volumetric limits for water extraction in Water Management Zones that limits the maximum take of water. Water may be	<ul style="list-style-type: none"> <li>• Riffles</li> <li>• Waterholes as refugia</li> <li>• Other GDE's</li> </ul>	Assessment of metered use of entitlements highlights that there are currently only 5 entitlements that are actively extracting water from Bed sands in the Gilbert River Water Management Area, zones 3–5. The metered use for the period of metering 2010–2017 varied between 178–2894 ML/a. This is substantially less than that allowed	<p>Low Risk.</p> <p>There is insufficient information available to determine if this outcome is being achieved. The Gilbert River bed sands resource in Zones 3 – 5 has remained at relatively low levels of utilisation. No</p>

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and Preliminary assessment of outcome
(ii) to support riparian vegetation; and (iii) to contribute to the flow of water in the Gilbert River;	reserves and EFOs which limit access to surface water flows. No new entitlements can be granted from the within bed sands zones from general reserve unallocated water. There are monitoring requirements as part of the plan.	transferred in these zones but only up to this maximum limit. Bed sand zones are capped to prevent an overall increase to bed sands take. The ROP also outlines the need for data collection and assessment.		as a total volumetric limit for these three zones of 5 082 ML/a.  Streamflow monitoring at the Gilbert River at Rockfields gauge (GS917001D) over this time shows that there are a number of times that stream flows have stopped, the maximum period of no flow was 216 days in 2014. However, further work is required to understand the chemical, biological and hydrological processes in this area.	permanent trades have been recorded and metered water use is low.
(g) maintenance of the permanence of water flows in the Gregory River and Lawn Hill Creek to provide aquatic habitat for native aquatic plants and animals, particularly during dry seasons;	The plan states the groundwater management areas where specific management of the resource occurs (Nicholson Groundwater Management Area) (GMA). Groundwater under prescribed watercourses (including the Gregory River and Lawn Hill Creek) is declared to be managed as water in the watercourse. The plan established maximum volumes for unallocated water reserves.	The ROP outlines that the chief executive may require a water entitlement to take water in this GMA to outline likely impact on groundwater or surface water flows. The ROP also outlines the need for chief executive data collection and assessment	<ul style="list-style-type: none"> <li>• Riffles</li> <li>• Freshwater turtles</li> <li>• Waterholes as refugia</li> <li>• Other GDE's</li> <li>• Stable flow spawning fish</li> </ul>	Groundwater discharge from the Georgina Basin limestones maintain baseflow. Streamflow monitoring has shown that the Gregory River at Gregory and Riversleigh has been permanent since the commencement of the plan.	Low Risk.  This outcome is being achieved. The plan provides the framework for the release of unallocated water and by processes in the resource operations plan that provide for its release. The GMA provides a basis for further management arrangements if required.
(h) maintenance of flood flows to the estuarine and marine environments of the Gulf of Carpentaria to stimulate breeding, growth and migration of native aquatic animals;	The plan protects the flood flows in the Gulf by identifying floodplain inundation as a performance indicator and setting wet season EFOs at key nodes in the plan. The plan established maximum volumes for unallocated water reserves. Overland flow and instream interferences	The ROP outlines the process to grant water licences for overland flow. The ROP provides additional considerations for unallocated water and for water licence trading within volumetric limits and zones. Flow conditions are also required and	<ul style="list-style-type: none"> <li>• Floodplain vegetation</li> <li>• Floodplain wetlands</li> <li>• Fluvial geomorphology and river forming processes</li> <li>• Southern Mitchell Aggregation/Southeast Karumba Plain Aggregation</li> <li>• Brackish estuarine habitat</li> <li>• Migratory aquatic</li> </ul>	The CSIRO study into the projected risks to estuarine fisheries highlighted the need to protect high flows, particularly during the wet season as these are important to a number of estuarine species (Bayliss et al. 2014). The higher risk species included White banana prawns and barramundi.	Low Risk.  This outcome is being achieved. To ensure that the potential impact to the growth and catch of banana prawns and barramundi is minimised, the release of unallocated water requires flow conditions that protect peak flows during January to March (the critical period for prawn migration). The regulation of overland flow and limitations on instream interferences will also assist to minimise threats.

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and Preliminary assessment of outcome
	are managed in the plan.	environmental needs must be assessed for water licence trading. The ROP also outlines the need for chief executive data collection and assessment	biota		
(i) maintenance of the natural variability of flood flows that inundate, and deliver nutrients, organic matter and sediment to, the wetlands of the areas known as the Southern Gulf Aggregation and the Southeast Karumba Plain Aggregation;	The plan protects the flood flows in the Gulf by setting EFOs at key nodes in the plan. The plan established maximum volumes for unallocated water reserves. Overland flow and instream interferences are managed in the plan.	The ROP outlines the process to grant water licences for overland flow. The ROP also outlines the need for chief executive data collection and assessment	<ul style="list-style-type: none"> <li>• Floodplain vegetation</li> <li>• Floodplain wetlands</li> <li>• Fluvial geomorphology and river forming processes</li> <li>• Southern Mitchell Aggregation/Southeast Karumba Plain Aggregation</li> </ul>	<p>DSITIA (2014) undertook a risk assessment process of the increased unallocated water reserves in the Flinders and Gilbert River catchments. It was found that there may be medium risks to the energy transfer to the aquatic biota through the interruption of flood flows to the floodplains by the allocation of unallocated water reserves.</p> <p>The moderation of volumes set in unallocated water reserves reduced the risk to these ecosystems somewhat, however there was still a degree of residual risk in the Gilbert River. It was thought that there was a linear impact to the floodplain subsidy by the reduction in the frequency and volume of the peak flood flows (DSITIA 2014). Modelling predicts that this can be mitigated by the requirement for off-stream water harvesting and peak flow conditions established for future water licences granted from unallocated water reserves</p>	<p>Low Risk.</p> <p>This outcome is being achieved. To ensure that there the potential impact to energy transfer is minimised, the release of unallocated water requires flow conditions that protect peak flows during January to March (the critical period for prawn migration). The regulation of overland flow and limitations on instream interferences will also assist to minimise threats</p>
(j) Maintenance of flows in the Gilbert River to provide brackish estuarine habitat suitable for juvenile banana prawn development.	The plan protects the flood flows in the Gulf by setting EFOs at key nodes in the plan. The plan established maximum volumes for unallocated water reserves and instream interferences are managed in the plan.	The ROP outlines the process to grant water licences for overland flow. The ROP also outlines the need for chief executive data collection and assessment.	<ul style="list-style-type: none"> <li>• Floodplain vegetation</li> <li>• Floodplain wetlands</li> <li>• Fluvial geomorphology and river forming processes</li> <li>• Southern Mitchell Aggregation/Southeast Karumba Plain Aggregation</li> <li>• Brackish estuarine habitat</li> </ul>	<p>Bayliss et al. (2014) did a review of the potential impacts to the banana prawn catch in the Gulf from increased unallocated water reserves. The report indicates that when both the Flinders and Gilbert catchments are considered, the general reserve volumes could potentially reduce Banana Prawn catch in the south eastern Gulf of Carpentaria by 10%. Further hydrologic modelling established water management rules that could mitigate any reduction to the potential productivity of Banana Prawn.</p>	<p>Low Risk.</p> <p>This outcome is being achieved. To ensure that the potential impact to growth and catch of banana prawn is minimised, the release of unallocated water requires flow conditions that protect peak flows during January to March (the critical period for prawn migration). The regulation of overland flow and limitations on instream interferences will also assist to minimise threats</p>

Plan Outcome (as per chapter 3 of Plan)	Plan strategies that provide for outcomes	Resource operations plan management rules that provide for outcome	Related ecological assets	Summary of monitoring and assessment	Qualitative risk ranking and Preliminary assessment of outcome
(2) Each of the following is an additional ecological outcome for groundwater in the plan area—					
(a) maintenance of groundwater contributions to the flow of water in watercourses, lakes and springs;	<p>The plan has declared water within 1 km of prescribed watercourses to be water within the watercourse as long as it is hydraulically connected.</p> <p>In addition, water licences in the Einasleigh groundwater management area are required to have an annual volumetric limit.</p>	The ROP outlines that the plan applies to groundwater that is not from GAB artesian or subartesian water.	<ul style="list-style-type: none"> <li>• Riffles</li> <li>• Waterholes as refugia</li> <li>• GDEs</li> </ul>	<p>McJannet et al. (2013) found that the larger waterholes along the Einasleigh River of the Gilbert catchment may be due to the groundwater discharge from the basalt. Jolly et al. (2013) found that several waterholes along the Einasleigh River and tributaries draining the basalt provinces had a high likelihood of receiving groundwater inflows. Otherwise the majority of river and waterhole sites sampled in both the Gilbert and Flinders catchments had a nil or low likelihood of groundwater inflow</p> <p>CSIRO (2009) also proposed that the Gilbert River formation (part of the GAB) may contribute to stream flows in sections of the Flinders River, Woolgar River, Hampstead Creek and Porcupine Creek. It was also suggested that the Sturgeon Basalt may provide baseflow to some tributaries.</p>	<p>Low Risk.</p> <p>There is insufficient information available to determine if this outcome is being achieved as there is uncertainty about the level of contribution from groundwater. However there has been limited water development in the plan area. Management strategies have been put in place to manage both surface water and groundwater as one resource. .</p> <p>Production bores not managed under the GABORA Water Plan are registered and the majority are for stock watering only. No unallocated groundwater is available in the water management areas.</p>
(b) the support of ecosystems dependent on groundwater, including, for example, riparian vegetation, wetlands and waterholes;	The plan has declared that hydrologically connected water within 1 km of prescribed watercourses to be water within the watercourse Water licences in the Einasleigh groundwater management area are required to have an annual volumetric limit	The ROP outlines that the plan applies to groundwater that is not from GAB artesian or subartesian water.	<ul style="list-style-type: none"> <li>• GDEs</li> <li>• Waterholes as refugia</li> </ul>	DSITIA (2014) conducted a risk assessment to riparian plant species potentially affected by water extraction from the Gilbert River bed sands. Under the full utilisation of entitlements, the bed sands were drawn down past the root zone (2.5 m) for a total of 4.5% of the total simulation period, suggesting a low risk to adult trees. However, it is known that Melaleuca seedlings may be more sensitive to drawdown. No studies on the hyporheic organisms and the hydrological and chemical processes that occur in this zone.	<p>Low Risk.</p> <p>There is insufficient information available to determine if this outcome is being achieved as there is uncertainty about the level of contribution from groundwater. Monitoring and research into targeted groundwater interaction and ecological studies at sites, groundwater level and usage data are needed for assessment of this outcome.</p>
(c) Allocation and management of groundwater in a way that is compatible with the outcomes of the Water Plan (Great Artesian Basin and Other Regional Aquifers) 2017 to the greatest practicable extent.	The plan outlines that only groundwater take in the Nicholson and Einasleigh groundwater management areas require a water licence, except for stock and domestic purposes.	The ROP outlines that the plan does not apply to water managed under the GABORA plan.	<ul style="list-style-type: none"> <li>• Waterholes</li> <li>• riffles</li> <li>• GDE's</li> </ul>	All new stock and domestic bores in the groundwater management areas are registered with the department.	<p>Low Risk.</p> <p>This outcome is being achieved across the plan area.</p>

Note: This table is prepared from "DNRME (2018). Review of Water Plan (Gulf) 2007 and Water Plan (Mitchell) 2007" and separate risk assessment work.

### **Appendix 3: Summary of the 2018 Hydrologic Model Assessment— Flinders, Gilbert and Leichhardt catchments**

The Queensland Hydrology Unit of the Department of Environment and Science DES (formerly DSITI) developed daily time-step Integrated Quantity-Quality Models (IQQM) for the Flinders, Gilbert and Leichhardt catchments for the Gulf water plan development. These models were reviewed in 2018 by DSITI and the review is summarised below.

The Flinders IQQM and Gilbert IQQM models (model simulation period 1890-2003) used for the original Gulf WP and ROP, were extended as IQQM models (up to 2008) by CSIRO in collaboration with DSITI for the Northern Australia Sustainable Yield (NASY) project in 2009-2010. These were subsequently redeveloped in 2012-2013 by CSIRO with some input from DSITI for use in the Flinders and Gilbert Agricultural Resource Assessment (FGARA) project using the Source platform. This work extended the simulation period of the original model from July 1890 to June 2011.

The 2018 review also considered the Leichhardt IQQM model (model simulation period 1890-2003). Since its initial development better methods of rainfall extraction and runoff calibration and more efficient automatic optimisation of the parameters of rainfall runoff models. An additional 14 years of rainfall and streamflow data is available for model calibration including the year 2013 which appears to be the lowest rainfall year on record at Mt Isa and would include the years that Julius Dam reached its lowest levels. More recent information could also help in the assessment of operational losses for the Julius Dam – Lake Moondarra system and could capture any change in operating arrangements following the construction of the Cloncurry Pipeline.

In conclusion the 2018 review shows that the Flinders, Gilbert and Leichhardt models satisfactorily represent climate variability, however further updating of the models and validation of the calibration, is desirable for any future changes to the water plans that intend to include updated development, change the performance indicators or the volume of unallocated water available. The Leichhardt is still on the IQQM platform and has the original simulation period. Whilst this is a robust model, it could be updated to Source if and when the opportunity presents itself. However this is not necessary for the proposed plan extension.

## Appendix 4: Plan and instruments amendments

Date	Milestone
November 2007	The plan commenced in 2007 and provides unallocated water for future water requirements through strategic and general reserves. The plan; provides for town water supply, natural ecosystems and a framework for establishing tradeable water allocations for Julius and Moondarra dams water supply schemes. The plan also recognises the cultural values water holds for traditional owners.
June 2010	The ROP commenced in, implementing objectives specified in the Plan including: <ul style="list-style-type: none"> <li>• improved specification of existing water entitlements,</li> <li>• converting area based licences to volumetric licences,</li> <li>• strategies to support a range of ecological outcomes and natural ecosystem monitoring requirements,</li> <li>• operating rules and management arrangements for water infrastructure operators</li> </ul>
November 2011	Plan amended to establish Indigenous reserves of unallocated water to establish Indigenous reserves of unallocated water to support aspirations of Aboriginal peoples and Torres Strait Islanders in the Cape York region, Morning Inlet, Settlement Creek and Staaten River catchments and the Gregory River subcatchment. ROP amended to allow water licences granted from the Indigenous reserves to be seasonally assigned
May 2013	Water licences granted in the Flinders and Gilbert river catchments via the unallocated water tender process: <ul style="list-style-type: none"> <li>• Three licences granted in the Flinders River catchment totalling 80,000ML (all available water allocated)</li> <li>• Three licences granted in the Gilbert River catchment totalling 14,220ML (of an available 15,000ML)</li> </ul>
February 2014	Water licences granted to Burke, Cloncurry and Flinders Shire Councils from the strategic unallocated water reserves after an expression of interest process. A total of 2266ML was granted.
June 2014	The plan was amended by the <i>Water Resource Plans Amendment Plan (No. 1) 2014</i> which: <ul style="list-style-type: none"> <li>• changed the Minister’s reporting period on the plan to five years;</li> <li>• removed unnecessary prescription while retaining policy intent</li> <li>• removed redundant provisions; and removed duplication – with the Water Act and the Water Regulation 2002.</li> </ul>
July 2014	ROP amended to allow licences in the Flinders and Gilbert catchments to be permanently and seasonally transferred.
August 2014	Water licence granted to Carpentaria Shire Council from the strategic unallocated water reserve after the expression of interest process.
August 2015	Plan and ROP amended to provide new reserves of unallocated water in the Flinders and Gilbert River catchments; and amended environmental flow objectives in the Flinders and Gilbert River catchments to protect the health of natural ecosystems both under current levels of water resource development and from future development decisions made under the plan.
December 2016	The plan was amended by the <i>Water Reform and Other Legislation Amendment Act 2014</i> and the Water Regulation 2016 to update the short title of the plan, clarify the definition for water to which the plan applies, and provide an interim definition for the term subartesian water until such time as the plan is reviewed and replaced, and to update cross references.
November 2016 – March 2017	Water licences were granted for a combined total of 100,000ML from general reserve unallocated water for Gulf catchments.
December 2017	Water licence granted to Etheridge Shire Council from the strategic unallocated water reserve after expression of interest process.



## Appendix 5: Water entitlements and use

**Table 6: Announced allocations and supplemented water use volumes from Moondarra Dam and Julius Dam water supply schemes from 2010-11 to 2016-17 water years**

Water Supply Scheme	Water Year	Announced allocation (percentage)	Water Entitlement (ML)	Water Extracted (ML)	Percentage of Water Entitlements Extracted	Seasonal water assignments	
						Number	Volume (ML)
Julius Dam	2016-17	100	48,850	1,815.41	3.7	0	0
	2015-16	100	48,850	5,072	10.4	0	0
	2014-15	100	48,850	11,037	22.6	2	9,888.68
	2013-14	100	48,850	11,666.8	23.9	1	1,988.68
	2012-13	100	48,850	8,676.06	17.8	0	0
	2011-12	100	48,850	8,037.97	16.5	0	0
	2010-11	100	48,850	7,922.32	16.2	0	0
Moondarra Dam	2016-17	100	26,300	13,957	53.1	0	0
	2015-16	100	26,300	14,733	56.0	0	0
	2014-15	1 July 2014 – 9% 1 Feb 2015 – 100%	26,300	16,966	64.5	0	0
	2013-14	60	26,300	11,334	43.1	0	0
	2012-13	100	26,300	19,487	74.1	0	0
	2011-12	100	26,300	18,037	68.6	0	0
	2010-11	100	26,300	17,540	66.7	0	0

## Appendix 6: Unallocated water

**Table 7: Initial unallocated water reserves in the plan area**

Reserve type	Purpose	Area	Volume (ML)
General	Any	Flinders River catchment	80 000
		Gilbert River catchment	15 000
		Gregory River subcatchment	2 500
		Lower Leichhardt River subcatchment	15 000
		Nicholson River	4 400
		Norman River catchment	3 000
Indigenous	For helping Aboriginal peoples and Torres Strait Islanders in the area achieve their economic and social	Part of plan area within the Cape York Peninsula Region <sup>1</sup>	1 000
Strategic	Any	Lake Corella	2 500
		Lake Mary Kathleen	1 100
	State <sup>2</sup>	Flinders River catchment	20 000
		Gilbert River catchment	5 000
		Gregory River subcatchment	5 000
		Lower Leichhardt River subcatchment	15 000
		Mornington Inlet catchment	1 000
		Nicholson River subcatchment	4 400
		Norman River catchment	2 000
		Settlement Creek catchment	1 000
		Staaten River catchment	1 000

<sup>1</sup> As defined under the *Cape York Peninsula Heritage Act 2007*.

<sup>2</sup> As defined under the Gulf water plan, state purpose means—a project of State significance, a project of regional significance, town water supply or ecotourism— where purpose of water use is for ecotourism, the area is restricted to Morning Inlet, Settlement Creek and Staaten River catchment areas, and the part of plan area within the Cape York Peninsula Region.

**Table 8: Amended Gulf water plan unallocated water reserves (2015)**

<b>Reserve type</b>	<b>Purpose</b>	<b>Area</b>	<b>Volume (ML)</b>
General	Any	Flinders River catchment	239 650
		Gilbert River catchment	467 000
Strategic	Any	Lake Corella	0
	State	Flinders River catchment	17 850
		Nicholson River subcatchment	4 282
		Norman River catchment	1 000

## Appendix 7: Statutory authorisations (Water Act s93-103)

Form of take	Catchment information sources
Authorisations that may not be limited by water planning instrument	
S93 General authorisations to take water e.g. firefighting, watering travelling stock, contaminated agricultural run-off storages	<p>No identified change in water taken under these authorities.</p> <p>Stock routes: Stock routes in the plan area are predominately classified as minor and unused.</p> <p>Camping: No noted increase in using water for camping purposes, other than around the constructed impoundments on Julia Creek.</p> <p>Fire Fighting/Emergency: No noted increase in use of water for fire-fighting purposes.</p>
S94 General authorisations to interfere with water e.g. overland flow, impoundments for state monitoring purposes	<p>No identified change in interference under these authorities.</p> <p>Monitoring: There are no gauging stations that interfere with water from a watercourse, lake or spring by impoundment for the purpose of collecting monitoring data. Monitoring data is collected at natural controls.</p>
S95 Aboriginal and Torres Strait Islander parties	<p>No identified change in water taken under these authorities.</p> <p>There has been no notified increased in the take or interference with water for traditional or cultural activities</p>
S96 Land owners may take water for stock or domestic purposes	<p>No identified change in water taken under these authorities.</p> <p>Potable water are supplied by local governments to towns, with the balance collecting domestic water supplies in rainwater tanks or taking water from a watercourse or groundwater system.</p> <p>Most of the land in the plan area is primarily used for low-density grazing. There is no noted increase in taking water for stock purposes.</p>
S97 Environmental authorities to take or interfere with overland flow	<p>No identified change in water taken or interfered with under these authorisations</p> <p>Notification for the construction of overland flow storages to satisfy an environmental authority or a development permit for carrying out an environmentally relevant activity is required under the Water Regulation. The department is not aware of a significant increase in the construction of overland flow dams for these purposes through the notification process. There has been a number of mining proposals that are either seeking approvals or have obtained approvals but have not yet commenced operations within the catchment and this could increase the amount of water taken through section 97 within the next term of the Water Plan. There has been no increase in the number of interferences with flow of water by impoundment where the interference was necessary to satisfy the requirements of an environmental authority. It is noted that the impacts of the take or interference are to be assessed as part of a grant of an environmental authority or development permit under the <i>Environmental Protection Act 1994</i>.</p>
S98 Resource activities that interfere with the flow of water by diversion of a watercourse	<p>No identified change to interference with watercourses under these authorisations.</p> <p>The impacts of interference by diversion are assessed through requirements of the Environmental Protection Act 1994. The department is not aware of an increase in the number of interferences by diversion for this purpose.</p> <p>Several large mining projects are proposed or have been approved recently in Galilee basin located in the Flinders River catchment and could lead to an increase in diversions.</p> <p>At least one mining project continues to manage diversions authorised under water licences before the commencement of this provision.</p>

Form of take	Catchment information sources
S99 Constructing authorities and water service providers	<p>No identified change in water taken under these authorisations.</p> <p>Construction Authorities: There are 12 current authorities with more than 104 locations.</p> <p>Water Service providers: No increase has been identified by the department with regards to water taken by service providers.</p> <p>There has been a noted increase in the number of notifications received since 2014 when this provision was introduced. However it is likely that some of this activity was due to these provisions replacing the need for water permits and also due to increased awareness of this provision through auditing and compliance activities.</p> <p>There has been increase in the interference with water with the completion of the raising of the Glenore weir.</p> <p>A new impoundment has been constructed on the Cloncurry River to help support tourism and to improve water security for Cloncurry.</p>

<b>Authorisations that may be limited by water planning instrument or regulation</b>	
s101 Authorisation that may be altered or limited by water planning instrument or regulation (e.g. moratorium notice)	<p>No identified change in water taken under these authorities.</p> <p>Volumes used under this authorisation are not known.</p> <p>Many properties do not have access to potable supplies and utilise rainwater, surface water or bores for prescribed activities. The land use is predominantly grazing with a scattering of feedlots and areas of minor irrigated development. Typically water for prescribed activities is used for mixing herbicides and pesticides, on farm road works and also building other infrastructure.</p> <p>Economic development through the growth of agricultural production and associated industries is expected across the Gulf catchments following the release of unallocated water in 2012 and 2015. 194 220 megalitres has been granted as new water licences as the result of both releases. A third release process for the Cloncurry and Gilbert River catchments commenced in 2017.</p> <p>It is possible that the use of water for prescribed activities will increase as these developments occur.</p>
s102 Authorisations under water plans or regulation	<p>Minor change in water taken under these authorities.</p> <p>The land use is predominantly grazing with a scattering of feedlots and areas of minor irrigated development in the Flinders and Gilbert catchments.</p> <p>Economic development through the growth of agricultural production and associated industries is expected across the Gulf catchments following the release of unallocated water in 2012 and 2015. 194 220 megalitres has been granted as new water licences as the result of both releases. A third release process for the Cloncurry and Gilbert River catchments commenced in 2017. It is possible that the use of water for authorisations under the Gulf water plan will increase as these developments occur.</p>
s103 Authorisations to take water for stock or domestic purposes may be limited (e.g. by plan or regulation)	<p>No identified change in water taken under these authorities.</p> <p>Potable water are supplied by local governments to towns, with the balance collecting domestic water supplies in rainwater tanks or taking water from a watercourse or groundwater system.</p> <p>Most of the land in the plan area is primarily used for low-density grazing. There is no noted increase in taking water for stock purposes.</p>

## Appendix 8: Environmental Flows Assessment Program and other research and monitoring

Many monitoring and research projects have been conducted in the Gulf water plan area during its implementation. In some cases these programs have been conducted across plan boundaries or have been based on areas that are influenced by water management, such as the Gulf fishery. These monitoring projects have been conducted by the Queensland Government and non-government science organisations. These include the Environmental Flows Assessment Program (EFAP), which implements projects focussed on characterising the flow requirements of ecological assets. EFAP is used by DNRME to assess the ecological performance of Water Plans (WPs) in meeting their stated ecological outcomes (McGregor et al. 2018). The purpose of EFAP is to:

- Confirm the critical flow requirements of selected ecological assets that represent the WP ecological outcomes;
- Determine if current flow management strategies and rules are providing these critical water requirements; and
- Determine the risk to selected ecological assets and evaluate if ecological outcomes are likely to be met under current flow management strategies.

The first step in EFAP is to select ecological assets with critical links to flow that represent the WP ecological outcomes. Ecological assets are defined as natural components of an ecosystem for which flow is critical. Ecological assets can encompass the full suite of flow-related ecosystem components including processes (e.g. longitudinal connectivity), functions (e.g. waterhole productivity), species (e.g. freshwater turtles), habitats (e.g. estuaries), geomorphology (e.g. channel variability/formation) and water quality (e.g. brackish conditions for prawn growth). General ecological research conducted in the plan area over the past ten years has been summarised in Table 9.

A brief summary of the ecological monitoring and research relevant to evaluating the effectiveness of the plan is provided here. Further details are provided in 'Review of Water Plan (Gulf) 2007 and Water Plan (Mitchell) 2007 Summary of Monitoring'<sup>3</sup>. A number of studies are summarised in this report that assess risk to the aquatic environment and specific plan ecological outcomes.

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<sup>3</sup> Search for title at: <http://qldgov.softlinkhosting.com.au/liberty/opac/search/reset.do>

**Table 9: State and federally funded research projects examining catchments of the Gulf and Mitchell water plans**

Project	Lead Organisation(s)	Timeline
<b>Northern Australia Water Futures Assessment (NAWFA)</b>	Department of Agriculture and Water Resources	2007–09
<b>NAWFA Ecological Programme</b>	Department of Agriculture and Water Resources	2009–12
<b>Northern Australia Land and Water Taskforce</b>	Office of Northern Australia	2010
<b>Northern Australia Sustainable Yields (NASY)</b>	CSIRO	2009
<b>North Queensland Irrigated Agriculture Strategy (NQIAS)</b>		2013
<b>Tropical Rivers and Coastal Knowledge (TRaCK)</b>	Collaboration of Universities and CSIRO	2005–current
<b>National Environmental Science Programme (NESP)</b>	Department of Environment and Energy	2015–21
<b>Northern Australia Water Resource Assessment (NAWRA)</b>	CSIRO	2016–June 18
<b>Tropical Rivers Inventory &amp; Assessment Project (TRIAP)</b>	Land & Water Australia	2006
<b>Northern Australia Irrigation Futures (NAIF)</b>	Land & Water Australia	2008
<b>National Groundwater Action Plan</b>	National Water Commission	2017
<b>National Groundwater Dependent Ecosystems (GDE) Atlas</b>	Bureau of Meteorology	2012–current
<b>Caring for Our Country High Conservation Value Aquatic Ecosystems</b>	Department Of Agriculture, Fisheries and Forestry and Department of Environment, Water, Heritage and Arts	2007
<b>Queensland Wetlands Program</b>	Queensland Government	2003–current
<b>Australian Natural Resources Atlas</b>	Department of the Environment, Water, Heritage and the Arts	2008–current
<b>Northern Australia Environmental Resources Hub</b>	National Environmental Science Programme	2011–15

Provided below is the summary of monitoring for the water plan. This is separated into a discussion on research and monitoring on individual ecological assets and more general monitoring programs.

### **Waterholes as refugia**

McJannet et al. (2013) targeted key aquatic refugia (persistent waterholes) within the Flinders and Gilbert catchments. A greater number of these refugia were located in the Gilbert catchment than were found in the Flinders, largely because the Gilbert has more persistent streamflow, but also because it has a wider channel. Waltham et al. (2013) considered water clarity to be a significant factor governing productivity in riverine waters, with quantitative modelling indicating that agricultural development has the potential to elevate sediment (turbidity), nutrient and pesticide inputs into these catchments.

Wallace et al. (2017) found that diurnal oscillations in water temperature in waterholes increased markedly as depth decreased. However waterholes retaining more than about 0.5m of water throughout the dry season provided thermally suitable refugia for fish especially if

water was turbid, as this lowered the risk of exposure to thermal extremes at the bottom of the waterhole. DERM (2011) monitored waterhole persistence in seven waterholes in each of the Flinders and Mitchell rivers. In the Flinders River waterholes, for five of the waterholes that were later used in the persistence modelling, the modelled persistence time varied between 380 and 640 days. It is thought that a number of the waterholes experienced high seepage rates. Light attenuation levels in waterholes were significantly restricted in many of the Flinders waterholes and it is thought that this has a significant impact on potential productivity.

Waterhole productivity is driven by water clarity, with the waterholes in the Flinders River generally more turbid than those in the Gilbert. Water temperature is also influenced by water clarity, and this also influences the level of dissolved oxygen available.

### **Perennial flow and riffles**

Dry season flow in the Gregory River and Lawn Hill Creek is fed by limestone springs in the Camooweal Dolostone and Thornton Limestone (CSIRO 2009). This is due to the strong groundwater influence of the largest karst terrain in the country, the Barkly Karst. Inland wetlands of the Gregory catchment are part of the Thornton Aggregation, a habitat frequented by over half of Queensland's migratory bird populations. Perennial flow in the Gregory River is essential to the maintenance of these wetlands, with discharge also critical to offshore seagrass beds and populations of dugong and prawns. CSIRO (2009) reported that a time lag of two years occurs between peak annual rainfall and peak dry season streamflow at gauge 912101A located at Gregory Downs, suggesting significant inertia and hence storage capacity within the surrounding aquifer.

### **Migratory aquatic biota**

Peverell (2009) showed that juvenile Largetooth Sawfish (*Pristis microdon*) migrate up into freshwater with elevated flows and move back downstream with the reduction back to baseflows. The adult fish tend to inhabit estuarine and marine environments. These results were obtained from tag and release, acoustic tracking and laser ablation of vertebrae.

### **Floodplain wetlands**

Floodplain wetlands are linked to several ecological outcomes in the water plans, particularly the Southern Gulf Aggregation, Southeast Karumba Plain Aggregation, Mitchell River Fan Aggregation and the Southeast Karumba Plain Aggregation.

CSIRO completed an assessment aimed to map and model flooding in the mid to lower reaches of the Flinders and in the lower reaches of the Gilbert catchments (Dutta et al. 2013). The findings indicate that during flooding events, the area of inundation of the Gilbert River floodplain would be reduced under potential water development scenarios and from the dryer future climate scenarios. This would place floodplain wetlands and floodplain vegetation at greater risk, with risk being highest during lower magnitude floods, such as the 2001 event.



## **Floodplain energy subsidy to riverine foodwebs**

Jardine et al. (2012a) studied the stable isotope signatures of stream biota in three catchments of Australia's wet-dry tropics. They found that the carbon isotope ratios of benthic invertebrates were tightly coupled to those of stream biofilm, suggesting that local resources are readily used as food. Floodplain food sources contributed over 30% of the diet of barramundi collected in the recreational fishery of the Mitchell delta during the dry season (Jardine et al. 2012b).

## **Q-catchments program (formerly Stream and Estuary Assessment Program)**

Q-catchments is a Queensland Government monitoring program managed by the Department of Environment and Science (DES). The program collects data to report on the ecological condition of Queensland's aquatic ecosystems with particular focus on riverine systems. Primarily, Q-catchments identifies and ranks threats to Queensland's aquatic ecosystems to improve understanding of the effect threats have on ecosystem condition.

Clifford et al. (2018) undertook an ecological risk assessment and threat prioritisation of riverine ecosystems in Queensland's Gulf catchments. The threat identification and prioritisation process resulted in a list of priority threats for the Gulf catchments. Of the threats assessed, only introduced riparian flora and fauna were considered high risk to the whole of the Gulf. Several threats ranked as moderate or low risk for the Gulf in its entirety were scored as high risk in individual catchments such as salinity in the Flinders, Norman and Gilbert catchments and acid soil runoff in the Settlement and Leichhardt catchments.

## **Department of Natural Resources, Mines and Energy's surface water level network**

The department manages, operates and maintains approximately 400 stream gauging stations across Queensland. There are 30 active gauge stations located within the plan area (<https://water-monitoring.information.qld.gov.au/host.htm>). Since 2007, there has been four new gauging stations constructed in the Flinders and Gilbert catchments to provide additional streamflow information to support water management into the future.

There is a specific ecological outcome in the water plan relating to providing perennial flow in the Gregory River. Flow in the Gregory River has been consistently above 100 ML/d at both stream measurement sites throughout the life of the plan.

Streamflow monitoring at the Gilbert River at Rockfields gauge (GS917001D) shows that although there are a number of times that stream flows have stopped, the maximum period of no flow was 216 days in 2014.

## **Summary**

Further detail of monitoring conducted within the plan area and its relevance to the water plan ecological outcomes can be found in the 'Review of Water Plan (Gulf) 2007 and Water Plan (Mitchell) 2007 Summary of Monitoring'<sup>4</sup>.

A number of studies are also currently underway that will be reporting results in 2018 or later that may assist in further understanding linkages between the ecosystems and river flows. For example, results from the NAWRA program will be available after June 2018 that may provide additional information to further manage water within the plan area. The NESP program that commenced in 2015 will continue to 2021 and aims to deliver research on topics such links between Gulf Rivers and coastal productivity. Much of this targeted research currently

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<sup>4</sup> Search for title at: <http://qldgov.softlinkhosting.com.au/liberty/opac/search/reset.do>

underway will be available for providing evidence-based science for future water planning processes.

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