

Minister's Performance Assessment Report

Water Plan (Mary Basin) 2006

April 2019

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Minister's foreword

I am pleased to publish this report which provides an overview of the implementation of the Water Plan (Mary Basin) 2006 (the plan) and summarises the findings of the assessments undertaken for the last five years. The plan supports urban water supply and a variety of industries including significant agricultural production, a growing tourism industry and fisheries.

In 2016 I postponed the expiry of the plan for a five-year period to allow the Department of Natural Resources, Mines and Energy (DNRME) time to complete technical assessments and properly consider the issues and options for the plan.

Implementation of the plan has been effective in achieving many of the plan outcomes. Implementation has included the regulation of the Cooloola Sandmass subartesian area, the conversion of 590 supplemented water entitlements to tradeable water allocations, and the specification of environmental flow rules for water infrastructure.

However, risk assessments undertaken to support this five-year review indicate that a number of issues need to be addressed to ensure that the plan can continue to provide for future urban needs and agricultural expansion, facilitate more flexible arrangements for water users and ensure the protection of threatened species such as the Mary River turtle, Mary River cod and the Queensland lungfish.

The next review of the plan and development of the replacement plan will take into account these considerations.

In the meantime, I encourage anyone with an interest in the management of water resources in the plan area to read this report.

Hon Dr Anthony Lynham MP

Minister for Natural Resources, Mines and Energy

Executive summary

Under the *Water Act 2000* (the Water Act), a report on each water plan must be prepared at least every five years to assess the effectiveness of the plan and its implementation. The Water Regulation 2016 (Water Regulation) states the matters to be addressed. The impacts of climate change and climate variation have also been considered and are presented in this report.

This report provides an assessment of the performance of the plan against these matters. **Table 1** provides a concise summary of the assessment.

Existing information indicates the implementation of the plan has been effective in achieving many of the plan outcomes. However, a number of issues have been identified including:

- changes in the future projected demand for unallocated water
- limited ability of the plan to provide for future agricultural expansion, including new large-scale projects and individual property-level enterprises
- lack of flexibility of the plan to provide for changes to water sharing and environmental management rules
- climate impacts on water security due to the Millennium drought period not captured in the current hydrologic model
- new science collected since 2006 that needs to be incorporated into the plan, including updated information on the water needs of threatened species (Mary River turtle, Mary River cod and Queensland lungfish)
- the need for further consultation with water users and Aboriginal peoples and Torres Strait Islanders to better understand current and emerging cultural water needs in the plan area.

The plan is due to expire on 1 September 2021. The next review of the plan and development of the replacement plan will take into account these considerations.

Table 1 – Summary of performance assessment of the plan

Matters to be addressed	Comment	Section of Report	Status
Effectiveness of the plan in advancing the sustainable management of Queensland's water resources.	Social, environmental and economic assessments indicate that the plan is achieving many of the purposes of the Water Act. However, looking forward, a number of issues have emerged during the life of the plan that must be addressed for the plan to continue to advance the sustainable management of water.	See Section 3	
Effectiveness of the implementation of the plan in achieving the plan outcomes.	Implementation of the plan has been effective in achieving many of the plan outcomes. Implementation has included: <ul style="list-style-type: none"> the regulation of the Cooloola Sandmass subartesian area the conversion of supplemented water entitlements to tradeable water allocations environmental flow rules for water infrastructure. However there are still a number of actions that have not been implemented. Unsupplemented entitlements have not yet been converted to water allocations which has limited the effectiveness of the plan to deliver flexible options for users to secure additional water and to promote water efficiency. There was insufficient information available to assess the outcome relating to water-related cultural values in the plan area.	See Section 4	
Summary of water usage and entitlements, including those taken or interfered with under statutory authorisations.	Information on water use and authorisations in the plan area has been reported upon and no issues were identified.	See Section 5	
Summary of research and monitoring findings.	Monitoring of various types has been conducted over the life of the plan. This includes ecological, hydrological as well as assessments of overland flow and aquifer usage. It has been identified that new science collected since 2006 on the flow requirements of ecosystems and threatened species needs to be considered as part of the plan review. The underpinning hydrologic model also needs to be updated to reflect recent climatic data including dry periods in the Millennium drought.	See Section 6	
Summary of amendments to the plan since its commencement.	Since the plan implementation a number of consequential amendments have been made to reflect administrative changes relating to the Water Act, and to improve the effectiveness of the plan.	See Section 7	
Summary of identified risks to the plan outcomes.	A number of potential risks to the plan outcomes were identified. Threats to plan outcomes include the inability of the current plan to provide for future agricultural expansion, changes in the future projected demand for unallocated water, climate change impacts to water security and flexibility of the plan to provide for changes to water sharing and environmental management rules. A risk assessment identified some high and medium risks to the outcomes that are not currently being addressed by existing plan strategies. Of the 23 general outcomes for the water plan, six plan outcomes were classed as being at high risk and one classed as being at medium risk. Furthermore, three plan outcomes were unable to be assessed because of insufficient information. Two of these outcomes that were not able to be assessed relate to cultural use of water in the plan area. 13 plan outcomes were classed as being low-risk.	See Section 8 and 9	
Summary of non-compliances under a water entitlement or other authorisation in the plan area.	There have been only minor non-compliances relating to water entitlements and other authorisations in the plan area recorded. These have been addressed in accordance with the normal water business practices.	See Section 10	
Overall status and recommendation for plan	The next Water Plan review to incorporate new science and address the risks and issues identified above.		
	Completed	On track / no issues	Some minor issues
	Some major issues	Not achieved	Insufficient information available

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1. Purpose of the report

The *Water Act 2000* (section 49) requires the Minister to prepare reports for each water plan. This is 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 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 including—

- a) whether the plan is advancing the sustainable management of Queensland's water resources
- b) an assessment of the effectiveness of the implementation of the plan in achieving the plan's outcomes
- c) information on water use and authorisations in the plan area, including—
 - i. water entitlements
 - ii. water taken or interfered with under statutory authorisations
- d) a summary of the findings of research and monitoring for the plan
- e) any identified risks to the plan's outcomes
- f) what amendments, if any, have been made to the plan since its commencement
- g) any noncompliance under a water entitlement or other authorisation in the plan area.

This report provides an overview of the above matters and evaluates the implementation of the water plan to date, with an emphasis on progress since the previous report was prepared in 2013.

2. Plan area

The plan area lies on the Fraser Coast in South East Queensland (SEQ) and includes the Mary, Burrum, Noosa, Maroochy and Mooloolah river catchments. The plan supports a variety of industries including significant agricultural production, a growing tourism industry and fisheries. The plan area contains six water supply schemes supplying significant volumes of water for irrigation and urban water supply needs—these schemes are the Baroon Pocket, Cedar Pocket, Lower Mary River, Mary Valley, Teddington Weir and Wide Bay water supply schemes. The plan applies to surface water, as well as underground water in the Cooloola Sandmass subartesian area (**Figure 1**).

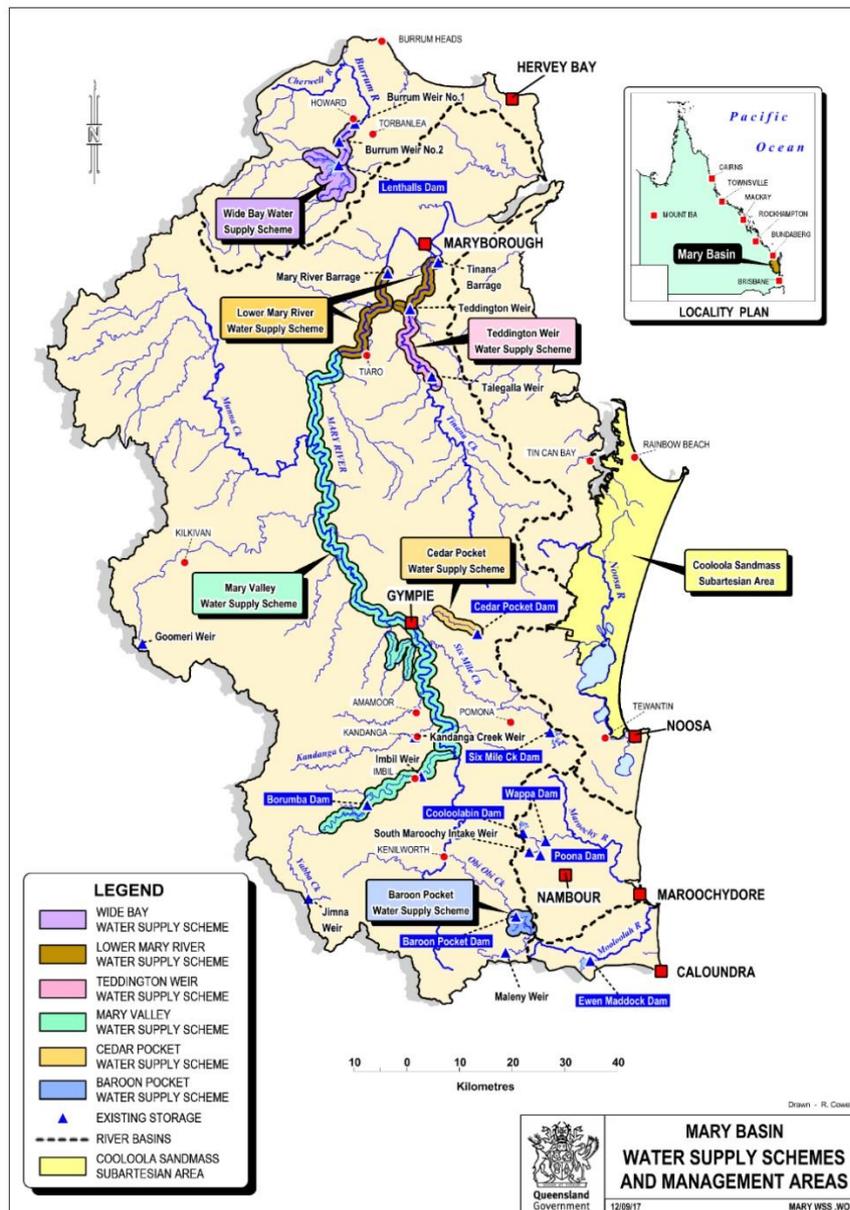


Figure 1 – Water supply schemes and management areas within the plan area

3. How the plan advances the sustainable management of Queensland's water resources

This section discusses how the plan advances sustainable management of Queensland's water resources by incorporating the principles of ecologically sustainable development. Each heading reflects the different aspects of sustainable management identified in section 2(2) of the Water Act.

The plan establishes a system for the allocation and use of water resources in the plan area for the economic, physical and social wellbeing of the people of Queensland. The plan also acknowledges the natural state of watercourses within the plan area have changed because of water infrastructure, flow supplementation and the taking of water.

In particular the plan provides outcomes and strategies to advance the sustainable management of ecosystems, water quality, water-dependent ecological processes and biological diversity associated with watercourses, lakes, springs, aquifers and other natural water systems. For a more detailed summary of the linkages between plan outcomes, strategies and rules see **Appendix A: Assessment of plan outcomes**.

3.1 Ecologically sustainable development

The plan was developed based on long-term hydrological models to better understand patterns of water use, availability and security. The plan includes outcomes that aim to encourage the efficient use of water, whilst protecting the availability of water for all users across all supply schemes. The management of water within the water supply schemes then utilises rules to implement the plan outcomes to ensure the security of supply for towns and other users, as well as providing environmental flows to maintain the ecological integrity of the river systems. Specific ecological outcomes for particular areas, ecological assets and subartesian water are also provided in the plan.

Threats to aquatic systems from stream flow changes were identified and managed using the best available information at the time of plan commencement. Scientific certainty of water management rules has been improved through targeted monitoring and research. For example, the lower Obi Creek has been rated as of high ecological value and the plan includes strategies that provide environmental flow releases to mimic a more natural stream flow regime to maintain biological diversity and ecological integrity of this system. Monitoring has highlighted that there are also additional changes to storage operating rules that could improve environmental flow downstream in Obi Obi Creek in the future.

To address risk of environmental damage, mitigation measures have been introduced, while monitoring is used to assess the success of these actions. For example, operating rules have been introduced for Lenthalls Dam to limit flooding of an important Indigenous site, the Wongi Waterholes, to maintain its ecological health. Water quality and level monitoring has been used to understand compliance with the rules and success of implementation.

Through understanding social, economic and ecological needs of water, the plan has provided certainty of water entitlements to boost economic growth, whilst enhancing environmental protection by increasing environmental flows provisions in key areas.

3.2 Allocation and use of water resources for the economic, physical and social well-being of the people of Queensland

The plan provides a framework for the allocation and use of water resources in the plan area for the economic, physical and social wellbeing of the people of Queensland. In addition, the plan supports sustainable and secure water supply and demand management for the SEQ region.

The plan establishes water allocations that provide certainty for water users to promote economic development. The plan also establishes a framework to ensure security for town water supplies and essential services to ensure the well-being of Queenslanders. The security of town water supplies are managed through operational rules.

The plan includes an outcome to provide consistency with regional planning. Water within the plan area is now integrated with the SEQ Water Grid that improves the security of regional water supplies.

However, the plan currently limits future agricultural expansion, including new large-scale projects and individual property-level enterprises, for example in the Maryborough area. Section 9 of this report provides more information regarding this matter.

3.3 Sustain the health of ecosystems

The plan contains ecological outcomes for a number of key catchments across the plan area. These ecological outcomes aim to support the ongoing protection of ecological assets and their habitats.

Implementation of these outcomes are provided through Environmental Flow Objectives (EFOs), environmental management strategies and conditions about the operation of water infrastructure specified in Resource Operations Licences (ROLs) and Operations Manuals.

The plan also requires consideration of the health of the ecosystems when making decisions under the plan, with particular provisions requiring consideration be given to the environmental values of a waterhole or lake for example.

However there has been new science collected since 2006 that needs incorporation into the plan, including updated information on the water needs of threatened species (Mary River turtle, Mary River cod and Queensland lungfish).

3.4 Recognise the interests of Aboriginal peoples and Torres Strait Islanders

The plan contains a general outcome to allow cultural use of water by the Traditional Owners of the plan area and a specific outcome relating to Cooloola Sandmass. There is also a specific ecological outcome that relates to minimising change to the flooding regime of the Wongi Waterholes, in recognition of the connection the Traditional Owners of the area have to the waterholes.

The recent amendment to the Water Act recognises the importance of water resources to Aboriginal peoples and Torres Strait Islanders, including their strong spiritual connection to water.

To better understand cultural water needs in the plan area, it has been identified that further engagement with Aboriginal peoples and Torres Strait Islanders is needed. To support the preparation of the plan review, DNRME is proposing to:

- re-engage with Aboriginal peoples and Torres Strait Islanders, continue the conversation and undertake further engagement
- improve understanding of cultural values and uses of water

- record the engagement process
- incorporate this information within a reviewed water plan.

3.5 Enable water resources to be obtained through fair, transparent and orderly processes

The plan provides reserves of unallocated water for general, strategic and town water supplies. The plan outcomes together with the Water Regulation provide the framework for fair and transparent release of this reserved water.

The plan also provides the foundation for establishing a water market for tradeable water allocations, with water trading implemented in water supply scheme areas.

3.6 Build confidence regarding availability, security and value of water entitlements and authorisations

The plan states multiple outcomes which aim to provide, protect and improve access to available water resources. The plan sets out Water Allocation Security Objectives (WASOs) for surface water which protect the probability of being able to obtain water under a water allocation.

In addition, the plan does not allow a decision on a surface water entitlement that would increase the average volume of water available to be taken in the plan area. This provision ensures the continued use of existing water entitlements.

However, the plan lacks flexibility to accommodate changing demands for existing entitlements in some areas, such as in the Maryborough area. Section 9 of this report provides more detail regarding this matter.

3.7 Promote efficient use of water through water markets, allocation, risk assessments and community education

The plan has a specific outcome which encourages the efficient use of water. The foundation for an effective and efficient water market has been established by the plan by providing a tradeable market for water allocations. The operational rules by which the market operates is governed by the ROP¹.

3.8 Facilitate community involvement in planning for the management and allocation of water

Community involvement is ensured through consultation processes for water planning initiatives. Community consultation including public submissions were integral to the development of the ROP in 2011, as well as the subsequent postponement of the plan expiry in 2016.

¹ 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.

4. Assessment of the effectiveness of the implementation of the plan in achieving the plan's outcomes

DNRME monitors the implementation of each plan to make sure it is achieving its outcomes. The plan's outcomes were effectively implemented by regulation of the take of water in the Cooloola Sandmass subartesian area, the conversion of supplemented water entitlements to tradeable water allocations with associated water sharing rules and water allocation change rules, and ongoing decisions to limit the granting of additional water entitlements to take water.

Specific ecological outcomes in the plan were implemented by the inclusion of environmental management strategies for water supply infrastructure requiring environmental flow releases and waterhole management. Conversion of unsupplemented water entitlements to tradeable volumetric entitlements and the release of unallocated water reserves are items that remain to be implemented and can be done under a water plan review process.

The plan's outcomes were implemented by the release of the ROP in September 2011, as well as other specific actions required by the plan. Key achievements in implementing the plan include:

- In 2011, the conversion of 590 supplemented water entitlements to tradeable water allocations in the six water supply schemes in the plan area, and implementation of associated seasonal and permanent water trading provisions. Section 5 of this report provides more detail of the scope of water allocation trading in the plan area
- The granting of ROLs for supplemented water supply schemes detailing the water sharing and infrastructure operating rules to ensure a reliable and secure water supply
- The splitting of a water supply scheme to produce two new water supply schemes (Lower Mary and Teddington water supply schemes), and the provision of water trading between those schemes to improve reliability of entitlements
- The granting of water licences to replace existing town water supply authorisations for Six Mile Creek Dam, Ewen Maddock Dam, Wappa Dam, Cooloolabin Dam and Obi Obi Creek at Maleny, the Mary River at Kenilworth, and various locations in the Gympie Regional Council area
- The inclusion of statutory environmental flow release requirements for Baroon Pocket Dam, Ewen Maddock Dam, Lenthalls Dam and Six Mile Creek Dam; and rules to manage water levels in the Wongi Waterholes. Section 6 of this report provides more detail of the effectiveness of these environmental management rules
- The introduction of regulatory provisions for the Cooloola Sandmass subartesian area, including the granting of water licences to authorise the existing take of subartesian water, and implementation of management provisions to limit further take of water, encourage efficient use of water, and prevent seawater intrusion
- Implementing specific plan provisions to limit the granting of additional entitlements to take water, to ensure that the long-term interests of existing entitlement holders and the environment are protected.

Appendix A: Assessment of plan outcomes provides a comprehensive assessment of the effectiveness of the implementation of the plan in achieving the plan's outcomes.

Existing information indicates the implementation of the plan has been effective in achieving many of the plan outcomes. However, a number of potential risks and emerging issues have been identified. These are described in sections 8 and 9 of this report.

5. Information on water use and authorisations in the plan area

Water users have access to water, taken under a water entitlement (e.g. water allocation, water licence) or under a statutory authorisation provided by the Water Act (e.g. low-risk or prescribed activities such as stock and domestic use). An announced allocation is a mechanism to equitably share the water available in a system in a particular water year, by limiting the volume of water that can be taken under a water entitlement in a specific water year. Unallocated water is reserved and can be made available for future use with consideration to protecting existing entitlements and the environment. Water trading within specific water markets provides certainty and flexibility to the water industry, facilitating a more efficient water use and improved business environment.

General information about water trading and pricing can be found on the Business Queensland website: www.business.qld.gov.au/industries/mining-energy-water/water/water-markets.

5.1 Information on water use under water entitlements

Entitlements within the plan area (**Appendix B, Table 6**) are spread across twenty sub-catchment areas, and consist of supplemented water allocations and water licences. There are no unsupplemented water allocations in the plan area. Of the 590 supplemented water allocations in the plan area, the majority are in the Lower Mary (219) and Mary Valley (317) water supply schemes.

DNRME is reviewing the current non-urban water meter policy and standard as part of the Queensland Government's response to the Independent Audit of Queensland Non-urban Water Measurement and Compliance which was released in June 2018. The review is seeking to address a number of key matters raised by the audit including the effectiveness of the meter validation process, the need for meter accuracy testing and a maintenance oversight regime. DNRME will provide recommendations to government in 2019 in relation to a new water measurement policy and standard which will support improvements or enhancements to water measurement, including metering across Queensland. DNRME will adopt a risk based approach to implementation of a new water measurement policy. Metering of water entitlements is discussed in section 5.3.

5.1.1 Announced allocation

Announced allocation provisions apply to water allocations in the supplemented water supply schemes in the plan area. Announced allocations for both high priority and medium priority water, where available, in all of the water supply schemes have been set at 100% at the commencement of each water year for the past six years (**Appendix B, Table 7**). Additional considerations for announced allocation decisions are included for relevant schemes below.

5.1.1.1 Baroon Pocket water supply scheme (BPWSS)

There is no requirement to calculate announced allocations in this water supply scheme as there are only two supplemented water allocations in the scheme totalling 36,500 megalitres (ML). Both are high priority allocations and held by the Queensland Bulk Water Supply Authority (Seqwater).

5.1.1.2 Cedar Pocket water supply scheme (CPWSS)

Water allocation holders in this water supply scheme can take up to two times the nominal volume specified on the water allocation in those water years where Cedar Pocket Dam overflows.

5.1.1.3 Lower Mary River water supply scheme (LMRWSS)

The total entitlement volume in this scheme varies for each water year due to trading between Teddington Weir and the Mary Barrage driven by short-term demands.

5.1.1.4 Teddington Weir water supply scheme (TWWSS)

This water supply scheme has a rule that prohibits the take of medium priority water when the level in Teddington Weir is equal to, or less than, 7.7m AHD. This rule was enforced during the water years 2013/14 and 2016/17. The total entitlement volume in this scheme varies for each water year due to trading between Teddington Weir and the Mary Barrage driven by short-term demands.

5.1.2 Entitlements granted from unallocated water reserves

The plan provides reserves of unallocated water which are composed of general, strategic and town water supply reserves. No water has been granted from the general or strategic reserve available in the plan area. Only the town water supply reserve for Six Mile Creek has been accessed thus-far, by the granting of a water licence with a nominal volume of 1500 ML/annum to Seqwater for urban water supply purpose.

5.1.3 Water trading

In the plan area, water trading is only available for water allocations in supplemented water supply schemes and is authorised by ROLs. ROL holders may also consent to the seasonal assignment of water held under a water allocation, otherwise known as temporary transfer.

Appendix B (Table 8 and Table 9) shows the number and volume of permanent water allocation trades and seasonal water assignments in the plan area for each of the water years since water trading was introduced in September 2011. No seasonal assignments of water allocations were made in the Baroon Pocket water supply scheme for this period.

5.1.4 Water use for unsupplemented water licences

There is limited available information on unsupplemented water use in the plan area apart from in the metered water entitlement areas as described in Section 5.3. Overall, current water use compared to what is authorised to be taken is estimated to be 50% of the unsupplemented water entitlements in the plan area. However, patterns of active use vary considerably in different parts of the plan area.

5.2 Water taken or interfered with under statutory authorisations

The Water Act and Water Regulation provide for statutory authorisations for the taking of water for certain purposes without the need for a water entitlement. Such take is considered to pose a low-risk of detrimentally affecting water users or the environment. Examples of such take in the plan area include take of water for stock and domestic purposes by riparian landowners, take of overland flow (OLF) water, taking of underground water outside of the Cooloola Sandmass subartesian area, and take of water by entities such as regional councils and the Department of Transport and Main Roads for road construction.

The take for road construction purposes by prescribed entities is estimated to equate to no more than 200 ML/annum across the plan area. Such take is monitored and assessed by DNRME, and conditions are imposed to manage any possible detrimental effects. The take of water under statutory authorisations, with the exception of take for road construction purposes by prescribed entities, is typically not quantified, making an accurate quantitative assessment difficult.

In general, based on DNRME's knowledge, it is considered that take under a statutory authorisation in the plan area is not detrimentally affecting existing water users' access to water or the environment. In addition, detailed assessments of the trends in take of subartesian water and OLF water have also been undertaken recently to inform this report and future planning priorities.

5.3 Metering of water entitlements

All supplemented entitlements are metered.

Most of the approximately 1000 unsupplemented water entitlements in the plan area are not metered. However there are water licences in some unsupplemented areas of the plan that are metered. These are in Tinana, Six Mile, Widgee, and Wide Bay Creek sub-catchments and the Cooloola Sandmass subartesian area. DNRME is currently completing a review of the non-urban water metering policy as part of the response to the Independent Audit of non-urban water measurement and compliance.

6. Summary of research and monitoring findings for the water plan

The water planning framework is supported by water monitoring activities that include water quantity and quality of surface freshwater and underground water systems across Queensland. Together with targeted ecological monitoring for water plans, this information is vital for continued improvement of water planning.

The Environmental Flows Assessment Program (EFAP) undertakes ecological monitoring to assess the ecological performance of each water plan in meeting its stated ecological outcomes. Ecological assets with critical links to flow that represent the plan ecological outcomes, and the various aspects of the flow regime, are selected as indicators of the broader ecosystem for monitoring.

DNRME manages, operates and maintains approximately 400 stream gauging stations across Queensland, 15 of which are located in the plan area. Streamflow measurements are an integral part of producing volumetric data at gauging stations, and measurements are taken throughout a full range of low and high flow conditions to enable derivation of accurate streamflow volumes. DNRME also manages, operates and maintains approximately 4300 underground water monitoring bores across Queensland. In the plan area there are 31 monitoring bores that are currently monitored. Water monitoring data can be accessed at: water-monitoring.information.qld.gov.au/host.htm.

DNRME has conducted a review of the level of underground water resource development within unmanaged aquifers of the plan area. This information builds on previous DNRME studies of underground water resources in the plan area and incorporates current data from DNRME databases.

DNRME has conducted a review of overland flow (OLF) development in the plan. OLF is water that flows over land after rainfall, or rises to the surface naturally from under the ground. It is an important source of water in rural communities and provides water to watercourses where it sustains critical environmental processes. OLF is captured using water storage infrastructure, typically dams located in gullies, although it is not currently regulated under the plan.

Finally, an assessment of current environmental management rules in the ROP is presented as a prelude to the review of the plan. Rules assessed included: low flow and high flow release strategies; nominal operating levels; releases for downstream landholders; operating rules for the Wongi Waterholes; and release rules for water licences (Ewen Maddock Dam and Six Mile Creek Dam).

6.1 Summary of ecological monitoring

Many monitoring and research projects have been conducted in the plan area since plan commencement. The monitoring projects have been conducted by the Queensland Government and non-government science organisations. These include 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 in meeting their stated ecological outcomes (McGregor et al. 2018).

The purpose of the program is to:

- confirm the critical flow requirements of selected ecological assets that represent the plan's ecological outcomes
- determine if current flow management strategies and rules are providing these critical water requirements
- determine the risk from water resource development to selected ecological assets and evaluate if ecological outcomes are likely to be met under current flow management strategies
- determine potential mitigation strategies to address identified risks from water resource development.

Ecological assets are defined as natural components of an ecosystem for which flow is critical. These 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. fish), habitats (e.g. estuaries), geomorphology (e.g. channel variability/formation) and water quality (e.g. salinity).

Monitoring and information has been collated on a range of assets in the plan area including species and ecological functions over the life of the plan. These assets include waterholes, Mary River turtle, Mary River cod, Australian lungfish, and estuaries. Projects have been designed to identify critical flow requirements of assets and address identified knowledge gaps in the scientific literature.

A summary of monitoring associated with selected ecological assets is presented in **Appendix C: Monitoring results for selected ecological assets.**

6.2 Water monitoring

The stream gauging station network is operated by trained hydrographic staff within a quality management framework under International Organisation for Standardisation ISO 9001:2015 accreditation. Measurements taken at stream gauging stations show that the plan area is characterised by highly-variable river flows both within and between years. Annual rainfall varies from 2000 mm in the ranges around Maleny and Mapleton at the southern headwaters of the catchment, 1200 mm near Maryborough in the north, and 880 mm at Kilkivan in the drier, western parts of the catchment.

Discharge data from selected gauging stations within the catchment demonstrating the variability in discharge is presented in **Appendix D, Table 10.**

The highest discharges recorded since commencement of the water plan occurred during the 2010/2011 and 2013 wet seasons. The 2006/2007 period was very dry with very low flows recorded at all sites, particularly the western sub-catchments including:

- Wide Bay Creek at Brooyar (138002C)—recording an annual mean daily discharge of 0.0 ML/day
- Munna Creek at Marodian (138004B)—recording an annual mean daily discharge of 0.2 ML/day.

The maximum instantaneous discharge recorded at the most downstream gauging station, 138014A Mary River at Home Park, over the life of the plan, was in January 2013 with 872 562 ML/day, while in February 2017 the river stopped flowing altogether.

Water monitoring data can be access at: water-monitoring.information.qld.gov.au.

6.3 Assessment of low–risk aquifers

The majority of aquifer formations in the plan area are largely discontinuous, span multiple sub-catchments and extend beyond the boundaries of the plan area. Alluvial aquifers within the plan area are generally narrow, shallow and weakly connected longitudinally with limited number of bores sharing the same resource. For those reasons, it is considered that there is a low-risk associated with take of water from the aquifers in the plan area, with the exception of the Cooloola Sandmass subartesian area, which is regulated under the plan.

Most of the bores identified in the low-risk aquifers in the plan area were associated with peri-urban areas (1333 bores) and potential extractive use (271 bores). Potential extractive bores identified are those that would require an entitlement to take water if the take is regulated (e.g. irrigation, stock intensive, and commercial). Water quality (measured by electrical conductivity) in the aquifers is highly variable.

Given the high reliability of surface water throughout much of the plan area, it is considered that underground water use is supplementary to other sources of water in many instances. An assessment of the annual growth in construction of bores (including replacements) since the commencement of the plan found that the growth has been stable, averaging 6% per annum.

The low-risk aquifers within the plan area do not provide significant volumes of good quality water and hence there is a low number of bores within the plan area. Development of bores during the life of the plan has been primarily in peri-urban areas within the Sunshine Coast sub-catchments. There are no known issues with underground water supplies, quality or surface water interaction based on trend analysis. Likewise it is thought that there is limited impact to identified groundwater dependant ecosystems. More detail on the low-risk underground water resources in the plan area can be found in the Mary Basin Water Plan Review: Unmanaged Groundwater Report (DNRME 2018).²

6.4 Assessment of overland flow (OLF) development

During preparation of the plan, low levels of OLF development were identified in the plan area, and risk was low that further OLF development would impact on the plan’s objectives during the life of the plan. Investigations undertaken during preparation of the plan recommended that OLF development trends be monitored through the life of the plan.

High resolution satellite imagery and improved Geographical Information Systems (GIS) methods allowed detailed analysis of current OLF storage development, storage development trends, and the determination of areas available in the plan area for future development.

² [DNRME library - Mary Basin water planning documents at—tinyurl.com/yatqwb63](http://DNRME.library-MaryBasinwaterplanningdocumentsat-tinyurl.com/yatqwb63)

This analysis demonstrated minimal increase in OLF development in the plan area between 2006 and 2014/15. The number of storages increased by 1.4% per annum with an estimated increase in storage volume of 1.2% per annum during this period.

Modelled water use and flow data used in hydrological modelling for the existing plan was used to assess the potential impacts of increased OLF development on surface water systems through interception of rainfall run-off that contributes to streamflow. Results of this assessment show that OLF storages (0.5 ML capacity and greater) have the maximum capacity to absorb up to approximately 2.1% of mean annual flow in the plan area.

Assessment of the size and volume of storages highlights that a majority are less than 5 ML in capacity. This indicates that OLF development in the plan area is primarily for stock and domestic purposes. However, the data also shows that storages of 5 ML and greater represent the majority of the volume (approximately 70%) of OLF take.

Historical increases in rates of OLF development may provide an indication of future rates of development. Based on past increases in the development of storages 5 ML and greater, there is the potential for the volume of take to increase from around 53,500 ML in 2015 to around 63,500 ML by 2030, or an increase from 1.5% to 1.8% of mean annual flow if that trend continues.

More detail on the level of OLF development in the plan area can be found in the Mary Basin Water Plan Review: Overland Flow Report (2018).³

6.5 Summary of existing environmental management rules

Final recommendations for specific rules and monitoring requirements will be made following completion of an ecological risk assessment for selected assets and review of ecological outcomes at the time of plan review. A summary of the implementation and effectiveness of existing rules follows.

More detail is provided in the Review of Water Plan (Mary Basin) 2006 and Resource Operations Plan: Assessment of Existing Environmental Management Rules report (DNRME 2018).⁴

6.5.1 Baroon Pocket water supply scheme

The water level in Baroon Pocket Dam remained above the minimum operating level since the ROP was implemented in 2011, therefore daily low flow releases were made based on inflows recorded at the Gardeners Falls gauging station. In general, releases met ROP requirements on the majority of days across the reporting period, with the exception of one period (01/02/2014–28/02/2014) where no releases were made due to instrumentation failure. Releases made from Baroon Pocket Dam achieved their intent of supporting downstream environmental processes.

Releases provided connectivity for turtle movements between waterholes. When supplemented with natural flow events, these releases created conditions to allow for movement of larger bodied fish (such as Mary River cod and Australian lungfish), which require greater depths at riffles between habitats. The current low flow release rule represents a significant improvement on the low flow requirements originally specified in the interim resource operation licence. Low flow environmental releases are also sometimes supplemented by releases made for downstream landholders, fulfilling requests made by the Water Advisory Group.

³ [DNRME library - Mary Basin water planning documents at—tinyurl.com/yatgwb63](https://www.tinyurl.com/yatgwb63)

⁴ [DNRME library - Mary Basin water planning documents at—tinyurl.com/yatgwb63](https://www.tinyurl.com/yatgwb63)

6.5.2 Wide Bay water supply scheme

Releases from Lenthalls Dam have generally maintained the Nominal Operating Level (NOL) at Burrum Weir No.2 between October and April. The water level at Burrum Weir No.1 periodically falls below the NOL, but releases have been made from Lenthalls Dam in accordance with the interim program—and later in the ROP—to maintain the NOL. Maintaining the downstream weirs at close to full supply level supports freshwater flow delivery to the estuary (through an increase in overflowing events), providing critical habitat for many estuarine species. The ROP rule represents a significant improvement on the interim method for operating levels for storages.

Since the expiry of the interim program in September 2014, low flow releases from Lenthalls Dam have met ROP requirements for the low flow release strategy, allowing flows to reach the estuary. Inflows in excess of 5000 ML triggered high flow releases in January 2012, March 2012 and January 2016. High flow releases were also made during March 2013 as pre-emptive measure for further expected heavy rain. Releases made to satisfy both the high and low flow release strategy facilitate the transmission of freshwater flow to the Burrum River estuary between October and April. The low flow releases were originally aimed to allow for fish passage between freshwater and estuarine environments once an operational fishway was installed on No.1 Weir. In the absence of an operational fishway limited fish movement is possible only during overflowing or down-out events over the weir.

6.5.3 Operating rules for Wongi Waterholes

The Wongi Waterholes are a unique ecosystem with cultural, social and environmental significance. Wide Bay Water have met ROP requirements by pumping water from the Wongi Waterholes when the waterholes overflow. Dissolved oxygen levels fall in the waterholes following the commencement of pumping, warranting further investigations into the flooding impacts on the temporary changes to water quality of the Wongi Waterholes.

6.5.4 Operating rules for Ewen Maddock Dam

Since implementation of the ROP, the storage level in Ewen Maddock Dam exceeded the minimum operating level, therefore daily releases were required based on inflows (when the storage was not overflowing). For the assessment period (01/01/2012–30/06/2016), the dam was overflowing for a combined 978 days, therefore there were no requirements for releases on these days. When not overflowing, releases met ROP requirements on 469 days, and did not meet ROP requirements on 196 days.

6.5.5 Operating rules for Six Mile Creek Dam

The storage level in Six Mile Creek Dam exceeded the minimal operating level since ROP implementation, so daily releases were required to be made based on inflows (when the storage was not overflowing). For the assessment period (01/07/2013–30/06/2016), the dam was overflowing for a combined 413 days therefore there were no requirements to make releases on these days. When not overflowing, releases met ROP requirements on 523 days, and did not meet ROP requirements on 160 days. The environmental flow releases for Six Mile Creek Dam outlined in the ROP are an improvement over the former operating arrangements, but do not appear to be transmitted far down the creek.

Releases under the current licence are not sufficient to maintain the pool and riffle depths and other hydraulic habitat downstream of the dam. Increases in both the volume and consistency in low flow

releases would allow flows to reach further down Six Mile Creek and may reduce the risk of fish deaths that have occurred downstream of Lake MacDonald.

6.6 Summary of ROL holder operations

There have been few instances where ROL holders could not meet the requirements of the rules for operation of water supply schemes. Most of these were associated with equipment failure or extenuating climatic conditions such as the effects of extreme weather events. **Appendix E (Table 11, Table 12 and Table 13)** provides more detail.

The ROP outlines that ROL holders must provide operational reports where there are instances where ROL holders cannot comply with rules. The instances of a non-compliance with the rules in the ROP were dealt with as part of normal operational business and did not represent risks to either water allocation holders or the environment.

6.7 Social and economic

The plan supports growth in population and industries and aims to maintain flows that support water-related economic values in the plan area. The Australian Bureau of Statistics (ABS) census data (ABS 2016) was used to assess whether the plan is providing for the social and economic outcomes. This information was collected using the Queensland Government Statisticians Office generation of a report based on relevant Statistical Areas - level 2 (SA2s) (QGSO 2018).⁵ For the purpose of the report the conglomerate of SA2s chosen to represent the plan area has been called the 'Mary Basin region'.

6.7.1 Population information

As at 30 June 2017, the population growth rate of 2% in the Mary Basin region for the last five years is slowing slightly compared to previous estimates, but still about Queensland average. Population growth rates throughout the plan area are variable, both in location and trends across the last 16 years, however growth rate over the whole area has exceeded the Queensland average since 2011. These areas of growth have primarily been focussed on the Hervey Bay area and the Sunshine Coast. Whilst the plan contains a strategic reserve of water, the release of this water to service targeted growth areas such as these may be limited by the current plan strategies.

6.7.2 Employment by industry

The top 3 industries in the Mary Basin region are:

- health care and social assistance (14.9%)
- retail trade (11.3%)
- construction (11.1%).

The growth in employment of health care and social assistance within the Mary Basin region may be attributed to the increase in the population in the Hervey Bay and parts of the Sunshine Coast. In these areas, in particular, the median age has increased substantially as the number of retirees move to these coastal centres.

⁵ www.statistics.qgso.qld.gov.au/qld-regional-profiles

6.7.3 ABS farm surveys

ABS farm survey data are available for Natural Resource Management (NRM) group areas (ABS 2016).⁶ The NRM groups that relate to the Mary Basin water plan area are the Burnett Mary NRM Regional Group and the South East Queensland NRM (SEQ NRM) Group. However, the plan area only covers 19% of the Burnett Mary NRM area and 6% of the SEQ NRM group, so this data associates only in a very broad way to the plan area. The Burnett Mary NRM Regional Group area is chosen as the main NRM area to represent the plan area.

The current total value for agricultural commodities in the Burnett Mary NRM Regional Group was estimated at \$325 million, with a decrease of \$44 million since 2012–13. As the plan area only constitutes a very small percentage of the Burnett Mary NRM area there is minimum analysis that could be conducted. The current water plan does contain general water reserves; however, these are only able to be released as water allocations and are only small volumes over a number of subcatchments. The existing unsupplemented water entitlements would need to be converted to water allocations to facilitate these releases; however, the reserve volumes need to be reviewed to determine if the volumes align to potential agricultural expansion of the sugar industry around Maryborough and to facilitate growth in the dairying industry in the upper Mary River for example.

6.7.4 Water trading and water prices

Trade of water in the plan area occurs as transfers of supplemented surface water allocations within the plan's water supply schemes. **Table 2** shows the changes in transferred volumes, per cent turnover in volume and the average price per ML for the whole of the plan area. Water trading is not available for other entitlements in the water plan area.

Table 2 – Trading and pricing information for the Mary Basin water plan for the last five water years

Water year	Volume Transferred (ML)	Volume Turnover (%)	Weighted Average Price (\$/ML)
2013–14	571	<1	442
2014–15	45 231*	36	628
2015–16	2390	2	642
2016–17	2076	2	495
2017–18	4923	4	510

* This volume includes 36 495 ML from Baroon Pocket Dam. This allocation was transferred to the Queensland Bulk Water Supply Authority (Seqwater) from the SEQ Water Grid Manager.

More information can be found on DNRME's Water Market Information website.⁷

⁶ www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/7503.02016-17?OpenDocument

⁷ www.business.qld.gov.au/industries/mining-energy-water/water/water-markets/market-information#water-sales

6.8 Climate assessment

A review of the climate variability for the plan area was undertaken to determine if there has been a significant change that affects the plan’s ability to provide consumptive and non-consumptive water use for the remaining life of the Plan. Two assessments were carried out by the Department of Environment and Science to determine any:

1. variations in the climatic conditions since 1999 compared with the period used for hydrological modelling for the plan (1890–1999)
2. impacts of potential climate change based on climate projection scenario to the year 2030.

6.8.1 Recent climate variation

The rainfall, evaporation and flow data recorded since July 1999 to June 2017 (recent 18 years) was compared to the data used in the IQQM simulation from 1 January 1890 to 30 June 1999 (109 years).

The data recorded at the Miva gauge station was chosen for the comparison as being representative of the catchment and being of interest for the water security of the region. The annual streamflow at Mary River at Miva since 1999 is generally within the range of the historical data (**Figure 2**). However, of the 18 years of additional data, ten of those are less than the median (50%), and of those, two are the lowest stream flows on record. In general, this suggests that the recent climate since July 2007 is potentially slightly drier than the previous 109 years.

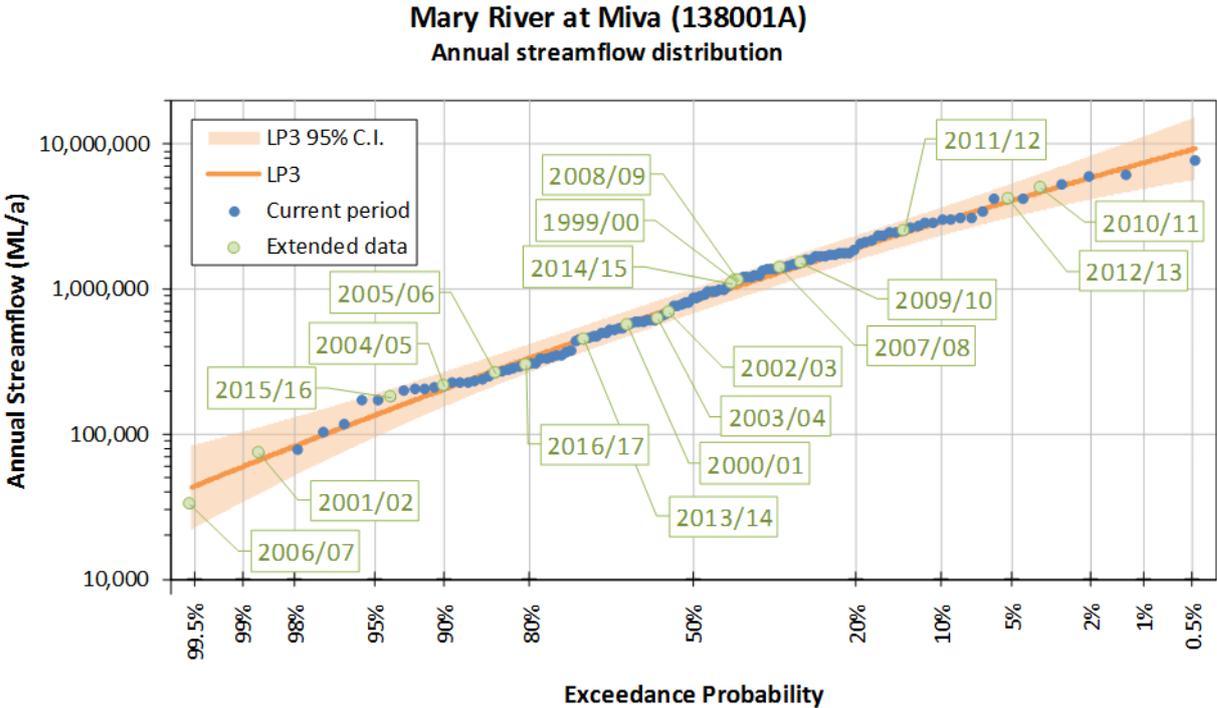


Figure 2 – Distribution of annual streamflow at Mary River at Miva (GS 138001A)

Over the recent period, Borumba Dam has also recorded its lowest water level on record (2003) (**Figure 3**). The lowest storage water level in this storage is recorded after the dam was raised in 1999 and highlights the increased demand on surface water storages in the plan area.

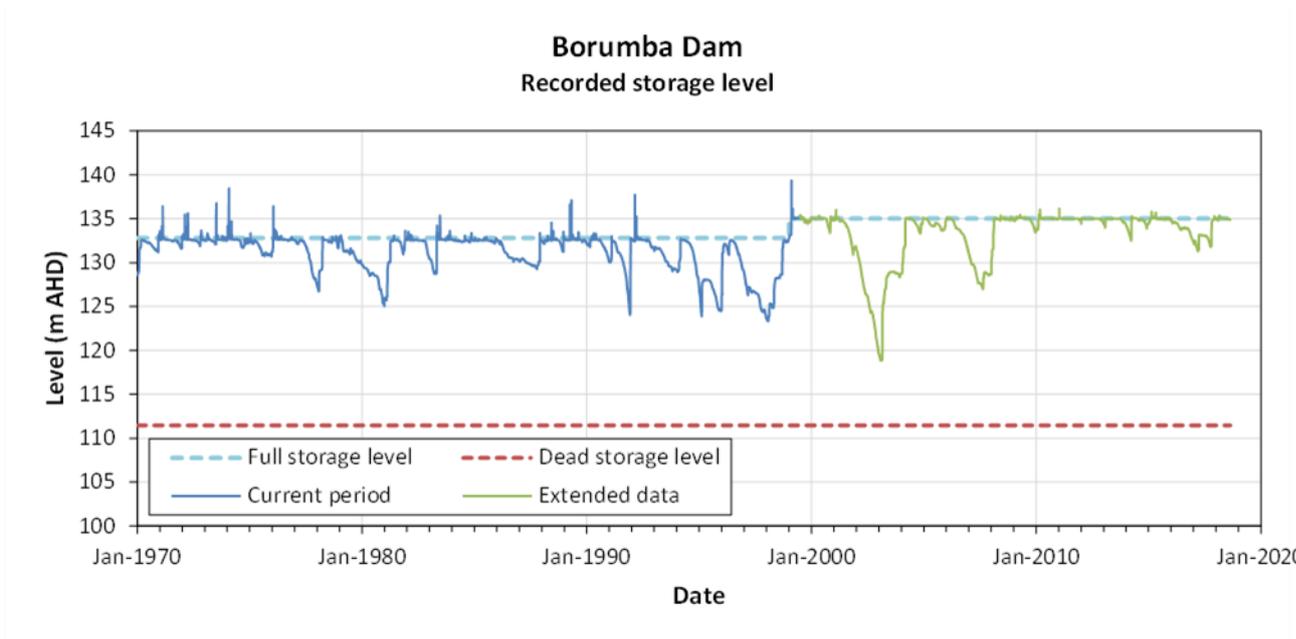


Figure 3 – Recorded storage level for Borumba Dam to August 2018 (Source: Seqwater 2018)

Likewise, the lowest water level in Baroon Pocket Dam has also been recorded within this recent climatic period (**Figure 4**). Water usage from Baroon Pocket Dam has increased since the storage was connected to the SEQ Water Grid.

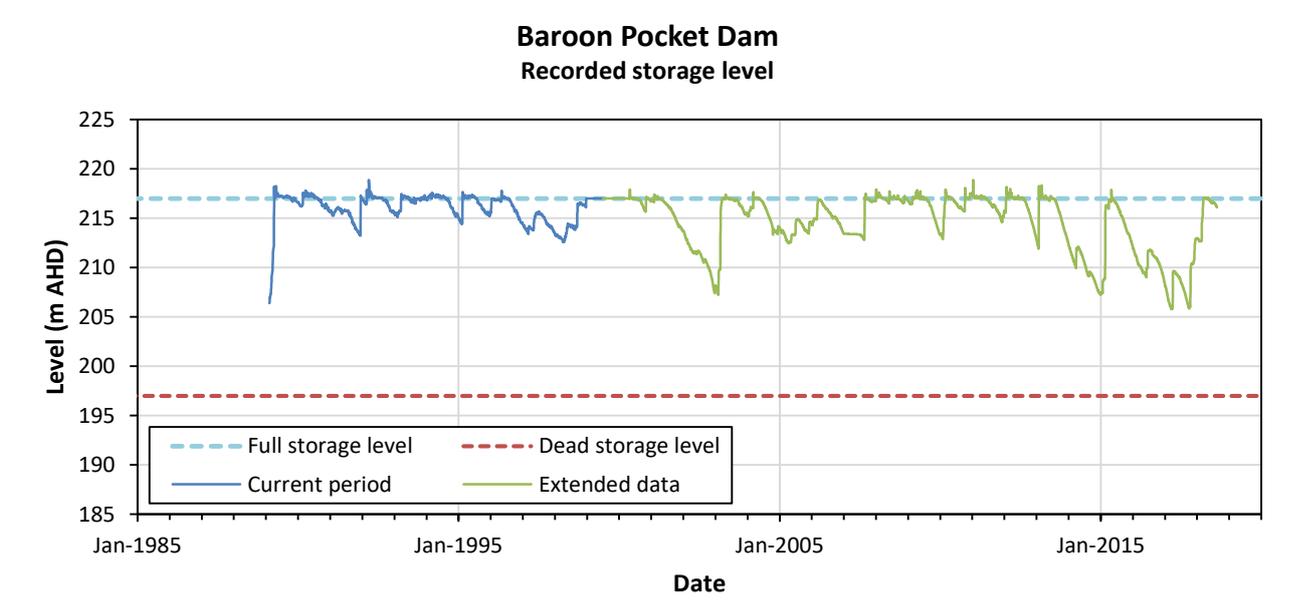


Figure 4 – Recorded storage level for Baroon Pocket Dam (constructed in 1989) to August 2018 (Source: Seqwater 2018)

Both of these storages highlight that there are low storage levels since 1999 which needs to be assessed for water supply security.

This recent sequence of climatic data needs to be accounted for in an updated hydrological model. This aligns to risks identified in Section 8 regarding the plan’s ability to provide for consumptive and non-consumptive use.

6.8.2 Climate change projections

A range of Global Circulation Models (GCMs) from were used in the assessment. The results consider the Representative Pathway Concentration (RCP) 8.5 emission scenario. This scenario is commonly used for climate change prediction work and corresponds to a business-as-usual scenario which follows current emission trends. Rainfall and evaporation data were sourced at the long-term gauge at Gympie (40039).

6.8.2.1 Evaporation

The monthly variation in the potential evaporation predicted for the years through to 2030 is shown in **Figure 5**. The GCMs predicted an increase in the median evaporation (denoted by ‘CC Median’) for all months to varying percentages as compared to the historical data (shown as reference black dashes). Increased evaporation will increase losses from farm storages, is aligned to greater crop water use and may cause water users to use additional water from surface water. For urban water security, increased evaporation will cause increased losses from water supply storages as well as drive increased demand by the public requiring to water gardens, green areas and fill swimming pools for example. This could put a greater strain on the water grid and potentially increase demand management or increase water failure periods. Increases in evaporation may reduce the persistence time of waterholes that are used for refugia by stream biota.

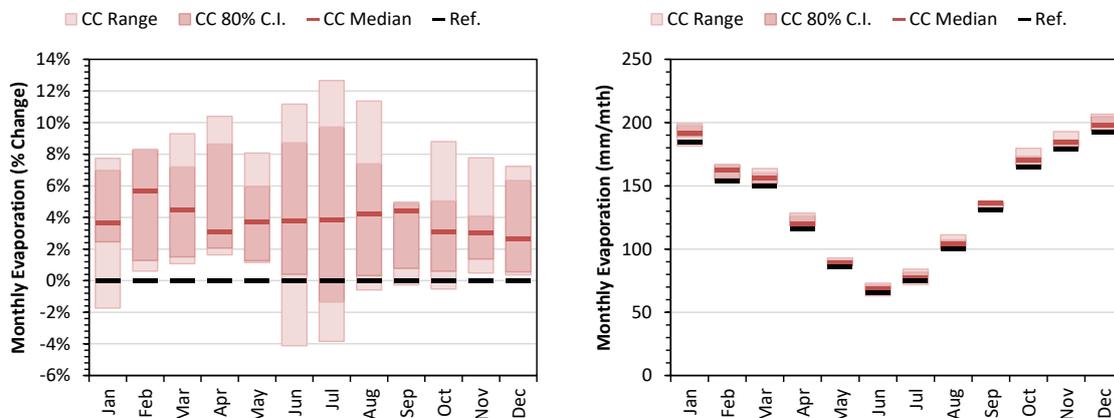


Figure 5 – Monthly potential evaporation projection for RCP 8.5 scenario through to the year 2030

6.8.2.2 Rainfall

The monthly variation in the rainfall predicted by the GCMs for the period until 2030 are shown in **Figure 6**. For the period to 2030, the median rainfall (shown as ‘CC Median’) tends to show a decrease in the expected rainfall during the drier winter months except for April, May and December. However there are still broad confidence limits around the median rainfall estimates which indicate some uncertainties in the projections.

Changes in rainfall patterns (including intensity) can affect:

- streamflow
- the volume of water that can be captured by OLF storages
- groundwater recharge.

Likewise on land, changes to rainfall patterns can influence decisions about which crops to grow, with consequential changes to pressures on water resources. Rainfall change can significantly affect water availability in storages used for both urban and agricultural purposes.

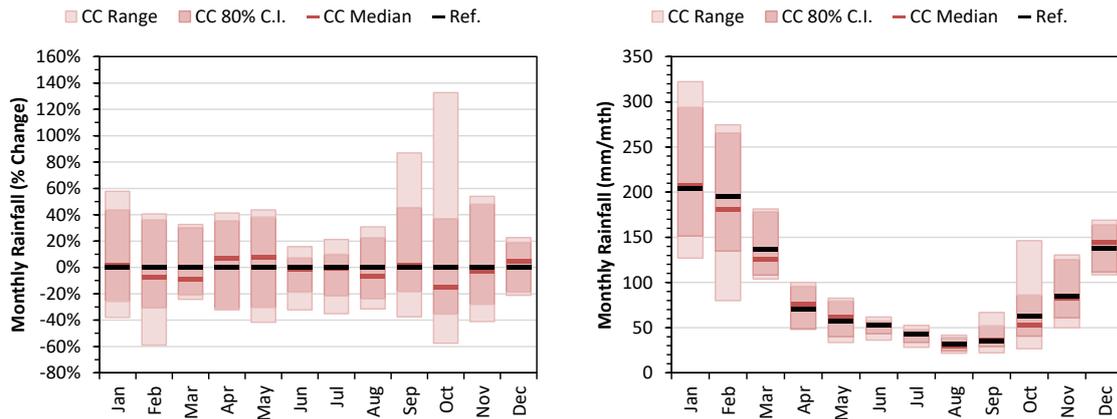


Figure 6 – Monthly rainfall projection for RCP 8.5 scenario through to the year 2030

Updated climate data will be included in future hydrological models for the next water plan to account for recent climatic data that will allow for more refined management approaches for entitlement holders and to the environment.

7. Plan amendments, previous assessments and reports

7.1 Plan amendments and milestones

A number of amendments have been made to reflect administrative changes relating to the Water Act. The main amending acts are:

- *the Water Supply (Safety and Reliability) Act 2008*
- *the Land, Water and Other Legislation Amendment Act 2013 (LWOLA 2013)*
- *the Water Reform and Other Legislation Amendment Act 2014 (WROLA 2014)*.

These amendments and other planning milestones are shown in **Figure 7**.

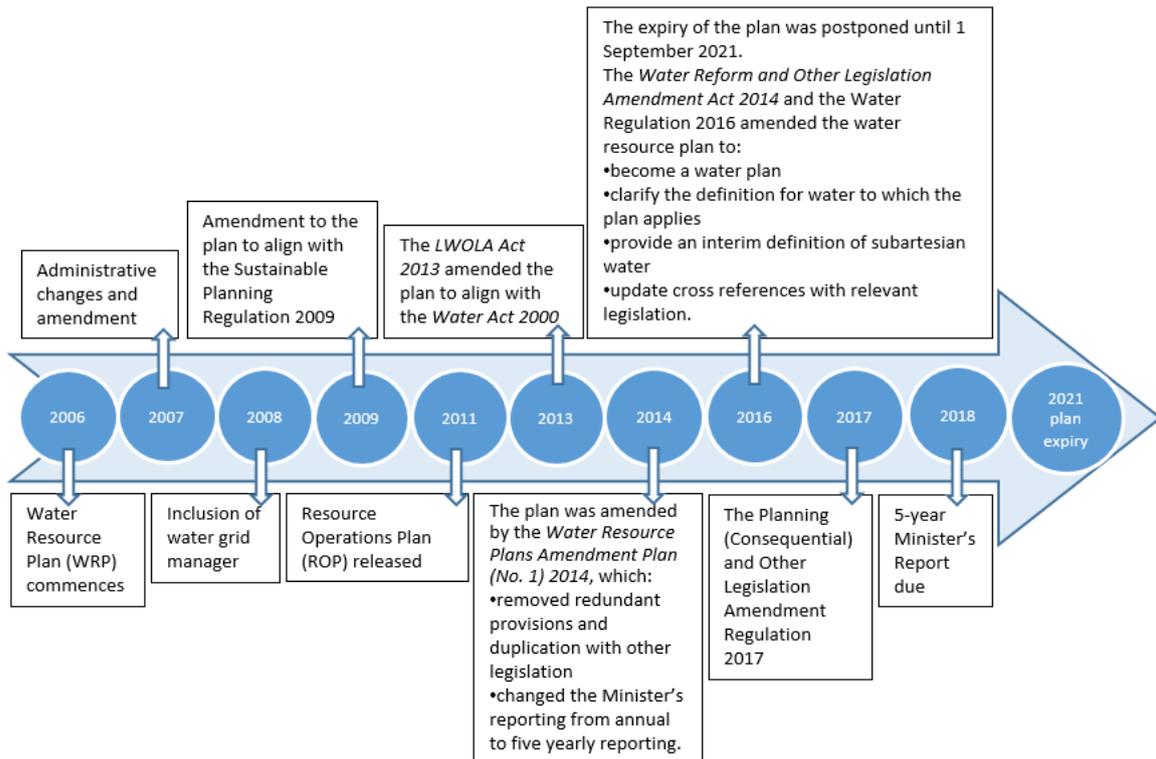


Figure 7 – Water planning milestones for the plan

Additionally the *Mineral, Water and Other Legislation Amendment Act 2018* was passed in October 2018 and new water plans or plan replacements will require the inclusion of plan outcomes for cultural values and climate change.

For more detail see **Appendix F, Table 14**.

7.2 Previous assessments and reports

The last Minister's report for the plan area was prepared in 2013. This report provided a snapshot of the level of implementation within the plan but did not assess in detail the effectiveness of implementation or risk to plan outcomes.

8. Identification of potential risks to the water plan's outcomes

A risk assessment was completed in August 2018 to identify current and potential risks to the plan's outcomes that could emerge within the life of the plan (expiring 1 September 2021). The risk assessment approach used was consistent with the ISO 31000:2018 Risk Management Guideline. This methodology ensures consistent, repeatable and defensible consideration of risks, and that outcomes of the assessment are documented for future reference.

Potential risks were identified by considering changes in the plan area over the life of the plan. Potential emerging issues were also identified by considering future water demands beyond the life of the plan (section 9 below). Evidence based on data and expert opinion was used to rank the likelihood and consequence of risk from a standardised list of threats, and the risk level and rationale for this ranking was documented (see Appendix A). Those risks assessed as either medium or high have mitigation strategies proposed where appropriate. Under this assessment framework, the level of risk, along with other factors, such as a plan's ability to continue to balance economic, social and environmental outcomes, was considered in recommending the most appropriate course of action.

In summary, of the 23 outcomes for the water plan:

- six were classed as being at high risk
- one was classed as being at medium risk
- three were unable to be assigned a risk ranking due to lack of information
- 13 were classed as being at low risk.

Of the plan outcomes classed as being either at medium or high risk, four of these outcomes related to surface water management and the remaining three were related to aquatic ecosystems. Much of the risk identified related to the lack of flexibility in the plan to meet future water demands across the plan, adaption to recent drought data and inability to change operating rules because of the current water plan framework. Two of the three outcomes that were not able to be assessed relate to cultural use of water in the plan area. Further engagement with Aboriginal peoples and Torres Strait Islanders will be completed as part of the plan review to better understand cultural water needs in the plan area.

For more detail see **Appendix A: Assessment of plan outcomes**.

9. Emerging issues

DNRME has identified a number of emerging issues that need to be able to be dealt with through a water plan replacement.

590 supplemented water entitlements have been converted to tradeable water allocations in water supply scheme areas. However as identified in section 4, conversion of unsupplemented water entitlements remains to be completed. There are approximately 1000 unsupplemented water licences in the plan area that have an entitlement specified only by the maximum area of land that may be irrigated. Because of this, the general water reserves within the plan cannot be released as these relate to water allocations only. In addition, these water licences are attached to land and cannot be re-located, hence there is no scope for existing irrigators to access additional water to meet their changing demand. Any future conversion of these licences to tradeable or relocatable entitlements would also require the use of an updated hydrological model as the current plan model does not include the last 18 years of hydrological data which contains a major drought period.

MSF Sugar, the owner of the only sugar mill in the plan area, has been exploring opportunities for enhancing water security and access to additional volumes to underpin the reliability of sugarcane production in the area. This includes consideration of an off-stream storage (Glendorf off-stream storage) to make use of existing unused water allocation within the Lower Mary water supply scheme. If this were to proceed, there are likely to be operational changes for the scheme.

Forecast regional water demand indicates that an additional urban water supply will be required in the plan area around 2040 (Seqwater 2016) to achieve regional water security. The strategic reserve volume in the plan is currently 150 000 ML, which significantly exceeds the forecasted urban water demand. Feedback obtained during the 2016 plan postponement revealed that certain stakeholders seek to have this volume revised.

Lake MacDonald (Six Mile Creek Dam) is planned for an upgrade in 2020–2022 as part of Seqwater's Dam Improvement Program. During construction, the water storage will be temporarily lowered to about 5% of its current capacity. The Noosa Water Treatment Plant will continue to operate using water from the Mary River. The plant will not use water from Lake MacDonald while the lake level is lowered. Supply will be supplemented from other dams across the region via the SEQ Water Grid.

A temporary lowering and dam safety upgrade is also planned at Ewen Maddock Dam in 2019–2020. Production at the Ewen Maddock Water Treatment Plant will be reduced during construction. While these upgrades occur, there will be additional demands on other water storages in the water grid to supplement supply.

The recent climate assessment highlighted that there were two years with less streamflow than the historical period, with a number of water storages recording the lowest levels on record. The current hydrological model for the water plan only uses data up to 1999 and does not include recent drought climatic data. An updated hydrological model would be required for any changes to the plan and would provide the best available science to inform future planning.

Through implementation of the water plan, ROL holders have discussed the need for greater flexibility in operational rules that reduce the effectiveness of delivery of water to both clients and the environment. A number of changes that would benefit both water users and the environment would require a change to the strategies and objectives in the plan and is based on an updated hydrological model. This, coupled with greater flexibility in release of unallocated water and a reassessment of water storage operations, could provide the required mechanisms to manage demand and

consequently reduce stressors on the water grid and provide more appropriate environmental flow rules. Changes to storage operating rules, for example for Lenthalls Dam and Baroon Pocket Dam, based on new science would provide both flushing flows to estuaries as well as increasing storage capacity through rationalisation of rules.

10. Any non-compliance under a water entitlement or other authorisation in the water plan area

In the last five years, DNRME investigated a number of reports of unauthorised take or non-compliance with the contents and conditions of entitlements such as water licences and water allocations in the plan area. These were relatively minor instances and have been dealt with in accordance with the standard departmental compliance response procedures (**Appendix G: Overview of non-compliance issues**).

11. Way forward

This report presents information and assessments that have been used as part of a decision making process to determine a way forward for the water plan. In summary:

- there are changes in the future projected demand for unallocated water in the plan area
- there is limited ability of the plan to provide for future agricultural expansion, including new large-scale projects and individual property-level enterprises
- there is a lack of flexibility of the plan to provide for changes to water sharing and environmental management rules
- climate impacts on water security due to the Millennium drought are not captured in the current hydrologic model
- new science (collected since 2006) needs to be incorporated into the plan, including updates on the water needs of threatened species (Mary River turtle, Mary River cod and Queensland lungfish)
- there needs to be further consultation with Aboriginal peoples and Torres Strait Islanders to understand current and emerging local cultural water needs.

The learnings gained from implementing the existing plan as well as the findings from this performance assessment report can be used to make improvements to the next plan. This approach would be part of an adaptive management cycle based on revised future water needs, increased scientific information and stakeholder consultation.

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Appendix A: Assessment of plan outcomes

Table 3 – General outcomes for surface water

Plan outcome (as per part 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
11. General outcomes			
<p>(a) to provide for future water requirements, including the opportunity for additional water to be taken;</p>	<p>The plan establishes strategic water reserves that provide for additional future town water supplies.</p> <p>The plan also allows a process to grant town water supply reserves.</p>	<p>The ROP provides for the following:</p> <ul style="list-style-type: none"> granting of licences for town water supply process to access the strategic reserve. 	<p>HIGH risk</p> <p>This outcome is partially being achieved.</p> <p>The plan includes a strategic water reserve for urban water supplies or projects of state significance that has not been accessed during the life of the plan. Current rules limit the capacity for release of additional water in existing water storages and access to the existing reserve is limited by plan objectives such that it cannot be potentially utilised evenly through the plan area.</p> <p>There are general water reserve volumes available throughout the plan area, however the volumes can only be accessed as a water allocation. To date, the unsupplemented water entitlements have not been converted to water allocations. Existing users cannot therefore access these reserves.</p> <p>Additionally, there have been potential future agricultural expansions identified that cannot occur without access to additional water through additional reserves.</p> <p>Changes to provide for future water requirements would require the use of an updated hydrological model to establish a new framework and rules and would require a replacement of the water plan.</p>

Plan outcome (as per part 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
11. General outcomes			
(b) to provide for the continued use of all water entitlements and other authorisations;	The plan provides for continued use of all authorisations by establishing water allocations to provide security. The plan also allows a process to grant licences for town water supply reserves.	The ROP grants the licences for town water supplies. The ROP also converted the supplemented water authorisations to water allocations. The ROP outlines a process to deal with unsupplemented water licence applications.	LOW risk This outcome has been achieved. Existing water entitlements have been converted to tradeable water allocations across supplemented priority areas of the plan. This is supported by implementation of resource operations plan rules for water allocations and water sharing arrangements that ensure water is shared equitably between water entitlement holders.
(c) to protect the probability of being able to obtain water under a water allocation;	The plan provides a framework for specifying tradeable water allocations with a defined level of security. Decisions made under the plan about the allocation or management of water in the plan area must be consistent with the water allocation security objectives stated in the plan.	The ROP provides for the following: <ul style="list-style-type: none"> • rules for converting to, and granting, water allocations • operating and environmental management rules and water sharing rules. 	LOW risk This outcome is being achieved. Existing water entitlements have been converted to tradeable water allocations across supplemented priority areas of the plan. These water allocations have specified water allocation security objectives which align with operational and water sharing rules. A review of underground water and OLF development within the plan area has identified limited expansion in these areas during the life of the plan. Underground water users are limited by the extent and supply of aquifers. OLF has been limited by the availability of suitable locations and demand. There is no current threat from expansion in these two areas and further management is not warranted, however the plan may require further assessments to monitor changes or trends.

Plan outcome (as per part 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
11. General outcomes			
(d) to provide options for water users to take action to ensure their own security of supply;	<p>The plan provides unallocated water from the general reserve to be released through a process in the ROP.</p> <p>Some sub-catchments contain an existing trading framework that allows additional access to water if required. The establishment of water allocations in the plan allows trading to secure supply.</p>	The ROP outlines trading rules to secure supply in water supply schemes.	<p>HIGH risk</p> <p>This outcome is partially being achieved. Current provisions in the plan allow for the release of unallocated water and water trading. However, while seasonal water trading has been active, only limited permanent trades have occurred in most supplemented schemes.</p> <p>Limitations on availability, type and location of unallocated water has limited potential expansion of some entitlement holders. As unsupplemented users have not been converted to water allocations, there is no access to unallocated water.</p> <p>Users have the ability in certain locations to secure supply through construction of OLF storages or access to groundwater resources.</p> <p>Changes to provide options for water users would require the use of an updated hydrological model to establish a new framework and rules and would require a replacement of the water plan.</p>
(e) to encourage the efficient use of water;	The plan establishes tradeable water allocations that allow users to purchase or lease existing water from other allocation holders.	The ROP establishes the boundaries and rules for trading.	<p>LOW risk</p> <p>This outcome has been achieved.</p> <p>Tradeable water allocations have been created in priority areas of the plan area to allow improved efficiencies in water use. Water is not able to currently be released from existing reserves as licences haven't been converted to water allocations and the demand may be remote from where volumes available.</p>
(f) to ensure water supply for essential services;	The plan establishes water allocations based on priority levels for supply. Water allocation security objectives are used as a measure to manage this security.	The ROP establishes rules for water sharing.	<p>HIGH risk</p> <p>This outcome is being partially achieved. The plan provides protection for high priority water and the release of strategic reserves for additional urban demand. However the plan also constrains flexibility for delivery of secure water supplies due to limitations of objectives in the plan. Future demand for urban water may occur in locations where strategic reserves are not accessible under the current plan. In addition, the current plan is based on a hydrologic model that only includes climatic conditions until 1999 which does not include the Millennium drought.</p> <p>Changes to provide improved the security of essential services would require the use of an updated hydrological model to establish new framework and rules and would require a replacement of the water plan.</p>

Plan outcome (as per part 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
11. General outcomes			
(g) to support natural ecosystems by minimising changes to natural flow regimes;	The plan outlines environmental flow objectives to establish boundaries for the level of flow alteration.	The ROP implements environmental management rules that aim to minimise changes the natural flow regime.	<p>MEDIUM risk</p> <p>This outcome is being partially achieved.</p> <p>The plan currently provides for natural ecosystems either through environmental flow objectives at a number of locations and/or specific flow rules within the ROP. Whilst the flow release rules have been successful at a number of locations, there are significant risks to threatened aquatic species through a lack of specific strategies to provide for ecological assets.</p> <p>Additional research has been conducted during the plan with ecological risk assessments to be conducted using an updated hydrological model. These will be used to support the hydrological requirements of ecological assets dependent on flow.</p> <p>Changes to provide increased protection would require a replacement of the water plan.</p>
(h) to maintain, as far as practicable, surface water and groundwater interactions;	The plan has gazetted the Cooloola Sandmass subartesian area to manage surface water and groundwater interactions.	The ROP establishes rules for water extraction from the management area as well as monitoring and reporting requirements.	<p>LOW risk</p> <p>This outcome is being achieved.</p> <p>The plan sets a cap on the amount of water taken from the plan area in underground water management areas. There are monitoring and reporting requirements to assess their effectiveness.</p> <p>A review of underground water development within the plan area has identified limited expansion in these areas during the life of the plan and low-risk to surface water interactions.</p>
(i) to ensure a reliable and secure supply of water from the plan area during the time this plan is in force;	<p>The plan provides a framework for specifying tradeable water allocations with a defined level of security.</p> <p>Decisions made under the plan about the allocation or management of water in the plan area must be consistent with the water allocation security objectives stated in the plan.</p>	<p>The ROP provides for the following:</p> <ul style="list-style-type: none"> • rules for converting to, and granting, water allocations • operating and environmental management rules and water sharing rules. 	<p>HIGH risk</p> <p>This outcome is being partially achieved. The plan has established water allocations within the supplemented water schemes and has established rules based on specified level of security. However the plan also constrains the flexibility of rules to deliver secure water supplies due to limitations in objectives in plan. The current water plan is based on a hydrologic model that only includes climatic conditions until 1999 which does not include the Millennium drought.</p> <p>Changes to provide and ensure the reliable and secure supply of water in the plan would require the use of an updated hydrological model to establish new framework and rules and would require a replacement of the water plan.</p>

Plan outcome (as per part 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
11. General outcomes			
(j) to allow cultural use of the plan area by the Traditional Owners of the area;	The plan seeks to provide for cultural use by providing for areas of high cultural value such as the Wongi Waterholes and establishing specific outcomes for this area.	The ROP contains operating and environmental management rules to minimise flooding of the Wongi Waterholes.	There was insufficient information available to assess this outcome. There is no specific current information available on cultural use of water in the plan area. Further engagement with Aboriginal peoples and Torres Strait Islanders is proposed as part of the plan review to better understand the current and emerging cultural water needs in the plan area.
(k) to provide consistency with the SEQ regional plan.	The plan contains strategies such as the strategic reserve that provide for the greater SEQ region.	The ROP is the mechanism to allocate and condition the release of any strategic reserve.	Not able to be assessed. The original SEQ regional plan included specific links to this water plan. Subsequent versions of the regional plan have changed this association. The plan outcome may need alteration to ensure linkages with more appropriate mechanisms for water security.

Table 4 – General outcomes for subartesian water in the Cooloola Sandmass subartesian area

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
12. General outcomes			
(a) to encourage the efficient use of water;	The water licence to take subartesian water for the Gympie Regional Council (GRC) has numerous restrictions on the take of the water. There are also monitoring requirements for the council.	The licence conditions for GRC associated with the take of subartesian water from the Cooloola Sandmass aquifer are stated in the ROP. This includes details of the monitoring and reporting requirements. The licence states both a daily volume and a maximum rate at which water may be taken.	LOW risk This outcome is being achieved. Licence conditions state a maximum daily volume and rate of take to encourage the efficient use of water.
(b) to maintain long-term water quality;	The water licence to take subartesian water for the GRC has numerous restrictions on the take of the water. There are also monitoring requirements for the council.	The licence conditions for GRC associated with the take of subartesian water from the Cooloola Sandmass aquifer are stated in the ROP. This includes details of the monitoring and reporting requirements.	LOW risk This outcome is being achieved. Licence conditions state a maximum daily volume and rate of take helps maintain long term water quality. In addition the monitoring and reporting requirements confirm no adverse changes are taking place.
(c) to prevent seawater intrusion of the Cooloola Sandmass aquifer;	Other than for town water supply purposes, only users that use water for stock and domestic purposes can currently take water from the Cooloola Sandmass aquifer. The water licence to take subartesian water for the GRC has numerous restrictions on the take of the water. There are also monitoring requirements for the council.	The licence conditions for GRC associated with the take of subartesian water from the Cooloola Sandmass aquifer are stated in the ROP. This includes details of the monitoring and reporting requirements.	LOW risk This outcome is being achieved. The use of licence conditions that state a maximum daily volume and rate of take, reduce the potential for seawater intrusion. In addition, monitoring and reporting requirements confirm no adverse impacts are occurring.
(d) to maintain subartesian water discharge to support wetlands and other groundwater-dependent ecosystems;	Other than for town water supply purposes, only users that use water for stock and domestic purposes can currently take water from the Cooloola Sandmass aquifer. The water licence to take subartesian water for the GRC has numerous restrictions on the take of the water. There are also monitoring requirements for the council.	The licence conditions for GRC associated with the take of subartesian water from the Cooloola Sandmass aquifer are stated in the ROP. This includes details of the monitoring and reporting requirements.	LOW risk This outcome is being achieved. Research shows that the subartesian water discharge from the aquifer appears mainly driven by longer-term climatic variability rather than being influenced by extraction.

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
12. General outcomes			
(e) to ensure reliable and secure water entitlements during the time this plan is in force;	<p>Other than for town water supply purposes, only users that use water for stock and domestic purposes can currently take water from the Cooloola Sandmass aquifer.</p> <p>The water licence to take subartesian water for the GRC has numerous restrictions on the take of the water. There are also monitoring requirements for the council.</p>	The licence conditions for GRC associated with the take of subartesian water from the Cooloola Sandmass aquifer are stated in the ROP. This includes details of the monitoring and reporting requirements.	<p>LOW risk</p> <p>This outcome is being achieved.</p> <p>Monitoring shows a direct relationship between rainfall and bore water level. The Cooloola Sandmass aquifer water levels align to longer term climatic patterns. The use of water from the aquifer is a more secure supply of water than the surface water, and licence conditions ensure a more consistent extraction of water from the aquifer to ensure a secure supply.</p>
(f) to allow cultural use of the plan area by the Traditional Owners of the area.	<p>Other than for town water supply purposes, only users that use water for stock and domestic purposes can currently take water from the Cooloola Sandmass aquifer.</p> <p>The water licence to take subartesian water for the GRC has numerous restrictions on the take of the water. There are also monitoring requirements for the council.</p>	The licence conditions for GRC associated with the take of subartesian water from the Cooloola Sandmass aquifer are stated in the ROP. This includes details of the monitoring and reporting requirements.	<p>There was insufficient information available to assess this outcome.</p> <p>There is no specific current information available on cultural use of water in the Cooloola Sandmass subartesian area. Further engagement with Aboriginal peoples and Torres Strait Islanders is proposed as part of the plan review to better understand the current and emerging cultural water needs.</p>

Table 5 – Ecological outcomes for particular parts of the plan area

Plan outcome (as per part 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
13. Each of the following is an ecological outcome for water a particular part of the plan area—					
<p>a) for the Noosa River, Mooloolah River and coastal streams north of Noosa River mouth— (i) to minimise changes to river-forming processes; and (ii) to minimise changes to a near-natural flow regime;</p>	<p>The seasonal and high flow EFOs for these areas of the plan have been set very high, supporting and maintaining river-forming processes.</p> <p>There has been no unallocated water provided in these areas.</p>	<p>No specific ROP rules associated with this outcome.</p>	<ul style="list-style-type: none"> • river forming processes • estuarine brackish habitat. 	<p>Ecosystem Health Monitoring Program (EHMP) monitoring of the Mooloolah and Noosa rivers noted a change in indicators after the 2011 flood. This flood was of a significant magnitude throughout the region and has the ecological role of resetting instream and riparian habitat by flushing out watercourses and providing geomorphic variability. Interestingly, indicators relating to Nutrient Cycling, Physical/Chemical variables and Ecosystem Processes, improved dramatically subsequent to extensive flooding. Indicators relating to Fish and Aquatic Macroinvertebrates however, did not improve post-flood, but rather improved the year after.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p> <p>In these rivers, the environmental flow objectives have been set to achieve these outcomes and no unallocated water reserves have been provided. In the Noosa catchment, the high flows are unrestricted, while the relatively small water storages found in the other catchments only impact on river-forming processes in the areas immediately downstream of the infrastructure.</p>

Plan outcome (as per part 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
13. Each of the following is an ecological outcome for water a particular part of the plan area—					
<p>(b) for the Mary River, upstream of the Mary River barrage pondage—</p> <p>(i) to minimise changes to the low flow regime of the river; and</p> <p>(ii) to minimise changes to the hydraulic habitat requirements of species such as the Mary River cod, the Mary River turtle and lungfish;</p>	<p>The plan sets EFOs for two sites on the Mary River upstream of the barrage.</p> <p>All entitlements to take water within the river are licenced, with limitations on trading and the release of unallocated water to limit impacts on ecological assets.</p>	<p>ROP rules outline the extent of water trading, water sharing rules and infrastructure operating rules.</p>	<ul style="list-style-type: none"> • Mary River cod • Mary River turtle • Australian lungfish • Waterholes • White-throated snapping turtle • Sea mullet • Freshwater mullet 	<p>EFAP monitoring highlighted that Mary River turtle nest during the relatively stable streamflow period of Oct–Dec. The turtles nest generally within 3.8 m of the water level at time of nesting. High flows during this time can inundate nests. Connell (2018) found the highest population density of Mary River turtles was in the upper reaches near Kenilworth, with juveniles also abundant as far downstream as Traveston. Riffles are important for all life-stages of Mary River turtle due to provision of food, refugia and dissolved oxygen requirements (Micheli-Campbell et al. 2017). The population of Mary River turtles in the main Mary River are genetically distinct to those from Tinana Creek: a fact now known for Mary River cod and Australian lungfish (Huey et al. 2013, Hughes et al. 2015, Schmidt et al. 2017). Movement studies on Mary River cod have shown them to be highly resident in pools, but adult fish still require connectivity with other pools for breeding in early spring and summer. Likewise, Australian lungfish require variable low flows in spring to spawn and allow eggs to hatch (Espinoza et al. 2013).</p>	<p>HIGH risk</p> <p>This outcome is currently being achieved however there is a high risk that this outcome will not be achieved in the future due to lack of adequate protection mechanisms in the current water plan. Upstream of the barrage on the Mary River, no change in water extraction during the life of the plan has occurred. Knowledge of the low flow requirements of ecological assets has been improved and will be utilised in a risk assessment to identify areas of high ecological importance and any areas requiring new environmental flow strategies. Mary River turtles in particular are dependent on near-perennial flows and current protection mechanisms are potentially inadequate (such as targeted EFOs) throughout the range of this and other threatened species. Changes to this and other strategies to address this risk would require a review and replacement of the water plan.</p>

Plan outcome (as per part 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
13. Each of the following is an ecological outcome for water a particular part of the plan area—					
(c) for Six Mile Creek— (i) to minimise changes to the low flow regime of the creek; and (ii) to minimise changes to the hydraulic habitat requirements of species such as the Mary River cod and lungfish;	In granting the unallocated water from town water supply reserves, conditions may be put on the licence. These conditions may include the requirement to pass inflows into storages for environmental flows.	The ROP outlines the low flow releases required from Six Mile Creek Dam.	<ul style="list-style-type: none"> • Mary River cod • Mary River turtle • Australian lungfish • waterholes • white-throated snapping turtle. 	<p>The hydraulic flow requirements for these species are documented in (b) above.</p> <p>Monitoring of the environmental flow releases from Six Mile Creek Dam (Lake Macdonald) have highlighted that although the low flow releases could be detected immediately downstream, the flows did not persist far downstream. In addition, as the flow releases were based on inflow to the storage, there were significant periods where the flow was quite low. At these times there have been documented cases of fish deaths.</p>	<p>HIGH risk</p> <p>This outcome is being partially achieved. The initial intent of the low flow releases was to match inflow, however only lower volumes could be released based on existing infrastructure capabilities. It is recommended that the flow releases are reviewed based on the ecological risk assessments. Six Mile Creek is a remaining stronghold for Mary River cod and would require additional environmental flow release to provide for this species. A review of the environmental flow release may involve a concurrent review of the available volume for extraction and any changes would require a water plan review and be enacted through a replaced water plan.</p>
(d) for Tinana Creek, upstream of Tallegalla Weir—to minimise changes to the hydraulic habitat requirements of existing ecological assets in the area;	<p>The EFOs for Tinana Creek have been set to maintain a near natural flow regime, supporting and maintaining ecological asset requirements and river-forming processes.</p> <p>There has been no unallocated water set in this sub-catchment.</p>	No specific ROP rules associated with this outcome.	<ul style="list-style-type: none"> • Mary River cod • Australian lungfish waterholes. 	<p>The hydraulic flow requirements for these species are documented in (b) above.</p> <p>The waterholes in Tinana Creek have generally extensive riparian vegetation and have a high abundance of large woody debris, suitable for Mary River cod (DNRM 2016). The streamflow is relatively unimpeded and along with intact vegetation provide good habitat for ecological assets. As discussed above in (b), Tinana Creek provides habitat for separate genetic stocks of at least three threatened ecological assets.</p>	<p>LOW risk</p> <p>This outcome is being achieved.</p> <p>In Tinana Creek, the environmental flow objectives have been set to achieve these outcomes by providing a relatively natural flow regime where no unallocated water has been reserved in this reach.</p>

Plan outcome (as per part 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
13. Each of the following is an ecological outcome for water a particular part of the plan area—					
(e) for Obi Obi Creek, in the Obi Obi Creek Gorge area—to minimise changes to the hydraulic habitat requirements of existing ecological assets in the area;	In deciding the operating arrangements for water infrastructure on the Baroon Pocket water supply scheme the chief executive must consider the movement of fish and other aquatic species, water levels, water quality and other matters.	There is a specific ROP rule relating to low flow releases and releases for downstream landowners.	<ul style="list-style-type: none"> • Mary River cod • Mary River turtle • Australian lungfish • waterholes • white-throated snapping turtle. 	<p>The hydraulic flow requirements for these species are documented in (b) above.</p> <p>Obi Obi Creek environmental flow releases are larger than those provided in Six Mile Creek, with flow releases being detected at least nine kilometres downstream of Baroon Pocket Dam. Additionally, releases provided for downstream landholders (compensation releases) assist in both maintenance of water quality, and the hydraulic habitat requirements of resident ecological assets. Results from the animal tracking study for Obi Obi Creek highlight the importance of these releases, particularly for Mary River turtle, which were recorded frequently moving between habitats with the connectivity provided by environmental releases from Baroon Pocket Dam \geq 10 ML/d.</p>	<p>LOW risk</p> <p>The outcome is being achieved.</p> <p>Environmental flow releases have provided for connectivity for ecological assets and are well implemented. There may be some scope to further refine the rules to improve outcomes for these species based on the outcomes of ecological risk assessments.</p>

Plan outcome (as per part 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
13. Each of the following is an ecological outcome for water a particular part of the plan area—					
<p>(f) for the Burrum River— (i) in the Upper Burrum River above Lenthalls Dam—to minimise changes to the flooding regime at the Wongi Waterholes; and (ii) in the Lower Burrum River system below Lenthalls Dam—to minimise changes to variability in the low flow regime of the river system to improve opportunities for fish passage</p>	<p>In deciding the operating arrangements for water infrastructure on the Wide Bay Water WSS the chief executive must consider the movement of fish and other aquatic species, water levels, water quality and other matters. In addition, there are EFOs set for the downstream limit of the WSS to provide for this ecological outcome.</p>	<p>The ROP outlines pumping, storage gate operations, monitoring and reporting requirements to manage inundation of the Wongi Waterholes. In addition, high and low flow release rules as well as nominal operating levels are outlined in the ROP to provide for the downstream environment.</p>	<ul style="list-style-type: none"> • waterholes • sea mullet • estuarine brackish habitat. 	<p>The Wongi Waterholes were found to be 5 m deep throughout their footprint, consistent with their historic and cultural significance. The depth profile of this chain of waterholes suggests they are perennial with drying out events being extremely rare. The construction of Lenthalls Dam on the Burrum River has affected the flooding regime of the Wongi Waterholes. For example, in 2012, large floods in the catchment led to the Wongi Waterholes being inundated by Lenthalls Dam for approximately six months. The emergent sedge, <i>Lepironia articulate</i>, which lines the Wongi Waterholes, has been shown to grow in water depths up to four metres. However, the effects on other sedges such as <i>Gahnia sieberiana</i> are unknown. Water is being artificially pumped out of the Wongi Waterholes after inundation, which is minimising changes to the flooding regime of this culturally significant site.</p> <p>With the monitoring data available, it would seem that the low flow release strategy from Lenthalls Dam facilitates the transmission of flow events to the estuary, and consequently increases the extent of brackish habitat. However, assessment of the brackish habitat provision is complicated in this estuary due to three tributaries (Isis, Gregory and Cherwell rivers) entering the lower Burrum River within seven kilometres from the mouth. The intent of the release strategy was to provide flow for a fishway that was planned for Burrum Weir No. 1. However, since the fishway has never been constructed, there is only partial success of the environmental flow releases facilitating fish passage. The further effectiveness of the low flow release needs to be reviewed in the continued absence of a fishway on Weir No. 1.</p>	<p>LOW risk</p> <p>The outcome is being achieved.</p> <p>The operating rules in the ROP provide for Wongi Waterholes by limiting flooding.</p> <p>The high flow releases provide for the estuary by providing brackish conditions required by migratory fish as a movement cue as well as providing increased growing conditions. The low flow release and raised operating levels continue to provide these brackish conditions. However, without construction of a fishway on the weir, this outcome cannot be fully met as fish passage is only possible when the weir drowns out during flood flows.</p> <p>It is recommended to review the flow release rules and the outcome to focus on the brackish conditions in the estuary.</p>

Appendix B: Water entitlements

Table 6 – Water entitlements within the plan area

Entitlement Type	Entitlement numbers				Entitlement	
	All	Volumetric	Area	Other ¹	Volume (ML)	Area (ha)
Water licences	1281	174	846	261	29,712	5756
Supplemented water allocations	590	590	-	-	124,839	-

¹Entitlements with no volume or area specified, including entitlements to interfere with the flow of water.

Table 7 – Water usage in each water supply scheme, volume taken and the percentage of entitlements

Water year	Entitlement (ML)	Volume taken (ML)	Water taken as % of entitlements
Baroon Pocket water supply scheme – high priority water			
2011-12	36 500	27 970	76.6
2012-13	36 500	32 580	89.3
2013-14	36 500	33 942	92.9
2014-15	36 500	24 450	67
2015-16	36 500	28 866	79.1
2016-17	36 500	21 914	60
Cedar Pocket water supply scheme – medium priority water			
2011-12	495	150	30.3
2012-13	495	335	67.6
2013-14	990	517	52.2
2014-15	990	422	42.6
2015-16	990	386	39
2016-17	990	534	53.9
Lower Mary water supply scheme – high and medium priority water*			
2011-12	Data not available	3909	n/a
2012-13	30 459	10 679	35
2013-14	30 520	16 784	55
2014-15	30 814	7832	25.4
2015-16	30 689	12 716	41.4
2016-17	30 223	20 224	66.9
Mary Valley water supply scheme – high and medium priority water			
2011-12	45 019	8494	18.9
2012-13	45 019	8468	18.8
2013-14	45 019	14 525	32.3
2015-16	45 019	12 707	25.9
2016-17	45 019	15 100	33.5
Teddington Weir water supply scheme – high and medium priority water*			
2011-12	10 819	2989	27.6
2012-13	10 819	3848	35.6
2013-14	10 758	4918	45.7
2014-15	10 459	3689	35.3
2015-16	10 589	4181	39.5
2016-17	11 115	5012	45.1
Wide Bay water supply scheme – high and medium priority water			
2011-12	14 473	4544	31.4
2012-13	14 473	4226	29.2
2014-15	14 473	6940	48
2015-16	14 473	6627	45.8
2016-17	14 473	7384	50

* Note: water can be seasonally assigned between the LMWSS and TWWSS which will vary the total entitlement volume each year.

Table 8 – Permanent trades of supplemented surface water allocations

Water year	Priority group	Number of trades	Volume traded (ML)
Baroon Pocket water supply scheme			
2011-12	n/a	0	n/a
2012-13	n/a	0	n/a
2013-14	n/a	0	n/a
2014-15	High	1	36 495 *
2015-16	n/a	0	n/a
2016-17	n/a	0	n/a
Cedar Pocket water supply scheme			
2011-12	n/a	0	n/a
2012-13	Medium	1	5
2013-14	n/a	0	n/a
2014-15	n/a	0	n/a
2015-16	Medium	1	10
2016-17	n/a	0	n/a
Lower Mary River water supply scheme.			
2011-12	Medium	2	360
2012-13	Medium	1	20
2013-14	n/a	0	n/a
2014-15	Medium	8	544
2015-16	Medium	4	863
2016-17	Medium	8	719
Mary Valley water supply scheme			
2011-12	Medium	6	146
2012-13	Medium	9	514
2013-14	Medium	8	571
2014-15	High	1	6500*
2014-15	Medium	15	1336
2015-16	High	3	90
2015-16	Medium	25	873
2016-17	Medium	22	1357
Teddington Weir water supply scheme			
2011-12	n/a	0	n/a
2012-13	n/a	0	n/a
2013-14	n/a	0	n/a
2014-15	Medium	1	356
2015-16	Medium	2	506
2016-17	n/a	0	n/a
Wide Bay water supply scheme			
2011-12	n/a	0	n/a
2012-13	n/a	0	n/a
2013-14	n/a	0	n/a
2014-15	n/a	0	n/a
2015-16	Medium	1	48
2016-17	n/a	0	n/a

* This trade was associated with statutory changes to the arrangements for managing bulk water entitlements in South East Queensland.

Table 9 – Seasonal assignment of supplemented surface water allocations

Water year	Number of assignments	Volume assigned (ML)
Cedar Pocket water supply scheme		
2011-12	2	15
2012-13	2	10
2013-14	1	10
2014-15	1	34
2015-16	2	40
2016-17	2	46
Lower Mary River water supply scheme		
2011-12	6	252
2012-13	9	330.47
2013-14	79	8023.53
2014-15	8	647.75
2015-16	21	2772.32
2016-17	57	7802.3
Mary Valley water supply scheme		
2011-12	3	98
2012-13	9	520
2013-14	9	637
2014-15	17	1445
2014-15	8	2238
2015-16	23	1954.84
2015-16	3	98
2016-17	9	520
Teddington Weir water supply scheme		
2011-12	0	0
2012-13	1	50
2013-14	3	709
2014-15	2	410
2015-16	3	180.5
2016-17	10	632
Wide Bay water supply scheme		
2011-12	2	4
2012-13	3	3.28
2013-14	3	29
2014-15	4	28.5
2015-16	3	29
2016-17	3	40

Appendix C: Monitoring results for selected ecological assets

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 the Review of Water Plan (Mary Basin) 2006: Summary of Ecological Monitoring report 2018.⁸

Waterhole monitoring

DNRME undertook a long-term monitoring study of waterholes throughout the plan area, which included use of continuous water-level logging and depth profile and habitat mapping. Waterholes were found to persist at suitable depths throughout the study, and connectivity between waterholes was also found suitable to maintain aquatic ecosystem function and productivity. Large floods had significant impacts on the geomorphology of waterholes, demonstrating large changes in depth profiles and riparian habitat within the waterholes. Natural flows and releases generally kept waterholes within reaches connected. It was noted that low flow releases from Lake MacDonald did not always provide suitable waterhole conditions in Six Mile Creek.

The provision and maintenance of habitat within waterholes and connectivity between waterholes is critical to the long-term viability of key ecological assets in the plan area. Although the persistence of waterholes is generally not of concern in this catchment, the connectivity of waterholes within the breeding period of ecological assets should be further assessed.

Wongi Waterholes (cultural significance)

Protecting culturally significant sites such as the Wongi Waterholes is a key plan outcome. The raising of Lenthalls Dam on the Burrum River has the potential to change the flooding regime of the Wongi Waterholes. In 2012, large floods in the catchment led to the Wongi Waterholes being inundated by Lenthalls Dam for approximately six months. Water was pumped out of the Wongi Waterholes during these events (as per operational rules in the ROP), which helped to minimise flooding at this site.

Mary River turtle

Primary aims of research and monitoring projects on the Mary River turtle were to monitor the breeding period (Jul–Dec), focusing on connectivity for movement, heights of nests, and potential nest inundation rates within the catchment.

Mary River turtles rely on riffles that connect waterhole habitats for dissolved oxygen (respiration), feeding and predator avoidance. Connectivity is also important for movement of turtles particularly during the breeding season to locate partners and access nesting habitat. Connectivity was assessed across the catchment and found to be suitable for Mary River turtles, though extremely dry periods such as the Millennium drought (2001–2009) were not part of the monitoring period.

Mary River turtles were found to nest after rainfall, primarily in October and November. A significant proportion of nests were laid within 2.5 m of water levels.

Mary River turtle movement in Obi Obi Creek was closely associated with rainfall and local flow events and the breeding season (July-December). Male turtles made repetitive movements in the early breeding season around flow events (most likely associated with partnering and foraging). Female turtles made longer movements, primarily mid and late breeding season (most likely associated with

⁸ [DNRME library - Mary Basin water planning documents at—tinyurl.com/yatgwb63](https://tinyurl.com/yatgwb63)

nesting). Importantly, flow releases (environmental and compensation) were utilised by turtles for movement between habitats throughout the year.

Connell (2018) found that the highest population density of Mary River turtles occurred in the upper reaches of the Mary River near Kenilworth. High relative abundance of juveniles occurred as far downstream as Traveston. High frequency of riffle habitat within this reach is important for refugia, nutrition and dissolved oxygen requirements of juvenile and adult Mary River turtle (Micheli-Campbell et al. 2017). In addition, separate genetic sub-populations of Mary River turtle have been identified in the Mary River and Tinana Creek, mirroring results for other key species including Mary River cod and Australian lungfish (Huey et al. 2013, Hughes et al. 2015, Schmidt et al. 2017).

Mary River cod

Primary aims of research and monitoring projects on the Mary River cod were to consolidate its distribution within the catchment, focusing on optimal habitat and movement requirements.

In terms of distribution, monitoring identified areas re-established by cod (Conondale and Kenilworth), sites not previously recorded (Traveston), and known sites (Obi Obi, Tinana–Coondoo and Six Mile creeks). Critical habitat for Mary River cod is best represented by (1) instream woody structure, (2) shade – including undercut banks, (3) water depth >1.5 m, (4) riffles, and (5) food availability. All of these habitats are affected directly or indirectly by water management.

DNRME monitoring showed that cod movement was possible in the majority of seasons, across all sites. Tracking of Mary River cod revealed that it is a largely sedentary species, with even large flood flows not instigating movement. During the breeding season, however, short term return movements to and from specific habitat were recorded. A majority of these movements occurred on smaller flows associated with releases from Baroon Pocket Dam. Importantly, without baseflow releases from the dam, suitable depth to provide connectivity for these large fish may not have been provided.

Australian lungfish

Primary aims of research and monitoring projects on the Australian lungfish focused on identifying environmental drivers of recruitment, together with optimal habitat and movement requirements.

Australian lungfish are a long-lived species requiring specific conditions for spawning and recruitment. Dense macrophytes (aquatic plants) were found to be the most important habitat factor involved in lungfish reproduction. This habitat is negatively affected by large floods (scouring) for up to three years, and smaller floods for approximately one year. Lack of suitable macrophyte habitat prevents successful spawning and recruitment of Australian lungfish. When macrophytes are available, variable low flows are important to maintain this habitat, trigger spawning and ensure recruitment (Espinoza et al. 2013). In addition >90% of Australian lungfish movements were associated with flow events, highlighting the importance of natural flows for this species. Large flow events during the wet season commonly led to large-scale movements of lungfish.

Estuary monitoring

The provision of freshwater flow to estuaries (brackish habitat) is a key process that supports recruitment, growth and productivity of important commercial, recreational and ecological species. These include prawns, barramundi, sea mullet and mangroves. The plan area contains a number of estuaries associated with river and creek systems. These estuaries provide valuable ecosystem services and were assessed to highlight any potential impacts from water development.

The Mary River estuary receives perennial freshwater flows which create suitable brackish conditions in both space and time for estuarine health.

The mid-estuary was found to be brackish for more than 70% of the period assessed. Extended periods without flow or rainfall, generally in the dry season, led to hypersaline conditions in the Mary River estuary. The Burrum River, in contrast, was primarily a saline estuary with reduced freshwater flows. Brackish habitat in the Burrum River is complicated by three tributaries (Isis, Gregory and Cherwell rivers) entering the estuary near the mouth, which can create brackish habitat independently of Burrum River flows. The Maroochy River was found to provide suitable brackish habitat in terms of frequency of events (small flows) and persistence (large flows) however, the Mooloolah River estuary was found to be a more saline environment. The salinity dynamics in each estuary are affected by many factors including estuary shape, tidal patterns and freshwater inputs.

Longitudinal connectivity (environmental flow releases for Six Mile Creek and Obi Obi Creek)

Environmental flow strategies developed for Six Mile and Obi Obi creeks intend to minimise changes to the low flow regime of respective watercourses, and also minimise changes to hydraulic habitat requirements of resident ecological assets. It is important to note that releases for downstream users may also serve environmental purposes in watercourses and must therefore also be taken into consideration when assessing impacts to flow regimes.

Current environmental releases from Lake MacDonald in Six Mile Creek are not being transmitted effectively down the creek and are a potential concern for resident ecological assets, considering its perennial status prior to water resource development. Environmental flow releases are generally only detected in the reach immediately below Lake Macdonald.

Environmental flow releases from Baroon Pocket Dam on Obi Obi Creek (up to 15 ML/d) were shown to create water depths of 150 mm over riffles 10 km downstream of the wall, and 50–100 mm over riffles ~20 km downstream of the dam. In addition, releases provided for downstream landholders assist in both maintenance of water quality and the hydraulic habitat requirements of resident ecological assets.

Cooloola Patterned Fens

The Cooloola Patterned Fens are globally-unique wetlands that are located adjacent to Rainbow Beach in the Great Sandy National Park. These wetlands also overlay the Cooloola Sandmass, a regional aquifer that is currently managed under the plan. Underground water is found in both perched aquifers and the larger regional aquifer, with perched aquifers being found above the regional aquifer. Underground water is extracted for purposes such as town water supply, domestic use and sand-mining operations. Monitoring aimed to determine the dependence of the Patterned Fens on either regional or perched aquifers through water chemistry analysis and assess impacts of water extraction from the regional aquifer.

Water chemistry of the Patterned Fens most closely matched that of the perched aquifers, whereas the water chemistry of Searys and Teewah creek systems more closely matched that of the regional aquifer. The extraction of water for Rainbow Beach from the regional aquifer causes very temporary (sub-daily) reductions in water level close to the production bores, with recovery observed within hours. No impacts have been observed throughout more distant monitoring bores throughout the sandmass.

Appendix D: Surface water monitoring

Table 10 – Discharge summaries for gauging stations in the plan area since commencement of the plan

Gauging station	Parameter	Discharge in ML/day (year)
Mary River at Home Park (138014A)	Instantaneous maximum	872 562 (2012/13)
Tinana Creek at Bauple East (138903A)	Instantaneous maximum	91 366 (2011/12)
Six Mile Creek at Cooran (138107B)	Instantaneous maximum	41 031 (2011/12)
Wide Bay Creek at Brooyar (138002C)	Instantaneous maximum	209 513 (2012/13)
Munna Creek at Marodian (138004B)	Instantaneous maximum	322 279 (2012/13)
Mary River at Moy Pocket (138111A)	Instantaneous maximum	247 851 (2010/11)

Appendix E: Operational reporting by ROL holders

Table 11 – Non-compliance incidents for the Lower Mary water supply scheme

Non-compliance Area	Details	Management Actions
Taking of medium priority water by customers	In Feb 2013, customers were restricted from taking medium priority water within the water supply scheme. This was due to Walker Point, Owanyilla, Copenhagen Bend and Main Roads pump stations being inoperable until an inspection could be carried out to determine the extent of damage due to recent floods and if they could be operated satisfactorily.	SunWater provided an operational report to advise of the situation and that they had notified their customers of the situation

Table 12 – Non-compliance incidents for the Baroon Pocket water supply scheme

Non-compliance Area	Details	Management Actions
Environmental management strategies	The required release of 15 ML/day was not achieved on 23/6/2015 as the release had to be shut down for a period of time to allow for operational maintenance to be undertaken	Seqwater provided an operational report to advise of this issue
Environmental management strategies	The required release of 15 ML/day was not achieved on another two occasions in September 2015 and again on two occasions in January 2016 due to computer system error	Seqwater provided operational reports to advise of each incident and to advise that they were working to improve the system to prevent future occurrences of this problem
Environmental management strategies	The required releases were not made during the period 01–28/02/2014 due to instrumentation failure	Seqwater provided an operational report to advise of the issue

Table 13 – Non-compliance incidents for the Wide Bay water supply scheme

Non-compliance Area	Details	Management Actions
Crest gate operation	During the early stages of commissioning there were some issues with the crest gates on Lenthalls Dam not operating as designed. These issues were highlighted during flood events in February and March 2012 and January and March 2013	Wide Bay Water Corporation provided an operational report on each occasion to advise of the issue with the operation of the crest gates. They undertook a crest gate modification project between June and September 2015 to fix the problem and the gates seem to have operated as designed during flood events since that time
Environmental management strategies	For a period in March 2013 releases were not made strictly in accordance with section 174 of the ROP (Low flow release strategy for Lenthalls Dam)	Wide Bay Water Corporation provided an operational report to advise of the circumstances leading to the decision to amend the releases. A significant volume of water had been released earlier in anticipation of expected heavy rainfall which did not eventuate as forecast. WBWC approached DNRME requesting that the previous release be considered an offset to the low flow release requirement.
Environmental management strategies	In April 2017 releases were not made in accordance with section 174 of the ROP during 1–30 April 2017	Wide Bay Water (Fraser Coast Council) provided an operational report to advise of non-compliance with the low flow release strategy for Lenthalls Dam. After releasing water from the storage under high flow release strategy, the level in the dam fell below FSL however the strategy was still triggered. They advised that they had stopped releases as at 1 April and requested that DNRME approve the cessation of releases under this section until the end of April. This request was reviewed by DNRME and recommended that we acknowledge the non-compliance from 1 April to date and approve the cessation of releases until the end of April 2017.
Operating rules for the Wongi Waterholes	There have been several incidents of non-compliance relating to the pumping of the Wongi Waterholes to maintain the appropriate level	On each occasion Wide Bay Water Corporation/Fraser Coast Regional Council provided an operational report detailing the reason for the non-compliance. e.g. damage to the pump by vandals and the pump being required for an emergency elsewhere

Appendix F: Plan amendments and milestones

Table 14 – Water planning milestones for the plan

Effective date	Milestone
28 July 2006	The plan commenced in July 2006 and applied to surface water and underground water in the Cooloola Sandmass. The plan identified general, strategic and town water supply reserves to provide for future water requirements, including the opportunity for additional water to be taken. The plan allowed continued use of all water entitlements and improved certainty of supply for water entitlement holders. The plan also provided the framework for conversion of water entitlements to tradeable water allocations, and water for essential supplies and natural ecosystems as well as recognising cultural values important to Traditional Owners.
14 December 2007	In 2007 the following amendments were made to the plan— <ul style="list-style-type: none"> • administrative changes to reflect existing operating arrangements in the Lower Mary River water supply scheme by transferring responsibility for operating and managing parts of the scheme from SunWater to Maryborough City Council by creating a new water supply scheme • amendments to the annual volumetric limits for licences granted to Rainbow Shores Pty Ltd, without increasing the total volume of water taken • inclusion of water allocation security objectives (WASOs) for the Wide Bay water supply scheme • inclusion of Teddington Weir water supply scheme and its water allocation security objectives.
1 July 2008	<i>The Water Supply (Safety and Reliability) Act 2008</i> amended the plan to include the water grid manager as an entity to be granted unallocated water from the town water supply reserve.
18 December 2009	The Sustainable Planning Regulation 2009 made consequential amendments to the plan to align cross references and sections in the plan with relevant sections in the regulation.
September 2011	The Resource Operations Plan (ROP) was released in 2011 and created 530 supplemented water allocations across the six water supply schemes. The ROP implemented the plan by providing routine operational rules and requirements for: <ul style="list-style-type: none"> • the protection of existing water entitlements • processes for dealing with unallocated water • the establishment of trading zones and specifying rules for trading water allocations • the establishment of water sharing rules and infrastructure operating rules applicable to the water supply schemes.
27 September 2013	The <i>Land, Water and Other Legislation Amendment Act 2013</i> amended the plan to update a section number cross reference with the Water Act.
27 June 2014	The plan was amended by the Water Resource Plans Amendment Plan (No. 1) 2014 which: <ul style="list-style-type: none"> • changed the Minister’s reporting period on the plan to five years • removed unnecessary prescription while retaining policy intent and standardised, simplified and enhanced the transparency of selected provisions, removed redundant provisions; and removed duplication – with the Water Act and the Water Regulation 2002.
8 July 2016	The Water Resource (Mary Basin) Plan (Postponement of Expiry) Notice 2016 postponed the expiry of the plan until 1 September 2021.
06 December 2016	The plan was amended by the <i>Water Reform and Other Legislation Amendment Act 2014</i> and the Water Regulation to: <ul style="list-style-type: none"> • update the short title of the plan • clarify the definition for water to which the plan applies • provide an interim definition for the term subartesian water until such time as the plan is reviewed and replaced • to update cross references.
3 July 2017	The Planning (Consequential) and Other Legislation Amendment Regulation 2017 amended the plan to change the definition of the SEQ regional plan.

Appendix G: Overview of non-compliance issues

Table 15 – Summary of compliance actions in past five years

Year	Number of non-compliance	Types of non-compliance	Outcome
2013/14	16	10 Unauthorised take 6 Unauthorised interference	14 No offence detected 1 Compliance notice 1 Warning Notice
2014/15	19	8 Unauthorised take 11 Unauthorised interference	15 No offence detected 1 Compliance Notice 1 Warning Letter 2 Negotiated outcome - authorisation now in place
2015/16	5	4 Unauthorised take 1 Unauthorised interference	5 No offence detected
2016/17	17	10 Unauthorised take 7 Unauthorised interference	14 No offence detected 3 Negotiated outcome - authorisation now in place
2017/18	8	5 Unauthorised take 3 Unauthorised interference	7 No offence detected 1 Negotiated outcome

*The details supplied in this table are correct as of October 2018. Any changes that occurred after that date will not be reflected in the table.