DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Namoi Long Term Water Plan

Part B: Namoi planning units

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Cover photo: Namoi River at Carroll off the Oxley Highway, Terry Cooke

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Acknowledgement of Traditional Owners

The Department of Planning, Industry and Environment pays its respect to the Traditional Owners of the Murray–Darling Basin and their Nations. The contributions of earlier generations, including the Elders, who have fought for their rights in natural resource management are valued and respected.

In relation to the Namoi catchment, the Department of Planning, Industry and Environment pays its respects to the Traditional Owners – the Kamilaroi/Gamilaraay people – past, present and future. We look forward to building upon existing relationships to improve the health of our rivers, wetlands and floodplains, including in recognition of their traditional and ongoing cultural and spiritual significance.

Figure 1 **Nardoo plant, Namoi River near Wee Waa**
Photo: N. Foster

Abbreviations

AHIMS	Aboriginal Heritage Information Management System
Basin Plan	Murray–Darling Basin Plan 2012
BF	Baseflow
BK	Bankfull
BWS	Basin-wide environmental watering strategy
C	Critically Endangered
CAMBA	China – Australia Migratory Bird Agreement
CEWO	Commonwealth Environmental Water Office
CtF	Cease-to-flow
CtP	Cease-to-pump
DBH	Diameter at breast height
DO	Dissolved oxygen
DOC	Dissolved organic carbon
DPIF	NSW Department of Primary Industries Fisheries
DPIE	Department of Planning, Industry and Environment
DPIE–BC	Department of Planning, Industry and Environment – Biodiversity and Conservation Division
DPIE–Water	Department of Planning, Industry and Environment - Water
E	Endangered
EEC	Endangered ecological community
EWA	Environmental water allowance
EWR	Environmental water requirement
GDE	Groundwater-dependent ecosystem
GL/yr	gigalitres per year
ha	hectares
HEW	Held environmental water
IDEL	Individual daily extraction limit
“J” or JAMBA	Japan – Australia Migratory Bird Agreement
“K” or ROKAMBA	Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)
LF	Large fresh
LLS	Local Land Services (NSW)
LTWP	Long Term Water Plan
m/s	metres per second
MDBA	Murray–Darling Basin Authority
MER	Monitoring, evaluation and reporting
mg/L	milligrams per litre
ML	megalitre

MZ	Management zone
NF	Native fish objective
NPWS	NSW National Parks and Wildlife Services
NSW	New South Wales
OB	Overbank
PCT	Plant community type
PEW	Planned environmental water
PU	Planning unit
RAS	Resource availability scenario
RCM	Regional Climate Model
ROKAMBA	Republic of Korea – Australia Migratory Bird Agreement
RRG	River red gum
SDL	Sustainable diversion limit
SF	Small fresh
TDEL	Total daily extraction limit
V	Vulnerable to extinction
VF	Very low flow
WAL	Water access licence
WL	Wetland inundating flow
WQMP	Water quality management plan
WRP	Water resource plan
WRPA	Water resource plan area
WSP	Water sharing plan

Glossary

Actively managed floodplain	The area of floodplains and wetlands that can be inundated by flows from regulated rivers (see 'Regulated river').
Adaptive management	A procedure for implementing management while learning about which management actions are most effective at achieving specified objectives.
Allocation	The volume of water made available to water access licence or environmental water accounts in a given year by DPIE-W, which is determined within the context of demand, inflows, rainfall forecasts and stored water.
Alluvial	Comprised of material deposited by water.
Bankfull flow (BK)	River flows at maximum channel capacity with little overflow to adjacent floodplains. These flows engage the riparian zone, anabranches, flood runners and wetlands located within the meander train. They inundate all in-channel habitats including benches, snags and backwaters.
Baseflow (BF)	Reliable background flow levels within a river channel that are generally maintained by seepage from groundwater storage, but also by surface inflows. They typically inundate geomorphic units such as pools and riffle areas.
Basin Plan	The Basin Plan as developed by the Murray–Darling Basin Authority under the *Water Act 2007*.
Biota	The organisms that occupy a geographic region.
Blackwater	Occurs when water moves across the floodplain and releases organic carbon from the soil and leaf litter. The water takes on a tea colour as tannins and other carbon compounds are released from the decaying leaf litter. The movement of blackwater plays an important role in transferring essential nutrients from wetlands into rivers and vice versa. Blackwater carries carbon which is the basic building block of the aquatic food web and an essential part of a healthy river system.
Carryover	Water allocated to water licences or environmental water accounts that remains un-used in storage at the end of the water year which, under some circumstances, may be held over and used in the following water year.
Catch per unit effort (CPUE)	An indirect measure of the abundance of a target species.
Cease-to-flow (CtF)	The absence of flowing water in a river channel that leads to partial or total drying of the river channel. Streams contract to a series of isolated pools.

Cease-to-pump (access rule in WSP) (CtP)	Pumping is not permitted: • from in-channel pools when the water level is lower than its full capacity • from natural off-river pools when the water level is lower than its full capacity • from pump sites when there is no visible flow. These rules apply unless there is a commence-to-pump access rule that specifies a higher flow rate that licence holders can begin pumping.
Cold water pollution	The artificial lowering of water temperature that occurs downstream of dams. In older dams, particularly those with a depth greater than 15 metres, water is typically released from the bottom of the dam where water temperatures can be significantly lower than surface readings. For native fish, that respond to temperature cues to breed, the effects of cold water pollution can be particularly harmful. Cold water pollution can reduce the availability of food, increase fish mortality and reduce the frequency and success of breeding events. The impact of cold water pollution can extend for hundreds of kilometres along the river from the point of release.
Constraints	The physical or operational constraints that affect the delivery of water from storages to extraction or diversion points. Constraints may include structures such as bridges that can be affected by higher flows, the volume of water that can be carried through the river channel, or scheduling of downstream water deliveries from storage.
Consumptive water	Water that is removed from available supplies without return to a water resource system (such as water removed from a river for agriculture).
Cultural water-dependent asset	A place that has social, spiritual and cultural value based on its cultural significance to Aboriginal people. Related to the water resource.
Cultural water-dependent value	An object, plant, animal, spiritual connection or use that is dependent on water and has value based on its cultural significance to Aboriginal people.
Discharge	The amount of water moving through a river system, most commonly expressed in megalitres per day (ML/d).
Ecological asset	The physical features that make up an ecosystem.
Ecological function	The resources and services that sustain human, plant and animal communities and are provided by the processes and interactions occurring within and between ecosystems.
Ecological objective	Objective for the protection and/or restoration of an ecological asset or function.
Ecological target	Level of measured performance that must be met in order to achieve the defined objective. The targets in this long term water plan are SMART (Specific/Measurable/Achievable/Realistic/Time-bound).
Ecological value	An object, plant or animal which has value based on its ecological significance.

Ecosystem	A biological community of interacting organisms and their physical environment. It includes all the living things in that community, interacting with their non-living environment (weather, earth, sun, soil, climate and atmosphere) and with each other.
Environmental water	Water for the environment. It serves a multitude of benefits to not only the environment, but communities, industry and society. It includes water held in reservoirs (held environmental water) or protected from extraction from waterways (planned environmental water) for the purpose of meeting the water requirements of water-dependent ecosystems.
Environmental water requirement (EWR)	The water required to support the completion of all elements of a lifecycle of an organism or group of organisms (taxonomic or spatial), consistent with the objective / target, measured at the most appropriate gauge. It includes all water in the system including natural inflows, held environmental water and planned environmental water.
Flow category	The type of flow in a river defined by its magnitude (e.g. bankfull).
Flow regime	The pattern of flows in a waterway over time that will influence the response and persistence of plants, animals and their ecosystems.
Freshes	Temporary in-channel increased flow in response to rainfall or release from water storages.
Groundwater	Water that is located below the earth's surface in soil pore spaces and in the fractures of rock formations. Groundwater is recharged from, and eventually flows to, the surface naturally.
Held environmental water (HEW)	Water available under a water access right, a water delivery right, or an irrigation right for the purposes of achieving environmental outcomes (including water that is specified in a water access right to be for environmental use).
Hydrological connectivity	The link of natural aquatic environments.
Hydrology	The occurrence, distribution and movement of water.
Hypoxic Blackwater	Occurs when dissolved oxygen (DO) levels fall below the level needed to sustain native fish and other water dependent species. Bacteria that feed on dissolved organic carbon use oxygen in the water. When they multiply rapidly their rate of oxygen consumption can exceed the rate at which oxygen can be dissolved in the water. As a result, oxygen levels fall and a hypoxic (low oxygen) condition occurs. Dissolved oxygen is measured in milligrams per litre (mg/L). Generally native fish begin to stress when DO levels fall below 4 mg/L. Fish mortality occurs when DO levels are less than 2 mg/L.
Large fresh (LF)	High-magnitude flow pulse that remains in-channel. These flows may engage flood runners with the main channel and inundate low-lying wetlands. They connect most in-channel habitats and provide partial longitudinal connectivity, as some low-level weirs and other in-channel barriers may be drowned out.
Lateral connectivity	The flow linking rivers channels and the floodplain.
Longitudinal connectivity	The consistent downstream flow along the length of a river.

Long Term Water Plan (LTWP)	A component of the Murray–Darling Basin Plan. Long term water plans give effect to the Basin-wide environmental watering strategy (MDBA 2014) relevant for each river system and will guide the management of water over the longer term. These plans will identify the environmental assets that are dependent on water for their persistence, and match that need to the water available to be managed for or delivered to them. The plan will set objectives, targets and watering requirements for key plants, waterbirds, fish and ecosystem functions. DPIE-BC is responsible for the development of nine plans for river catchments across NSW, with objectives for five, 10 and 20-year timeframes.
Overbank flow (OB)	Flows that spill over the riverbank or extend to floodplain surface flows.
Planned environmental water (PEW)	Water that is committed by the Basin Plan, a water resource plan or a plan made under state water management law to achieving environmental outcomes.
Planning Unit (PU)	A division of a water resource plan area based on water requirements (in catchment areas in which water is actively managed), or a sub-catchment boundary (all other areas).
Population structure	A healthy population structure has individuals in a range of age and size classes. These populations demonstrate regular recruitment and good numbers of sexually mature individuals.
Priority ecological asset	A place of particular ecological significance that is water-dependent and can be managed with environmental water. This includes planned and held environmental water.
Priority ecological function	Ecological functions that can be managed with environmental water.
Ramsar Convention	An international treaty to maintain the ecological character of key wetlands.
Recruitment	Successful development and growth of offspring; such that they have the ability to contribute to the next generation.
Refugium / refuge habitat	An area in which a population of plants or animals can survive through a period of decreased water availability.
Regulated river	A river that is gazetted under the *NSW Water Management Act 2000.* Flow is largely controlled by major dams, water storages and weirs. River regulation brings more reliability to water supplies but has interrupted the natural flow characteristics and regimes required by native fish and other plant and animal to breed, feed and grow.
Riffle	A rocky or shallow part of a river where river flow is rapid and broken.
Riparian	The part of the landscape adjoining rivers and streams that has a direct influence on the water and aquatic ecosystems within them.
Risk management strategy	A plan of management to overcome risks to achieving environmental outcomes.

Small fresh (SF)	Low-magnitude in-channel flow pulse. Unlikely to drown out any significant barriers but can provide limited connectivity and a biological trigger for animal movement.
Substrate	A habitat surface such as a stream bed.
Supplementary access	A category of water entitlement where water is made available to licence holder accounts during periods of high river flows that cannot otherwise be controlled by river operations. Water can be taken and debited from licence accounts during a declared period of high flow.
Surface water	Water that exists above the ground in rivers, streams creeks, lakes and reservoirs. Although separate from groundwater, they are interrelated and over extraction of either will impact on the other.
Sustainable diversion limit (SDL)	The grossed-up amount of water that can be extracted from Murray–Darling Basin rivers for human uses while leaving enough water in the system to achieve environmental outcomes.
Unregulated river	A waterway where flow is mostly uncontrolled by dams, weirs or other structures.
Very low flow (VF)	Small flow in the very-low flow class that joins river pools, thus providing partial or complete connectivity in a reach. These flows can improve DO saturation and reduce stratification in pools.
Water quality management plan (WQMP)	A document prepared by state authorities and accredited by the Commonwealth under the Basin Plan. It forms part of a water resource plan and aims to provide a framework to protect, enhance and restore water quality in each water resource plan area.
Water resource plan (WRP)	A document prepared by state authorities and accredited by the Commonwealth under the Basin Plan. The document describes how water will be managed and shared between users in an area.
Water resource plan area (WRPA)	Catchment-based divisions of the Murray–Darling Basin defined by a water resource plan.
Water sharing plan (WSP)	A plan made under the NSW *Water Management Act 2000* that sets out specific rules for sharing and trading water between the various water users and the environment in a specified water management area. It forms part of a water resource plan.
Water-dependent system	An ecosystem or species that depends on periodic or sustained inundation, waterlogging or significant inputs of water for natural functioning and survival.

Definitions and explanatory text for EWRs

Flow category	Flows in rivers vary over time in response to rainfall, river regulation, extractions and other factors. The sequence of flows over time can be considered as a series of discrete events. These events can be placed into different flow categories (e.g. baseflows, freshes, bankfull, overbank and wetland flows) according to the magnitude of flow discharge or height within a watercourse, and the types of outcomes associated with the events (e.g. inundation of specific features such as channel benches, riparian zones or the floodplain). Flow categories used in LTWPs are illustrated and defined in Figure 9 and Table 7 in Part A of each LTWP.
Environmental water requirement (EWR)	An environmental water requirement (EWR, singular) describes the characteristics of a flow event (e.g. magnitude, duration, timing, frequency, and maximum dry period) within a particular flow category (e.g. small fresh), that are required for that event to achieve a specified ecological objective or set of objectives (e.g. to support fish spawning and in-channel vegetation). There may be multiple EWRs defined within a flow category, and numerous EWRs across multiple flow categories within a Planning Unit. Achievement of each of the EWRs will be required to achieve the full set of ecological objectives for a Planning Unit.
EWR code	Each EWR is given a specific code that abbreviates the EWR name (e.g. SF1 for small fresh 1). This code is used to link ecological objectives and EWRs.
Gauge	The flow gauging station that best represents the flow within the planning unit, for the purpose of the respective EWR and associated ecological objective(s). To assess the achievement of the EWR, flow recorded at this gauge should be used.
Flow rate or flow volume	The flow rate (typically ML/d) or flow volume (typically GL over a defined period of time) that is required to achieve the relevant ecological objective(s) for the EWR.
Timing	The required timing (or season, typically expressed as a range of months within the year) for a flow event to achieve the specified ecological objective(s) of the EWR. In some cases, a preferred timing is provided, along with a note that the event may occur at ‘anytime’. This indicates that ecological objectives may be achieved outside the preferred timing window, but perhaps with sub-optimal outcomes. In these instances, for the purposes of managing and delivering environmental water, the preferred timing should be used to give greater confidence in achieving ecological objectives. Natural events may occur at other times and still achieve ecological objectives.
Duration	The duration for which flows must be above the specified flow rate for the flow event to achieve the specified ecological objective(s) of the EWR. Typically, this is expressed as a minimum duration. Longer durations will often be desirable and deliver better ecological outcomes. Some species may suffer from extended durations of inundation, and where relevant a maximum duration may also be specified. Flows may persist on floodplains and within wetland systems after a flow event has past. Where relevant a second duration may also be specified, representing the duration for which water should be retained within floodplain and wetland systems.

Frequency	The frequency at which the flow event should occur to achieve the ecological objective(s) associated with the EWR. Frequency is expressed as the number of years that the event should occur within a 10-year period. In most instances, more frequent events will deliver better outcomes, and maximum frequencies may also be specified, where relevant. Clustering of events over successive years can occur in response to climate patterns. Clustering can be ecologically desirable for the recovery and recruitment of native fish, vegetation and waterbirds populations, however extended dry periods between clustered events can be detrimental. Achieving ecological objectives will require a pattern of events over time that achieves both the frequency and maximum inter-flow period, and the two must be considered together when evaluating outcomes or managing systems. Where a range of frequencies is indicated (e.g. 3–5 years in 10), the range reflects factors including the natural variability in population requirements, uncertainty in the knowledge base, and variability in response during different climate sequences (e.g. maintenance of populations during dry climate sequences at the lower end of the range, and population improvement and recovery during wet climate sequences at the upper end of the range). The lower end of the frequency range (when applied over the long term) may not be sufficient to maintain populations and is unlikely to achieve any recovery or improvement targets. As such, when evaluating EWR achievement over the long-term through statistical analysis of modelled or observed flow records, DPIE-BC recommend that the average of the frequency range is used as the minimum long term target frequency.
Maximum inter-flow or inter-event period	The maximum time between flow events before a significant decline in the condition, survival or viability of a particular population is likely to occur, as relevant to the ecological objective(s) associated with the EWR. This period should not be exceeded wherever possible. Annual planning of environmental water should consider placing priority on EWRs that are approaching (or have exceeded) the maximum inter-event period, for those EWRs that can be achieved or supported by the use of environmental water or management.
Additional requirements and comments	Other conditions that should occur to assist ecological objectives to be met, for example rates of rise and fall in flows. Also comments regarding limitations on delivering environmental flows and achieving the EWR.

Introduction

To manage the complexity of the Namoi Water Resource Plan Area (WRPA), the Namoi Long Term Water Plan (LTWP) has been divided into 36 planning units (PU) (Figure 3). For each PU the following local-scale information is provided:

- the location of some key environmental assets identified as part of plan's development.
- the ecological values, including native fish, waterbird species, native vegetation communities and cultural water-dependent assets that occur within the PUs priority environmental assets
- *for regulated PUs,* and a few unregulated PUs, the environmental water requirements (EWRs) to support ecological values and objectives at representative gauges in the PU
- *for unregulated PUs* - an evaluation of the impact of water resource development on local hydrology and recommended management strategies for mitigating these changes to meet LTWP objectives and targets.

The PU boundaries typically align with the water source area boundaries in the Namoi Water Resource Plan (WRP). However, some of these water sources have been amalgamated or modified slightly in regulated stretches to reflect how water can be managed.

The PUs are then grouped into four management areas. These management areas align with the boundaries of the 'Fish and Flows' work DPI Fisheries are undertaking in the valley. Namely the Namoi regulated[1], the Peel, Upper Namoi and Lower Namoi management areas (Figure 3). These management areas contain varying hydrology and geomorphology traits and are covered by different Water Sharing Plans (WSPs).

For the PUs that contain unregulated reaches, information is presented on the hydrology and the degree of alteration, as determined by DPIE-W in their Namoi WRPA Risk Assessment (DPIE-W 2019). This assessment compares flows under modelled near natural conditions (with no dams or water extractions) and flows under modelled current conditions. Table 1 describes how the hydrological change is presented in each unregulated PU.

Table 1 Key to hydrological alteration

Key to hydrological alteration from *Risk assessment for the Namoi water resource plan area* (NSW DPIE-Water 2019)
L = Low: less than 20% departure (+/-) from the base case for each hydrologic metric
M = Medium: 20–50% departure (+/-); from the base case for each hydrologic metric
H = High: greater than 50% departure (+/-) from the base case for each hydrologic metric
N/A = no risk outcome or modelling available due to no hydrological data available
$^{+}$ increase near-natural condition
$^{-}$ decrease near-natural condition
^{0} no change from near-natural condition

Source: (NSW DPIE 2019a)

[1] Note. Some units within the regulated management area are not entirely regulated, for example the Pian Creek planning unit and the Lower Namoi Water source. However, the management of regulated water can affect ecological assets in these units.

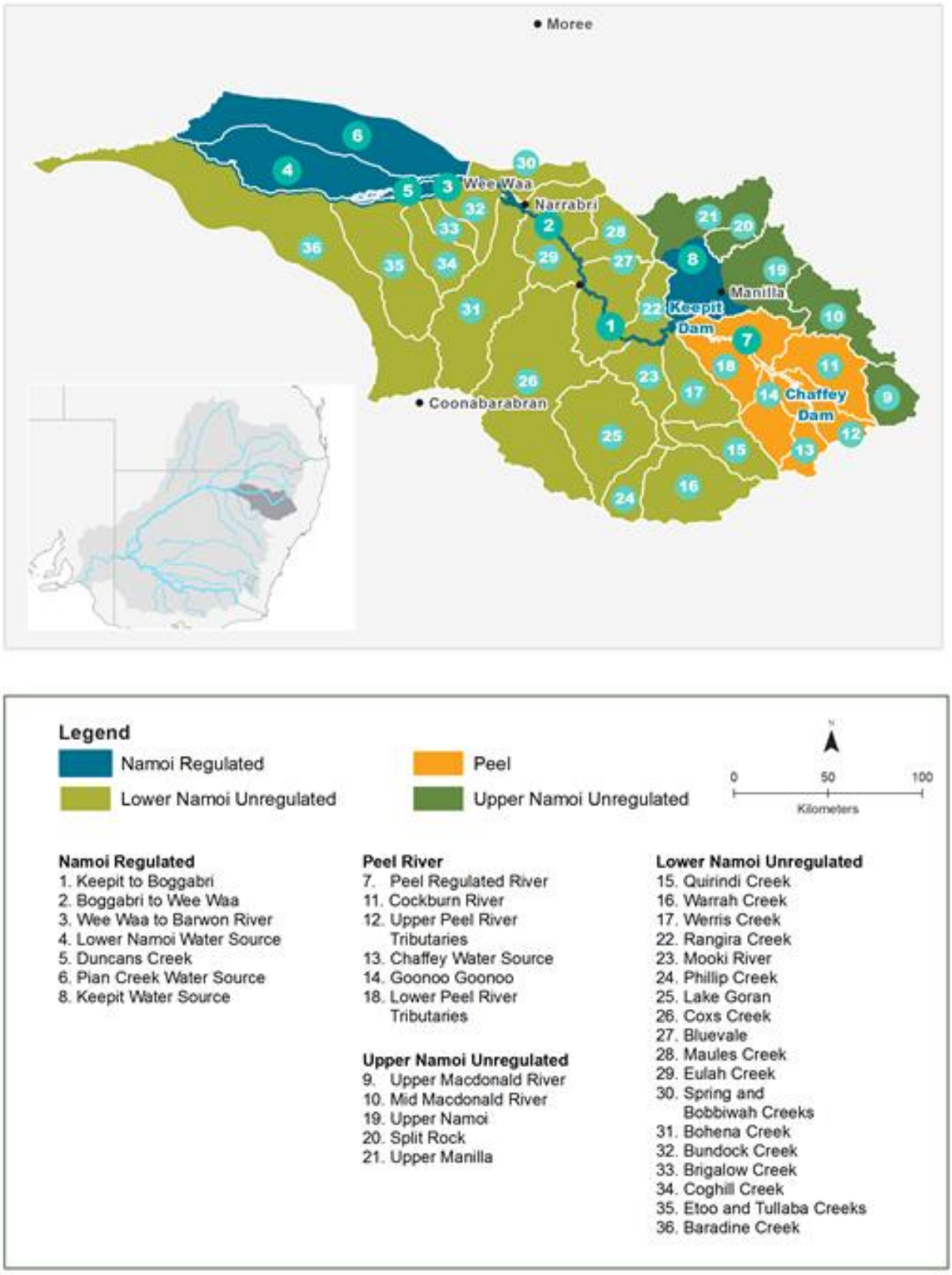


Figure 2 Map of management areas and planning unit boundaries

1. Namoi regulated planning units

The Namoi Regulated management area includes the extent of the regulated Namoi River, starting downstream of Split Rock Dam, flowing through Gunnedah, Boggabri, Narrabri, Wee Waa and Burren Junction to Walgett. Downstream of Wee Waa a series of effluent creeks split from the Namoi River, including Pian Creek, Gunidgera Creek, Duncans Warrambool and Cubbaroo Warrambool. There are seven PUs in this management area, all regulated except for the Lower Namoi PU and the section of the Pian Creek downstream of Dundee Weir. The Lower Namoi PU is situated to the north of the Namoi River between Wee Waa and Walgett and can be affected by water management in the regulated river, given the effluent nature of this area.

The associated storage and diversion infrastructure in this management zone has increased the potential for river flows to be managed and targeted to meet the needs of the environment. Held environmental water (HEW) (currently only owned by the Commonwealth Environmental Water Holder) released from Split Rock and Keepit dams can be delivered to priority environmental assets in these areas, together with planned environmental water (PEW) and water delivered for consumptive use.

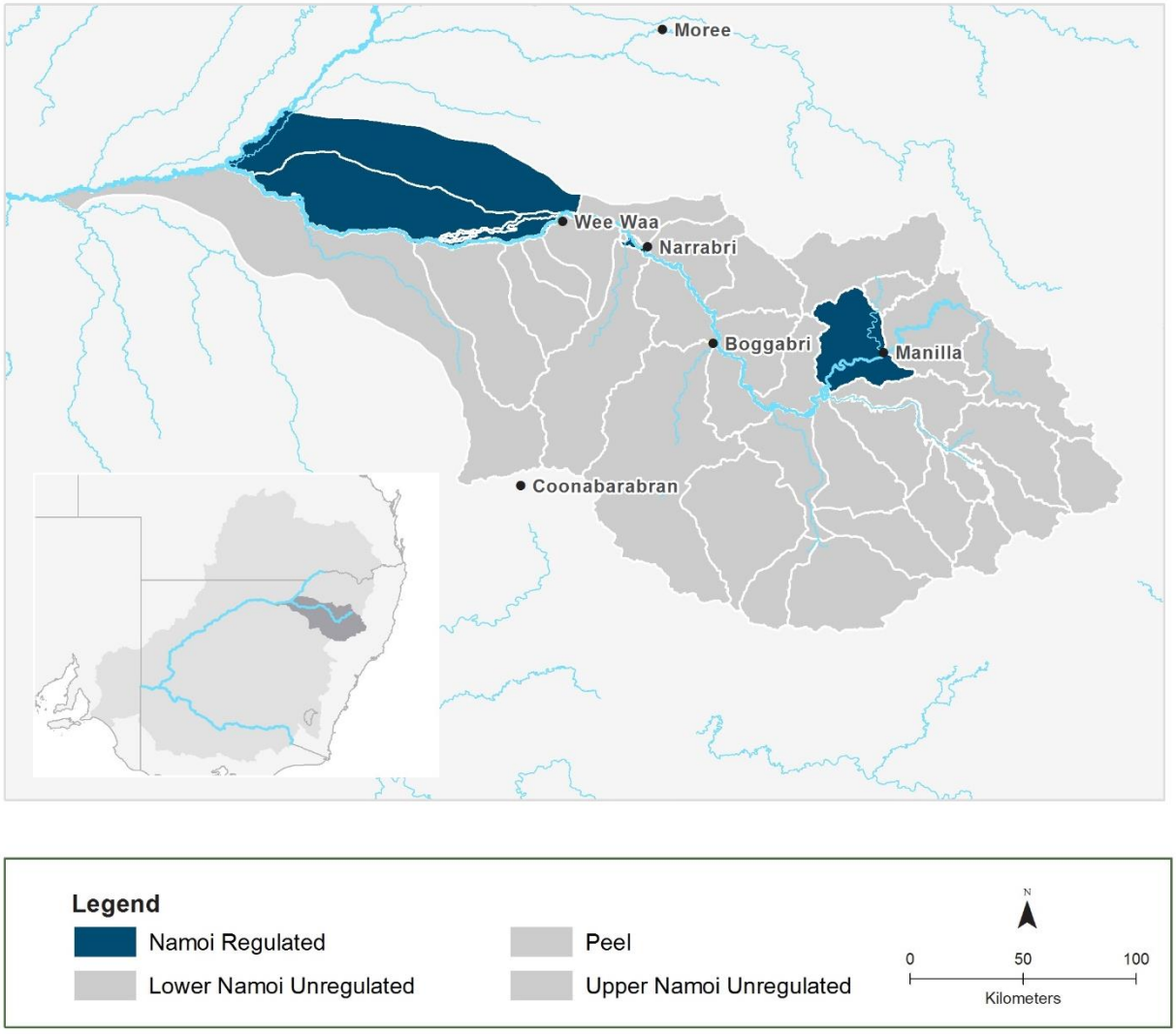
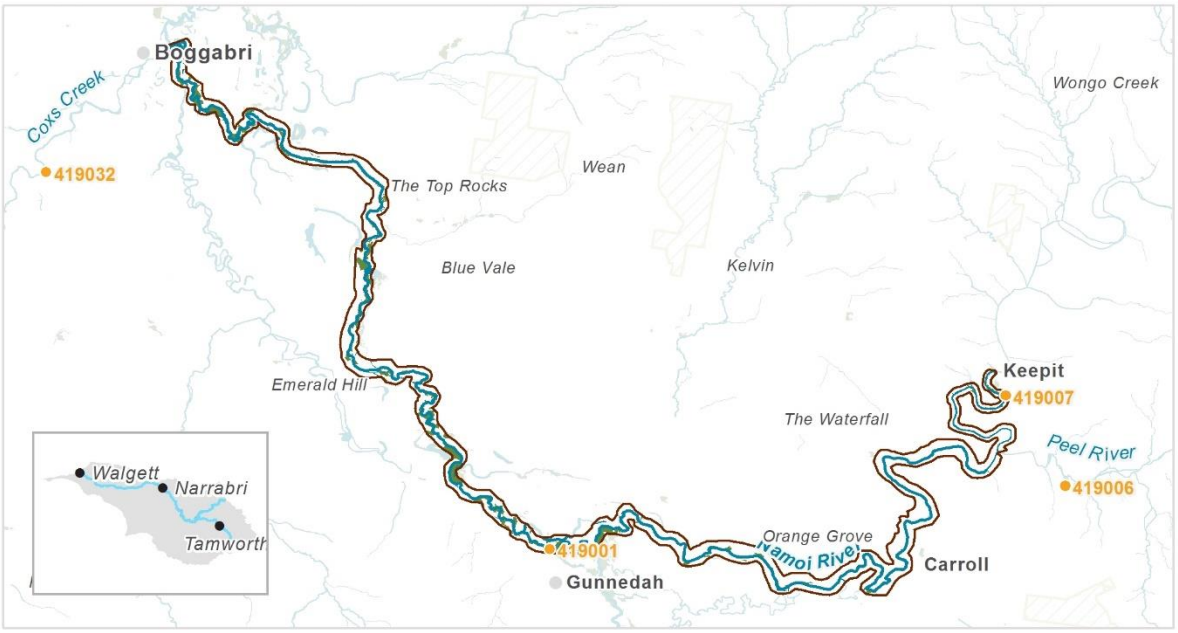


Figure 3 Regulated Namoi management area

PU1: Keepit to Boggabri



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- The Namoi River and its instream habitat and fringing vegetation communities
- Gulligal Lagoon provides important drought refuge and waterbird habitat. It is known to fill when river height at Gunnedah is 5 m
- Landry Lagoon – provides aquatic drought refuge
- Gunnible Lagoon – provides aquatic drought refuge and waterbird feeding and breeding habitat
- The start of Barbers Lagoon
- Carroll Creek, Coxs Creek, Deadmans Gully, Pig Hollow

Native fish	• unspecked hardyhead • carp gudgeon • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • spangled perch	• Murray cod • freshwater catfish • olive perchlet • silver perch
Birds	36 water-dependent bird species recorded, including: • Australasian darter	• Australian painted snipe	
Native vegetation	6 water-dependent plant community types, including: • river red gum woodland • sedgeland fens wetlands (EEC)	• wetland sedgeland	• canegrass swamp grassland wetland
Registered cultural assets	• modified trees	• artefacts	

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, spangled perch, golden perch, silver perch, Murray cod, freshwater catfish, olive perchlet
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range: freshwater catfish
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Other Notes: 6 kms downstream of the confluence of the Namoi and Peel Rivers, floods inundate both sides of the river extensively, with a major breakout further downstream at Tommy Swamp (7000–8000 ML/d at Gunnedah).

Downstream of Gunnedah, flooding extends across the floodplain as a number of floodrunners come into effect. The principal flood runner is Dead Man’s Gully, which affects the western floodplain and runs from Gunnedah to Boggabri. Immediately upstream of Boggabri, the flow pattern is quite complex, with a major system of prior streams passing flood waters either side of Flood Hill.

Moderate to major flooding at Gunnedah occurs at volumes above 48,500 ML/d. Similar volumes result in flooding at Boggabri and Narrabri (Foster 2003).

Table 2 Environmental water requirements for the Namoi River downstream of Keepit Dam (gauge 419007)[2]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically Jan to June	Typically CtF events should be around 1 day. CtF should not persist for longer than 5 days	Should occur in no more than 20% of years	N/A	
Very-low flow	VF1	> 5 ML/d	Any time	365 days minimum (or 287 days minimum in very dry years)	Annually	5 days	
Baseflow	BF1	> 200 ML/d	Any time	209 days minimum (or 51 days minimum in very dry years)	Annually	131 days	
	BF2	> 200 ML/d	Sept to Mar	119 days minimum (or 19 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	>500 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annually	1 year	
	SF2	500– 1400 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (60% LTA)	2 years	
Large fresh	LF1	> 1400 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	>1400 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	

[2] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (LTA frequency)	Maximum inter-event period	Additional requirements & comments
Bankfull	BK1	> 3500 ML/d	Oct to Apr	4 days minimum* (ideally > 10 days[3])	5 years in 10 (50% LTA)	4 years	* can go below threshold for up to 5 days
	BK2	> 3500 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	
Overbank	OB1	> 6150 ML/d	Oct to Apr	2 days minimum* (ideally > 10 days[3])	4-5 years in 10 (45% LTA)	4 years	* can go below threshold for up to 5 days
	OB2	> 6150 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	
Large Overbank	OB3	> 15,000 ML/d	Aug to Feb (but can occur any time)	1 day 1–4 months (habitat inundated)	3–5 years in 10 (35% LTA)	5 years	Note: For river red gums: maintenance flows are ideal between Sept & Feb, & regeneration flows are best from Aug to Nov. Inundation is ideally between 1 and 2 months.

[3] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (low-lying wetlands, anabranches and, in the case of overbank flows, on floodplains).

Table 3 Environmental watering requirements for the Namoi River at Gunnedah (gauge 419001)[4]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	Jan to June	Typically CtF events should be around 6 days. CtF should not persist for longer than 29 days	Should occur in no more than 35% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	365 days minimum (or 280 days minimum in very dry years)	Annually	29 days	
Baseflow	BF1	> 200 ML/d	Any time	240 days minimum (or 70 days minimum in very dry years)	Annually	100 days	
	BF2	> 200 ML/d	Sept to Mar	140 days minimum (or 25 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 600 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annually	1 year	Gunnembene Crossing: Benches are 3000–9000 ML at Gunnedah
	SF2	600–5400 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (75% LTA)	2 years	Point bars are 5000–7000 ML/d at Gunnedah
Large fresh	LF1	> 5400 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (75% LTA)	2 years	Point bar: 5000–7000 ML/d at Gunnedah. Big Bend: Point bar: 7000–8000 ML/d

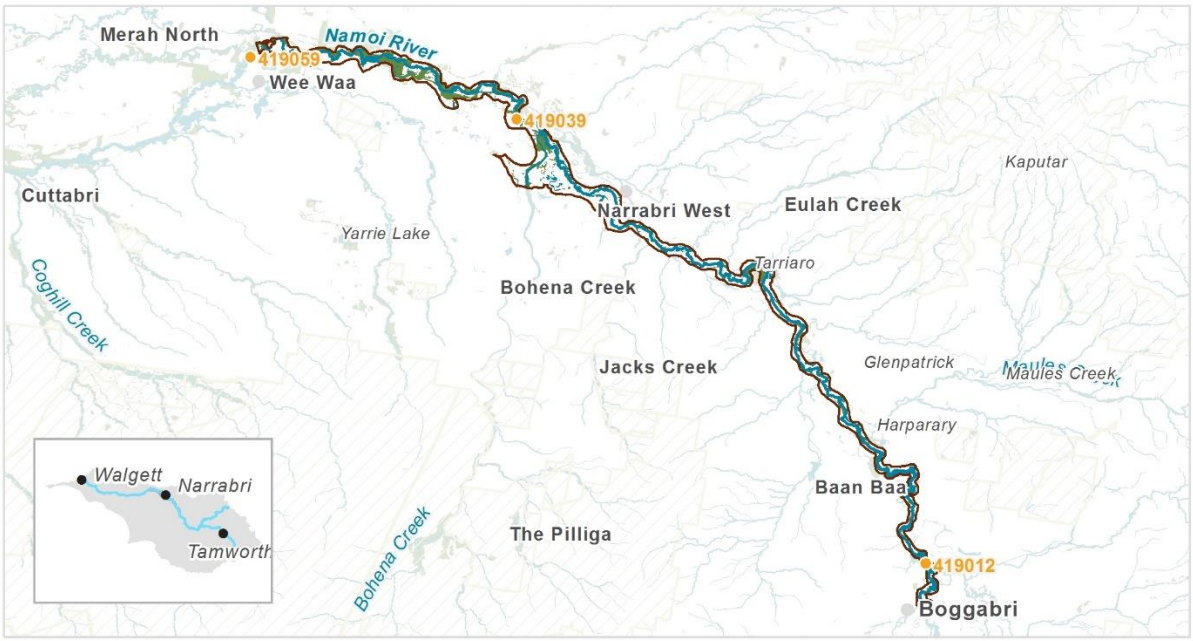
[4] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
	LF2	5400 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	Phantom Rock: Point bar/bench – 24,000 ML/d at Gunnedah Billabong: 14,000–16,000 ML/d at Gunnedah Backwater: 15,000–17,000 ML/d at Gunnedah
Anabranch connection	AC1	> 4600 ML/d	Aug to Feb (but can occur any time)	5 days minimum (ideally 1–2 months inundation for regeneration (RRG) 5–7 months inundation for maintenance (RRG))	3–10 years in 10 (65% LTA)	3 years	>4600 ML/d at Boggabri (for Barber's Lagoon). Inundates low commence-to-flow wetlands. AC2 to support floodplain specialist native fish spawning in off-channel habitats. This EWR would complement BK1 and OB1.
	AC2	> 4600 ML/d	Oct to Apr	5 days minimum (ideally >10 days[5])	5 years in 10 (50% LTA)	4 years	
Bankfull	BK1	> 32,700 ML/d	Sep to Apr	2 days minimum (ideally >10 days[5])	3-5 years in 10 (30% LTA)	5 years	
	BK2	> 32,700 ML/d	Sept to Feb (but can occur any time)	3 days minimum	3–5 years in 10 (30% LTA)	5 years	

[5] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (low-lying wetlands, anabranches and, in the case of overbank flows, on floodplains).

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Small Overbank	OB2	> 40,000 ML/d	Sept to Feb (but can occur any time)	2 days minimum (ideally >10 days[5])	3–5 years in 10 (40% LTA)	5 years	Also contributes to OB1 objectives
Large Overbank	OB3	> 45,000 ML/d	Aug to Feb (but can occur any time)	2 days minimum (to support 1–4 months habitat inundated)	3–5 years in 10 (33% LTA)	5 years	river red gum woodland

PU2: Boggabri to Wee Waa



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- The Namoi River & its instream habitat & fringing vegetation communities
- Barbers Lagoon, a 22 km anabranch of the Namoi River near Boggabri. Deep pools at downstream end that can serve as an aquatic drought refuge
- River red gum corridor between Mollee Weir & Gunidgera Weir. Small lagoons that need overbank flooding
- Large numbers of lagoons (most are small & require overbank flooding)
- The Namoi demonstration reach is located between Boggabri & Narrabri. The inundated floodplain provides a fish nursey habitat, particularly golden & silver perch that spawn in response to flooding. Habitat restoration has taken place in this area
- Other creeks and lagoons including: Barra Creek, Bibbla Creek, Black Gully, Bullawa Creek, Gurleigh Lagoon, Jack's Creek, Lochharba Lagoons, Sandy Creek, Sheep Station Creek, Tulla Mullen Creek and Yarrol Gully.

Native fish	• unspecked hardyhead • carp gudgeon • spangled perch • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • Murray cod • freshwater catfish	• flathead galaxias • olive perchlet • purple-spotted gudgeon • silver perch
Birds	48 water-dependent bird species recorded, including: • royal spoonbill	• Australian painted snipe, E	

Priority environmental assets and values			
	• marsh sandpiper, C J K • Latham's snipe, J K	• sharp-tailed sandpiper, C J K • eastern great egret, J	
Native vegetation	12 water-dependent plant community types, including:		
	• river red gum woodland	• coolibah woodland	• wetland sedgeland
Registered cultural assets	• burials • grinding grooves	• modified trees	• waterholes

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, spangled perch, golden perch, silver perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet, flat-headed galaxias
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, Flat-headed Galaxias, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Other notes: The floodplain between Boggabri and Narrabri is relatively narrow, especially in the area known as Gins Leap. There are a number of smaller anabranches or breakouts along the route; however the main area of flooding is where Maules Creek joins the Namoi River.

Table 4 Environmental watering requirements for the Namoi River at Boggabri (gauge 419012)[6]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season Jan to June	Typically CtF events should be around 8 days – CtF should not persist for longer than 46 days	Should occur in no more than 54% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	356 days minimum (or 224 days minimum in very dry years)	Annually	46 days	
Baseflow	BF1	> 150 ML/d	Any time	274 days minimum (or 91 days minimum in very dry years)	Annually	107 days	
	BF2	> 150 ML/d	Sept to Mar	154 days minimum (or 35 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 350 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annually	1 year	
	SF2	> 350-3600 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (75% LTA)	2 years	
Large fresh	LF1	> 3600 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	> 3600 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	

[6] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Anabranch connection	AC1	> 4600 ML/d	July to May (but can occur anytime)	2 days minimum Ideally 1–2 months inundation for regeneration (RRG) 5–7 months inundation for maintenance (RRG)	4–10 years in 10 (70% LTA)	3 years	Supports Barber's Lagoon located near the junction between this PU & the previous PU (PU1). Likely to also support other low-lying wetlands and anabranches in PU2. AC2 to support floodplain specialist native fish spawning in off-channel habitats. This EWR would complement BK1 and OB1.
	AC2	> 4600 ML/d	Oct to Apr	7 days minimum (ideally >10 days[7])	5 years in 10 (50% LTA)	4 years	
Bankfull	BK1	> 17,750 ML/d	Sep to Apr	2 days minimum (ideally >10 days[7])	5 years in 10 (50%)	4 years	
	BK2	> 17,750 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	
Small overbank	OB1	> 22,000 ML/d	Oct to Apr	2 days minimum (ideally >10 days[7])	4–5 years in 10 (45% LTA)	4 years	

[7] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (low-lying wetlands, anabranches and, in the case of overbank flows, on floodplains).

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
	OB2	> 22,000 ML/d	Sept to Feb (but can occur any time)	3 days minimum	3–5 years in 10 (40% LTA)	5 years	
Large overbank	OB3	> 37,500 ML/d	Aug to Feb (but can occur any time)	2 days minimum 1–4 months (habitat inundated)	3–5 years in 10 (40% LTA)	5 years	river red gum woodland

Table 5 Environmental watering requirements for the Namoi River at Mollee (gauge 419039)[8]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically all seasons at this gauge	Typically CtF events should be around 7 days. CtF should not persist for longer than 29 days	Should occur in no more than 17% of years	N/A	
Very-low flow	VF1	> 10 ML/d	Any time	343 days minimum (or 191 days minimum in very dry years)	Annually	29 days	
Baseflow	BF1	> 200 ML/d	Any time	267 days minimum (or 88 days minimum in very dry years)	Annually	120 days	

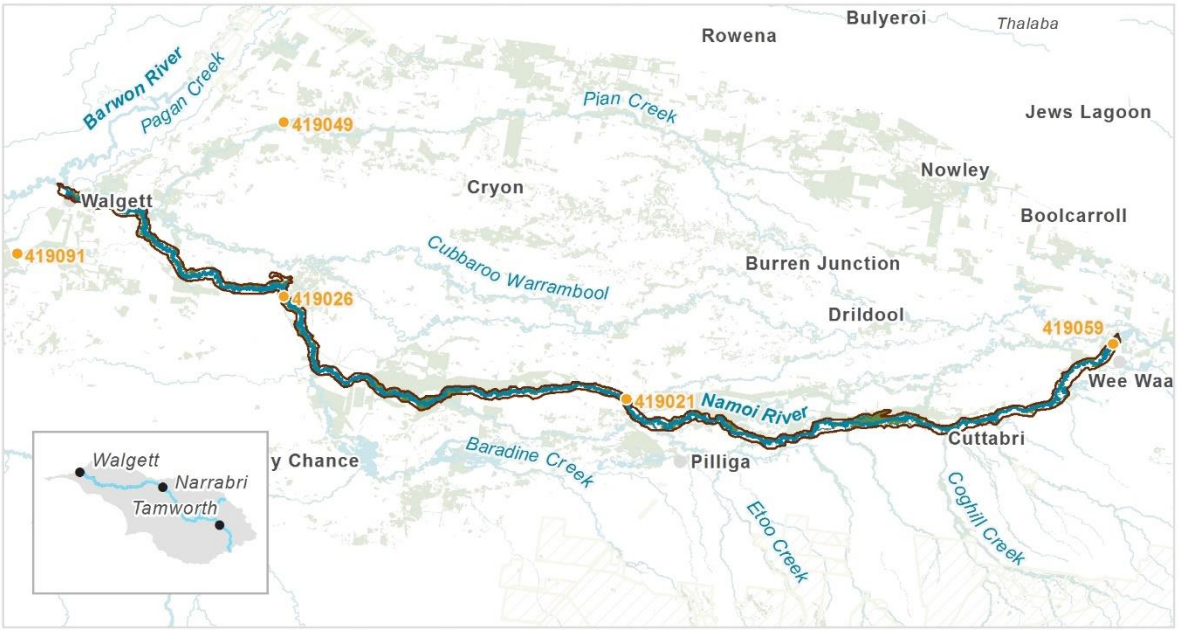
[8] Refer to Glossary for definitions of terms and explanatory text for EWRs.

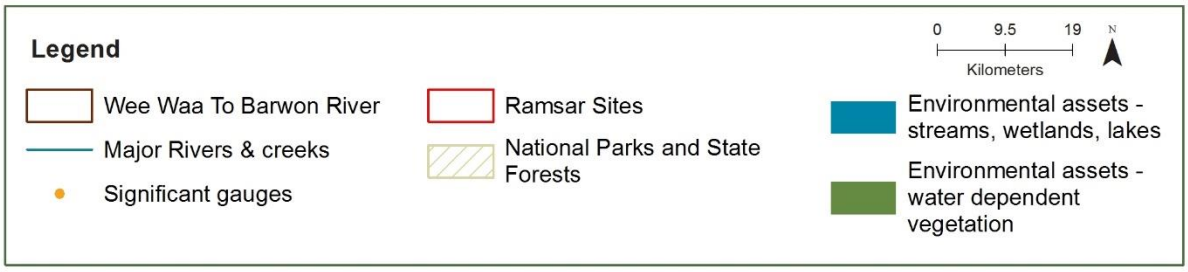
Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
	BF2	> 200 ML/d	Sept to Mar	154 days minimum (or 37 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 500 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annually	1 year	
	SF2	500–6000 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (75% LTA)	2 years	
Large fresh	LF1	> 6000 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	> 6000 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	
Bankfull	BK1	> 18,750 ML/d	Oct to Apr	2 days minimum (ideally > 10 days[9])	4.5 years in 10 (45% LTA)	4 years	
	BK2	> 18,750 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	
Small overbank	OB1	> 21,750 ML/d	Sep to Apr	2 days minimum (ideally > 10 days[9])	4–5 years in 10 (40% LTA)	4 years	
	OB2	> 21,750 ML/d		3 days minimum		5 years	

[9] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (low-lying wetlands, anabranches and floodplains). Shorter duration events (,10 days) may contribute to longer duration events at downstream locations (and associated improved outcomes for floodplain specialists).

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
			Sept to Feb (but can occur any time)		3–5 years in 10 (40% LTA)		
Large overbank	OB3	> 25,000 ML/d	Aug to Feb (but can occur any time)	2 days minimum 1-2 months inundation for regeneration; 5-7 months for maintenance	3–10 years in 10 (50% LTA)	5 years	River red gum forest
	OB4	> 40,000 ML/d	Aug to Feb (but can occur any time)	1 days minimum 1–4 months (habitat inundated)	3-5 years in 10 (40% LTA)	5 years	Coolibah woodland (PCT 39) and river red gum woodland

PU3: Wee Waa to Barwon River





Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Duncans Junction/Duncans Warrambool fills slowly from the Namoi River via the downstream end when flows are over 3300 ML/d
- Namoi river red gum corridor Gunidgera Weir to Weeta Weir
- Namoi river red gum corridor downstream Duncans Junction to Bugilbone
- Coolibah watercourse
- Bugilbone to Goangra – river red gum corridor
- Other creeks, wetlands and lagoons: Myall Camp, Cumberdoon, Shepherds and Drildool warrambools, Turragulla Creek and Gunidgera Creek

Native fish	• unspecked hardyhead • carp gudgeon • spangled perch • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • Murray cod	• freshwater catfish • olive perchlet • purple-spotted gudgeon • silver perch
Birds	20 water-dependent bird species recorded, including:		
	• eastern great egret, J • little black cormorant	• intermediate egret • Pacific black duck	• yellow-billed spoonbill
Native vegetation	13 water-dependent plant community types, including:		
	• river red gum woodland • water couch marsh grassland wetland • river red gum forest	• river coobah swamp wetland • lignum shrubland wetland	• black box woodland wetland • coolibah woodland wetland

Registered cultural assets	• modified trees	• burials	• Aboriginal ceremony and dreaming

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, spangled perch, golden perch, silver perch, Murray cod, freshwater catfish, olive perchlet, purple-spotted gudgeon
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range: olive perchlet
NF9 Increase the prevalence and/or expand the population of key moderate to long-lived flow pulse specialists native fish species into new areas (within historical range): silver perch
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Table 6 Environmental watering requirements for the Namoi River at Bugilbone (gauge 419021)[10]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically Jan to June	Typically CtF events should be around 7 days - CtF should not persist for longer than 32 days	Should occur in no more than 42% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	336 days minimum (or 170 days minimum in very dry years)	Annually	32 days	
Baseflow	BF1	> 150 ML/d	Any time	277 days minimum (or 93 days minimum in very dry years)	Annually	130 days	
	BF2	> 150 ML/d	Sept to Mar	158 days minimum (or 47 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 350 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annually	1 year	
	SF2	350–3200 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (75% LTA)	2 years	
Large fresh	LF1	> 3200 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	> 3200 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	

[10] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Anabranch connection	AC1	> 4500 ML/d[11]	Any time	7 days minimum (consecutive days)[12]	4-10 years in 10 (70% LTA)	3 years	CEWO 2018 - Supports riparian vegetation - Support fish movement, spawning, recruitment & condition.
	AC2	> 4500 ML/d	Oct - Apr	10 days minimum	5 years in 10 (50% LTA)	4 years	To support floodplain specialist native fish spawning in off-channel habitats. This EWR would complement BK1 and OB1 which occur at lower frequencies
Bankfull	BK1	> 9900 ML/d	Sep to Apr	3 days minimum (ideally >10 days minimum[13])	5 years in 10 (50% LTA)	4 years	
	BK2	> 9900 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	

[11] Foster 1999, An Assessment of the Commence-to-flow levels of Wetlands of the Lower Namoi Valley
[12] Northern Basin Review EWR
[13] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (low-lying wetlands, anabranches and, in the case of overbank flows, on floodplains).

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Overbank	OB1	> 13,400 ML/d	Oct to Apr	3 days minimum (ideally >10 days[13])	4–5 years in 10 (45% LTA)	4 years	
	OB2	> 13,400 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	
Large Overbank	OB3	> 25,000 ML/d	Aug to Feb (but can occur any time)	2 days minimum 1-4 months (habitat inundated)	3-5 years in 10 (40% LTA)	5 years	River red gum woodland and coolibah woodland (PCT 39)
	OB4	> 65,000 ML/d	Aug to Feb (but can occur any time)	2 days minimum up to 1 month of inundation	1 year in 10 or more (10% LTA)	10 years	Coolibah woodland (PCT40) which occurs further out on the floodplain
	OB5	> 35,000 ML/d	Any time	2 days minimum 2-6 months inundation for maintenance; 1-2 months inundation for recruitment	1–4 years in 10 (25% LTA)	7 years (ideally 5 years)	Lignum and black box woodland

Table 7 Environmental watering requirements for the Namoi River at Goangra (gauge 419026)[14]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically June to Oct	Typically CtF events should be around 8 days – CtF events should not persist beyond 46 days	Should occur in no more than 54% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	323 days minimum (or 135 days minimum in very dry years)	Annually	46 days	
Baseflow	BF1	> 25 ML/d	Any time	335 days (or 162 in very dry years)	Annually	110 days	
	BF2	> 25 ML/d	Sept to Mar	195 days (or 100 in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 65 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annually	1 year	
	SF2	65–1000 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (75% LTA)	2 years	
Large fresh	LF1	> 1000 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (75% LTA)	2 years	

[14] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
	LF2	> 1000 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	
	LF3	> 1000 ML/d	July to Sept (but can occur any time)	5 days minimum (ideally >11 days in line with natural)	9-10 years in 10 (95% LTA) Ideally triggered when LF1 at Barwon @ Collarenebri is detected within 18 months of LF2 at Darling @ Wilcannia	4 years (ideally 1 year in line with natural)	Connectivity with the Barwon River – for end of system connectivity events & migration / dispersal events
Bankfull	BK1	> 5800 ML/d	Oct to Apr	8 days minimum (ideally >10 days[15])	5 years in 10 (50% LTA)	4 years	
	BK2	> 5800 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	
Overbank small	OB1	> 8200 ML/d	Sep to Apr	5 days minimum (ideally >10 days[15])	5 years in 10 (50% LTA)	4 years	
	OB2	> 8200 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	

[15] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (low-lying wetlands, anabranches and, in the case of overbank flows, on floodplains).

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Overbank large	OB3	> 14,000 ML/d	Aug to Feb (but can occur any time)	2 days minimum 1-4 months (habitat inundated)	3-5 years in 10 (40% LTA)	5 years	River red gum woodland and coolibah woodland (PCT 39)
	OB4	> 35,000 ML/d	Aug to Feb (but can occur any time)	2 days minimum up to 1 month of inundation	1 year in 10 or more (10% LTA)	10 years	Coolibah woodland (PCT40) which occurs further out on the floodplain
	OB5	> 26,000 ML/d	Any time	2 days minimum 2-6 months inundation for maintenance; 1-2 months inundation for recruitment	1–4 years in 10 (25% LTA)	6 years (ideally 5 years)	Lignum and black box woodland

Table 8 Environmental watering requirements for the Namoi River upstream of Walgett (gauge 419091)[16]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically July and October	Typically CtF events should be around 4 days. Events should not persist beyond 34 days	Should occur in no more than 47% of years	N/A	

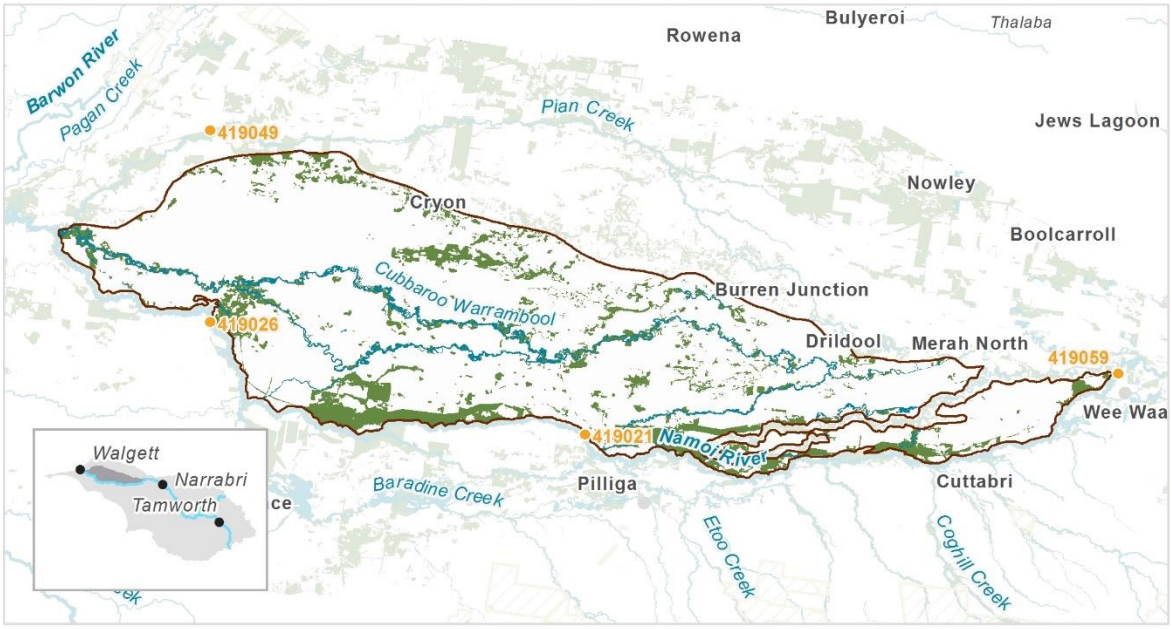
[16] Refer to Glossary for definitions of terms and explanatory text for EWRs.

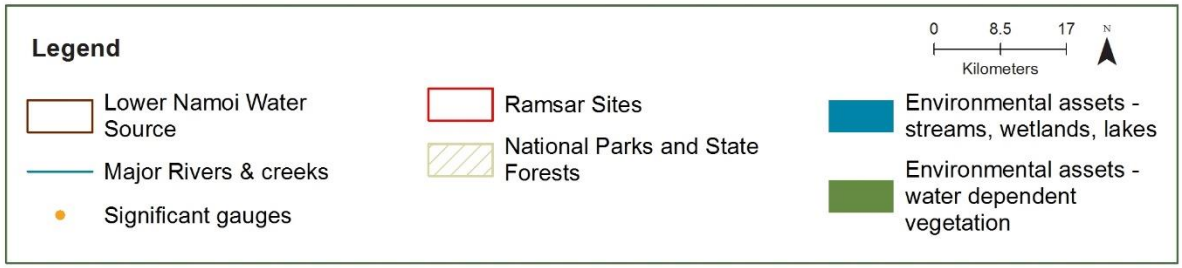
Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Very-low flow	VF1	> 1 ML/d	Any time	365 days minimum (or 110 days minimum in very dry years)	93% of years	34 days	
Baseflow	BF1	> 30 ML/d	Any time	347 days (or 20 days in very dry years)	93% of years	70 days	
	BF2	> 30 ML/d	Sept to Mar	200 days (or 12 in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 200 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annually (100% LTA)	1 year	
	SF2	200–2250 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (75% LTA)	2 years	
Large fresh	LF1	> 2250 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	> 2250 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	
	LF3	> 2250 ML/d	July to Sept (but can occur any time)	5 days minimum (ideally >11 days in line with natural)	9-10 years in 10 (95% LTA) Ideally triggered when LF1 at Barwon @ Collarenebri is detected within 18 months of LF2 at Darling @ Wilcannia	4 years (ideally 1 year in line with natural).	Connectivity with the Barwon River – for end of system connectivity events & migration / dispersal events

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Bankfull	BK1	> 8500 ML/d	Oct to Apr	4 days minimum (ideally >10 days[17])	3 years in 10 (30% LTA)	6 years	
	BK2	> 8500 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	
Small overbank	OB1	> 10,600 ML/d	Sept to Apr	10 days minimum	3 years in 10 (30% LTA)	6 years	
	OB2	> 10,600 ML/d	Sept to Feb (but can occur any time)	5 days minimum	3–5 years in 10 (40% LTA)	5 years	
Large overbank	OB3	> 10,600 ML/d	Aug to Feb (but can occur any time)	2 days minimum 1-4 months (habitat inundated)	3-5 years in 10 (40% LTA)	5 years	Coolibah woodland (PCT 39)
	OB4	> 20,000 ML/d	Any time	2 days minimum 2-6 months inundation for maintenance; 1-2 months inundation for recruitment	1–4 years in 10 (25% LTA)	5 years	Lignum and black box woodland

[17] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (low-lying wetlands, anabranches and, in the case of overbank flows, on floodplains).

PU4: Lower Namoi





This PU is technically an unregulated water source but receives effluent flows when irrigation orders are placed, or when large uncontrolled flow events occur. It is affected by how regulated water deliveries are managed.

Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Cubbaroo Warrambool, Coolibah watercourse & the fringing coolabah-black box EEC around these waterways
- Other wetlands and creeks: Drildool Warrambool, Long Swamp, Ulled Lagoon, Warbian Lagoon, Pian Creek, Dead Bullock Warrambool, Gunidgera Creek.
- This PU includes important water dependent vegetation adjacent to the Namoi River. This PU contains high environmental values & high bird diversity

Native fish	• unspecked hardyhead • carp gudgeon • spangled perch • silver perch	• bony herring • Australian smelt • golden perch • Murray cod	• freshwater catfish • olive perchlet • Murray–Darling rainbowfish
Birds	52 water-dependent bird species recorded, including: • common greenshank, C J K • marsh sandpiper, C J K	• brolga • Latham's snipe, J K	• sharp-tailed sandpiper • Australian painted snipe, E
Native vegetation	13 water-dependent plant community types, including: • river red gum woodland • river red gum forest	• lignum shrubland wetland	• black box woodland wetland

	• shallow freshwater wetland sedgeland	• river cooba swamp wetland	• coolibah woodland & wetland
Registered cultural assets	• modified trees		

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, silver perch, Murray cod, freshwater catfish, olive perchlet

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, olive perchlet

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range: olive perchlet

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Hydrology

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	NA	NA	NA	L^-	L^-	L^-
Relevant rules	Trade not permitted into the water source No pool drawdown					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in-channel flows in the water source within 5 years:

- consider introducing a CtP rule (relating to a flow or water level gauge)
- consider installing water level gauges at or near extraction sites.

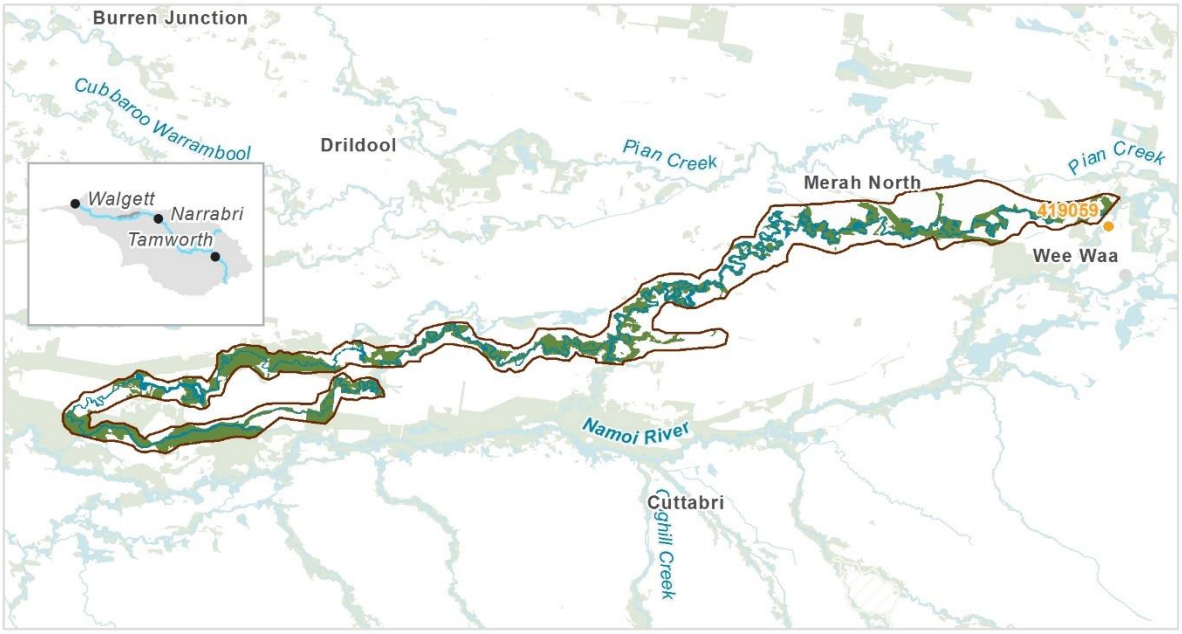
Consider introducing CtP & commence-to-pump rules (& any associated required amendments to WAL conditions) that protect HEW & water from the EWAs entering unregulated streams & off-channel pools (wetlands), in line with the Basin Plan requirement for implementation of prerequisite policy measures.

Ensure compliance with water access licence conditions including through metering of all licensed extraction.

As a minimum, maintain existing rules in the WSP for the Namoi Unregulated Water Sources that protect environmental assets & values.

Monitor for changes in water demand & review access rules if current usage is high or if the pattern of use changes.

PU5: Gunidgera Creek and Duncans Warrambool



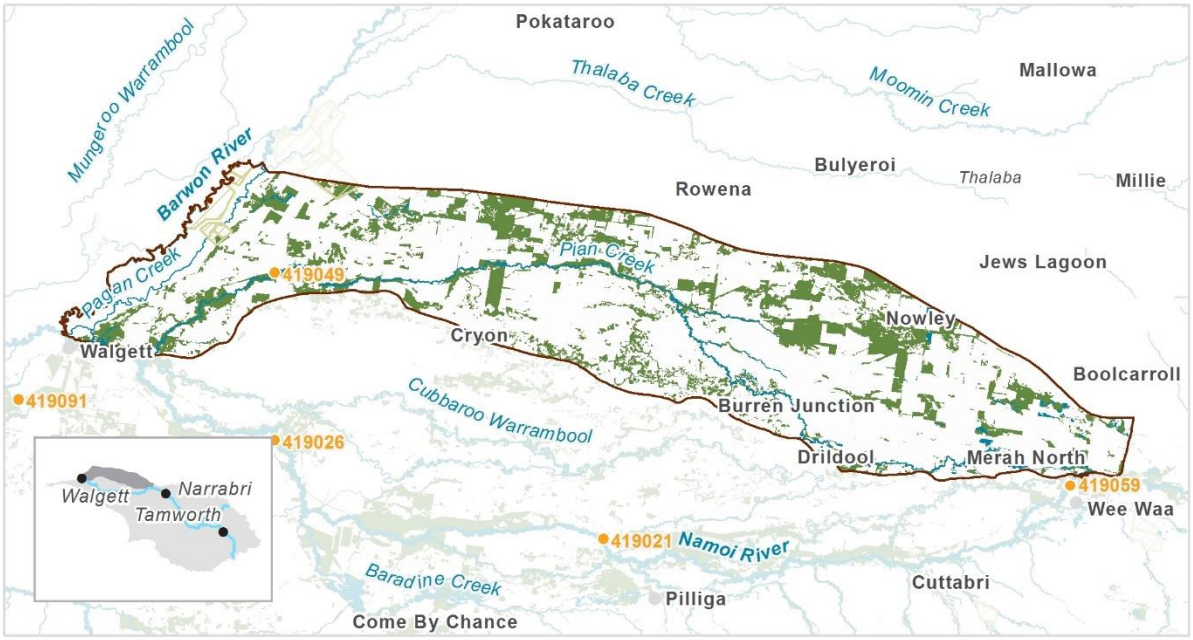
Priority environmental assets and values

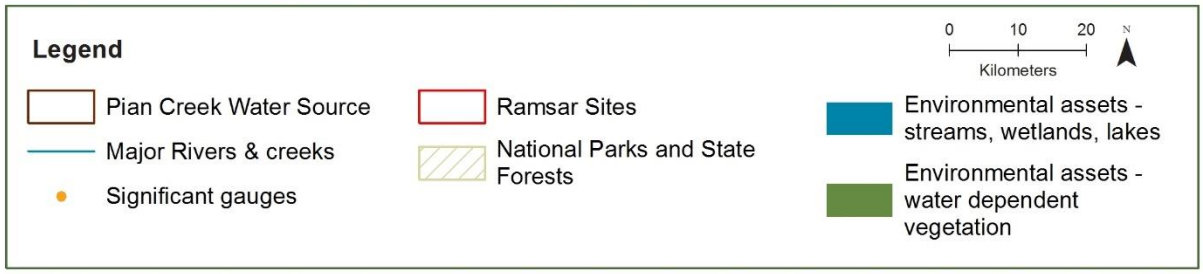
Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Instream & fringing vegetation of river red gums & coolibah black box EEC across the extensive & ecologically valuable floodplain in this area, including Myall Camp, Duncans Warrambool & Gunidgera Creek
- Other creeks and wetlands: Little Gunindgera Creek, Old Paddock Creek, Ulled Lagoon, Warbian Lagoon

Native fish	• unspecked hardyhead • carp gudgeon • spangled perch • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • Murray cod	• freshwater catfish • olive perchlet • silver perch
Birds	20 water-dependent bird species recorded, including:		
	• eastern great egret, J	• Australasian darter	• intermediate egret
Native vegetation	12 water-dependent plant community types, including:		
	• river red gum woodland • river red gum forest • river coobah swamp wetland	• lignum shrubland wetland • black box woodland	• water couch marsh grassland • coolibah woodland
Registered cultural assets	• modified trees		

PU6: Pian Creek





Pian Creek is regulated upstream of the Dundee Weir & unregulated downstream, to where it joins the Namoi River upstream of Walgett. It may only receive effluent flows when large uncontrolled flow events occur, or from regulated orders.

Priority environmental assets and values

A large area of the catchment's priority assets is found within this PU and are affected by water management and flows in Pian Creek and the Namoi River.

Priority environmental assets include rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- a complex network of unnamed anabranches & flood-runners that are fringed with water dependent vegetation including coolibah woodland EEC
- Myall Vale & Glencoe breakouts in this PU contain important instream & fringing vegetation adjacent to the Pian Creek
- other creeks and wetlands: Burren Creek, Cubbaroo Warrambool, Two-Mile Warrambool, Krui Swamp and Dead Bullock Warrambool

Native fish	• unspecked hardyhead • carp gudgeon • Murray–Darling rainbowfish • purple-spotted gudgeon	• bony herring • Australian smelt • golden perch • Murray cod	• freshwater catfish • olive perchlet • silver perch • spangled perch
Birds	53 water-dependent bird species recorded, including: • sharp-tailed sandpiper, C J K	• pacific golden plover, C J K	• caspian tern, J
Native vegetation	13 water-dependent plant community types, including: • river red gum woodland • river red gum forest	• black box woodland wetland	• coolibah

	• lignum shrubland wetland • river coobah swamp wetland	• water couch marsh grassland wetland	• river coobah woodland wetland • coolibah woodland
Registered cultural assets	• modified tree		

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, silver perch, spangled perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range: olive perchlet
NF9 Increase the prevalence and/or expand the population of key moderate to long-lived flow pulse specialists native fish species into new areas (within historical range): silver perch
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Table 9 Environmental watering requirements for Pian Creek at Waminda (gauge 419049)[18]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically May to Sept	Typically CtF events should be around 4 days – CtF events should not persist longer than 34 days	Should occur in no more than 78% of years	N/A	
Very-low flow	VF1	>1 ML/d	Any time	310 days minimum (or 115 days minimum in very dry years)	Annually	34 days	
Baseflow	BF1	> 50 ML/d	Any time	119 days minimum (or 14 days minimum in very dry years)	Annually (98% of years)	180 days	
	BF2	> 50 ML/d	Sept to Mar	63 days minimum (or 1 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 100 ML/d	Oct to Apr (but can occur any time)	3 days minimum (ideally >10 days[19])	Annually	1 year	
	SF2	100–250 ML/d	Sept to Apr	3 days minimum (ideally >14 days[20])	5–10 years in 10 (75% LTA)	2 years	

[18] Refer to Glossary for definitions of terms and explanatory text for EWRs.

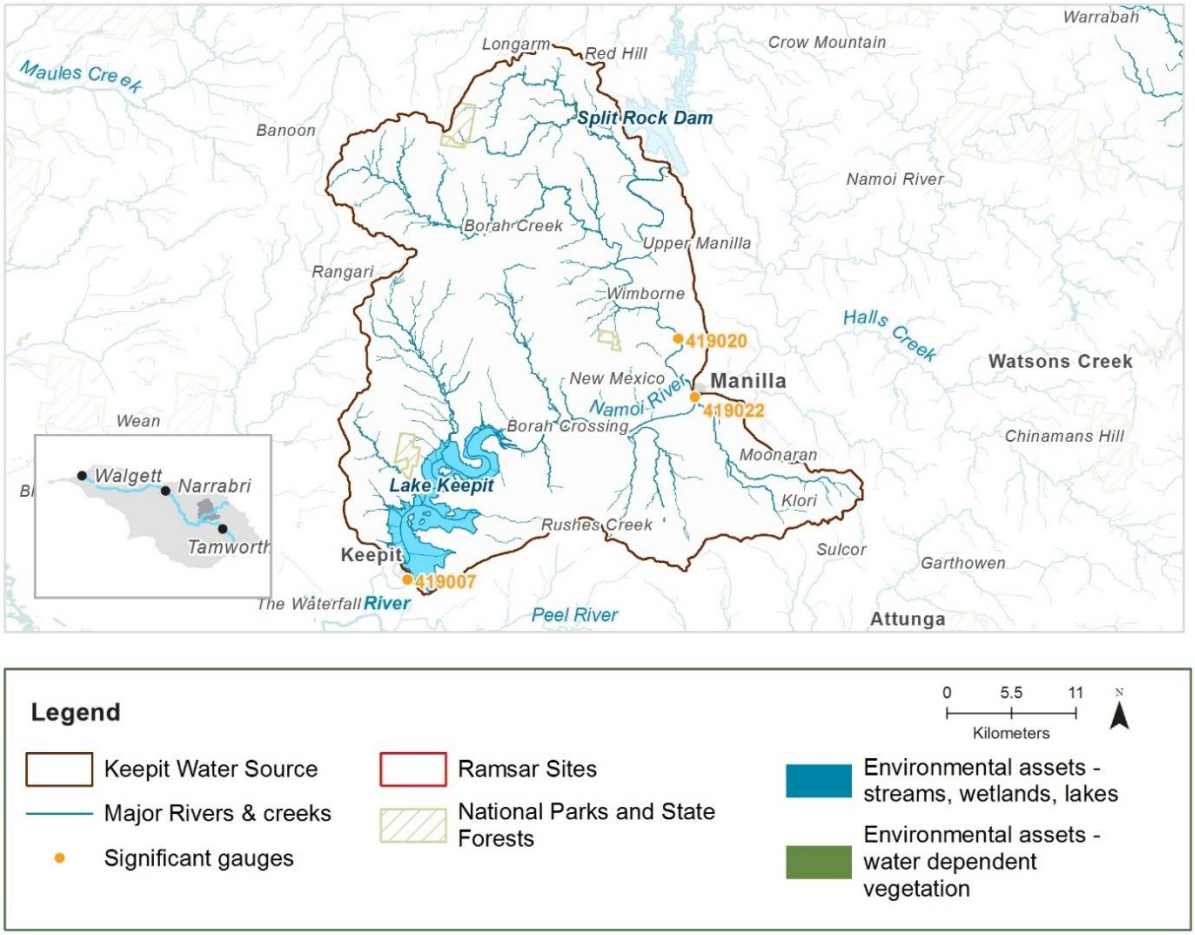
[19] Ideally flows should be above the flow rate threshold for 10 days or longer to support dispersal and condition of native fish, productivity and in-channel native vegetation.

[20] Ideally flows should be within the flow range for 14 days or longer to support spawning of riverine specialist and generalist native fish.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Large fresh	LF1	> 250 ML/d	July to Sept (but can occur any time)	3 days minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	> 250 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	
Bankfull	BK1	> 900 ML/d	Sep to Apr	4 days minimum (ideally >10 days[21])	3 years in 10 (30% LTA)	7 years	
	BK2	> 900 ML/d	Sept to Feb (but can occur any time)	4 days minimum	3–5 years in 10 (40% LTA)	5 years	
Small overbank	OB1	> 2150 ML/d	Sep to Apr	3 days minimum (ideally >10 days[21])	2 years in 10 (20% LTA)	8 years	
	OB2	> 2150 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (30% LTA)	5 years	
Large overbank	OB3	> 2500 ML/d	Aug to Feb (but can occur any time)	1 day minimum 1-4 months (habitat inundated)	3-5 years in 10 (40% LTA)	5 years	Coolibah woodland (PCT 39)
	OB4	> 3750 ML/d	Any time	1 day minimum 2-6 months inundation for maintenance; 1-2 months inundation for recruitment	1–4 years in 10 (25% LTA)	5 years	Lignum and black box woodland

[21] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (low-lying wetlands, anabranches and, in the case of overbank flows, on floodplains).

PU7: Keepit



Priority environmental assets and values

Most priority assets within this PU are higher upstream & include instream vegetation & fringing river oak - rough-barked apple - red gum woodland fringing rivers.
Priority environmental assets include rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Borah Creek, Brown's Springs Creek, Greenhatch Creek, Manilla River, Maynes Gully, Namoi River, Oaky Creek, Spring Creek, Tarpoly Creek, Wongo Creek.

Native fish	• unspecked hardyhead • purple-spotted gudgeon • Murray–Darling rainbowfish • obscure galaxias	• bony herring • Australian smelt • golden perch • spangled perch	• Murray cod • freshwater catfish • silver perch • carp gudgeon
Birds	39 water-dependent bird species recorded, including: • common greenshank, C J K	• sharp-tailed sandpiper, C J K	• eastern great egret, J
Native vegetation	4 water-dependent plant community types, including: • shallow freshwater wetland sedgeland	• river red gum woodland	• river oak forest

Registered cultural assets	No water-dependent cultural assets were found in the known site data[22]

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, silver perch, spangled perch, Murray cod, freshwater catfish, purple-spotted gudgeon
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range: freshwater catfish
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Hydrology

Gauge: **419020**	**80th percentile**: 3 ML/d	**50th percentile**: 10 ML/d	**20th percentile**: 50 ML/d
	1.5 ARI: 1124 ML/d	**2.5 ARI**: 1778 ML/d	**5 ARI**: 2628 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- cease-to-flow periods have been highly altered, & occur more frequently
- low flows & baseflows have been highly altered, occurring less frequently
- freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 13 unregulated WALs in this water source, equating to 774 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^-	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown					

[22] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources & beliefs that are important to Aboriginal people as part of their continuing culture may be present.

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within 5 years:

- consider introducing a CtP rule (relating to a flow or water level gauge)
- consider installing water level gauges at or near extraction sites
- consider rostering landholder water access or introducing individual &/or total daily extraction limits (IDEL/TDEL).

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

Table 10 Environmental watering requirements for the Manilla River at Brabri (gauge 419020)[23]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically Jan to June	Typically CtF events should be around 5 days. Events should not persist beyond 27 days	Should occur in no more than 60% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	346 days minimum (or 225 days minimum in very dry years)	Annually	27 days	
Baseflow	BF1	> 20 ML/d	Any time	225 days minimum (or 75 days minimum in very dry years)	Annually	60 days	
	BF2	> 20 ML/d	Sept to Mar	137 days minimum (or 30 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 100 ML/d	Oct to Apr (but can occur any time)	8 days minimum (ideally >10 days[24])	Annually	1 year	
	SF2	100–500 ML/d	Sept to Apr	10 days minimum (ideally > 14 days[25])	5–10 years in 10 (75% LTA)	2 years	

[23] Refer to Glossary for definitions of terms and explanatory text for EWRs.

[24] Ideally flows should be above the flow rate threshold for 10 days or longer to support dispersal and condition of native fish, productivity and in-channel native vegetation

[25] Ideally flows should be within the flow range for 14 days or longer to support spawning of riverine specialist and generalist native fish.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Large fresh	LF1	> 500 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	> 500 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	
Bankfull	BK1	> 1300 ML/d	Oct to Apr	2 days minimum (ideally >10 days[26])	5 years in 10 (50% LTA)	4 years	
	BK2	> 1300 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (40% LTA)	5 years	
Overbanks	OB1	> 2500 ML/d	Oct to Apr	1 day minimum	5 years in 10 (50% LTA)	4 years	
	OB2	> 2500 ML/d	Sep to Feb (but can occur any time)	3 days minimum	3–5 years in 10 (40% LTA)	5 years	
	OB3	> 2500 ML/d	Aug to Feb (but can occur any time)	2 days minimum 1-2 months inundation for regeneration; 5-7 months for maintenance (RRG forest)	3–10 years in 10 (50% LTA)	4 years (ideally 3 years)	To support river red gum forest maintenance and regeneration

[26] Ideally flows should be above the flow rate threshold for 10 days or longer to support spawning of floodplain specialist native fish in off-channel habitats (e.g. low-lying wetlands).

2. Peel River management area

The Peel management area is a major sub-catchment of the Namoi, covering 4700 square kilometres. The Peel River begins upstream from Nundle around 1100 M elevation and is regulated by Chaffey dam, completed in 1979. Below the dam, the Peel River runs through Dungowan and Piallamore and joined by the Cockburn River upstream of Tamworth. The Peel River then runs through Tamworth and Somerton, connecting with the Namoi River near Carroll, downstream of Keepit Dam.

There are six PUs in the Peel River Management area. The regulated reach is described in the Peel Regulated River PU, which has three corresponding EWR gauges (downstream of Chaffey Dam, Piallamore and Carroll). The other PUs are unregulated and include the Cockburn River, Upper Peel River tributaries, Chaffey Water Source, Goonoo Goonoo and the Lower Peel Tributaries.

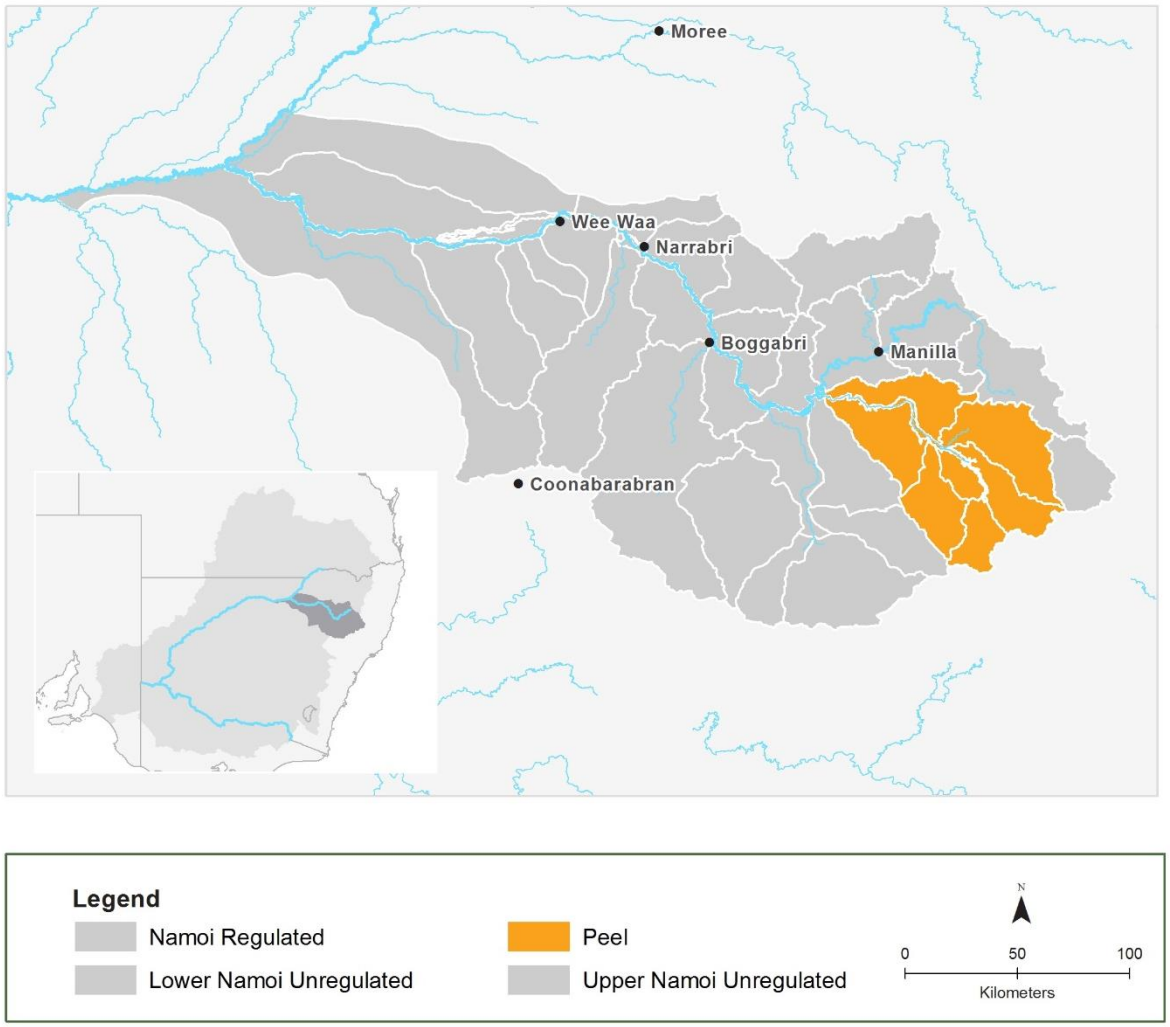


Figure 4 Peel River management area

PU8: Peel River – regulated

Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Reaches of the Peel River & Wallamore Anabranch support migratory bird species
- Provides vital habitat for native fish. It can support freshwater catfish (endangered) & purple-spotted gudgeon (endangered) (predicted)
- Capable of supporting significant levels of native biodiversity, including Australasian bittern & Murray cod
- Important floodplain vegetation & woodland to the west of this PU
- Other creeks and wetlands: Attunga Creek, Boltons Creek, Browns Spring Gully, Calala Creek, Catong Gully, Clay Water Hole Gully, Dungowan Creek, Goonoo Goonoo Creek, Jeffries Gully, Limestone Gully, Peel Anabranch, Reedy Creek, Sandy Creek, Tangaratta Creek, Timbumburi Creek, Yellow Gully.

Native fish	• unspecked hardyhead • mountain galaxias • Murray–Darling rainbowfish • Murray cod • obscure galaxias	• bony herring • Australian smelt • golden perch • carp gudgeon	• freshwater catfish • purple-spotted gudgeon • spangled perch • silver perch
Birds	37 water-dependent bird species recorded, including: • Latham's snipe, J K • eastern great egret, J		
Native vegetation	4 water-dependent plant community types, including: • river red gum woodland	• river oak, rough-barked apple, red gum forest	• sedgeland fens wetland

Registered cultural assets	• modified trees

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, mountain galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, silver perch, Murray cod, freshwater catfish, purple-spotted gudgeon
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias, mountain galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Table 11 Environmental watering requirements for Peel River d/s Chaffey Dam (gauge 419045)[27]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically Jan to June	Typical CtF events should be around 1 day. CtF events should not persist for longer than 23 days	Should occur in no more than 15% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	365 days minimum (or 310days minimum in very dry years)	Annually	23 days	
Baseflow	BF1	> 100 ML/d	Any time	60 days minimum (or 8 days minimum in very dry years)	Annually	143 days	
	BF2	> 100 ML/d	Sept to Mar	29 days minimum (or 2 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 250 ML/d	Oct to Apr (but can occur any time)	2 days minimum	Annually	1 year	Instream benches at 240 & 550 ML/d at Woolomin
	SF2	> 250–900 ML/d	Sept to Apr	2 days minimum (ideally >14 days[28])	5–10 years in 10 (75% LTA)	2 years	

[27] Refer to Glossary for definitions of terms and explanatory text for EWRs.

[28] Ideally flows should be within the flow range for 14 days or longer to support spawning of riverine specialist (e.g. Murray cod and freshwater catfish) and generalist native fish. Shorter duration flows (<14 days) at this gauge may support longer duration flows and associated improved spawning outcomes at downstream locations.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Large fresh	LF1	> 900 ML/d	July to Sept (but can occur any time)	2 days minimum	5–10 years in 10 (75% LTA)	2 years	Instream bench at 2280 ML/d at Woolomin
	LF2	> 900 ML/d	Oct to Apr	2 days minimum (ideally > 5 days[29])	3–5 years in 10 (40% LTA)	4 years	
Bankfull	BK1	> 2900 ML/d	Sep to Apr	1 day minimum	5 years in 10 (50% LTA)	4 years	
	BK2	> 2900 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (40% LTA)	5 years	
Overbank	OB1	> 6400 ML/d	Sep to Apr	1 days minimum	3–5 years in 10 (30% LTA)	5 years	
	OB2	> 6400 ML/d	Sept to Feb (but can occur any time)	1 day minimum	3–5 years in 10 (40% LTA)	5 years	
	OB3	> 6400 ML/d	Aug to Feb (but can occur any time)	1 day minimum 1-2 months inundation for regeneration; 5-7 months for maintenance	3–10 years in 10 (45% LTA)	5 years	

[29] Ideally flows should be above the flow rate threshold for 5 days or longer to support spawning of flow pulse specialist native fish (e.g. golden perch and silver perch). Shorter duration flows (<5 days) at this gauge may contribute to longer duration flows and associated improved spawning outcomes at downstream locations.

Table 12 Environmental watering requirements for the Peel River at Piallamore (gauge 419015)[30]

Flow category and EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically Jan to June	Typical CtF events should be around 5 days. CtF events should not persist for longer than 20 days	Should occur in no more than 8% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	365 days minimum (or 346 days minimum in very dry years)	Annually	20 days	
Baseflow	BF1	> 100 ML/d	Any time	130 days minimum (or 24 days minimum in very dry years)	Annually	114 days	
	BF2	> 100 ML/d	Sept to Mar	78 days minimum (or 11 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 250 ML/d	Oct to Apr (but can occur any time)	5 days minimum (ideally >10 days[31])	Annually	1 year	Instream benches at Piallamore at 320 ML/d & 730 ML/d

[30] Refer to Glossary for definitions of terms and explanatory text for EWRs.

[31] Ideally flows should be above the flow rate threshold for 10 days or longer to support dispersal and condition of native fish; transfer of nutrients, carbon and sediment; in-channel native vegetation; and to promote in-channel productivity.

Flow category and EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
	SF2	250–1350 ML/d	Sept to Apr	6 days minimum (ideally >14 days[32])	5–10 years in 10 (75% LTA)	2 years	
Large fresh	LF1	> 1350 ML/d	July to Sept (but can occur any time)	1 days minimum	5–10 years in 10 (75% LTA)	2 years	Instream benches at Piallamore at 1412 & 730 ML/d Instream benches d/s Dungowan at 320, 730 & 1412 ML/d
	LF2	> 1350 ML/d	Oct to Apr	3 days minimum (ideally >5 days[33])	3–5 years in 10 (40% LTA)	4 years	
Bankfull	BK1	> 5150 ML/d	Sep to Apr	1 day minimum	4 years in 10 (40% LTA)	4 years	
	BK2	> 5150 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (40% LTA)	5 years	
Overbank	OB1	> 13,400 ML/d	Sep to Apr	1 day minimum	1–5 years in 10 (15% LTA)	10 years (ideally 5 years)	
	OB2	> 13,400 ML/d	Sept to Feb (but can occur any time)	1 days minimum	2–5 years in 10 (20% LTA)	6 years	At this location, this EWR will also provide for river red gum woodland (OB3)

[32] Ideally flows should be within the flow range for 14 days or longer to support spawning of riverine specialist (e.g. Murray cod and freshwater catfish) and generalist native fish. Shorter duration SF2 flows (<14 days) at this gauge may support longer duration flows and associated improved spawning outcomes at downstream locations.

[33] Ideally flows should be above the flow threshold for 5 days or longer to support spawning of flow pulse specialist native fish. Shorter duration LF2 flows (<5 days) at this gauge may contribute to longer duration flows and associated improved spawning outcomes at downstream locations.

Table 13 Environmental watering requirements for the Peel River at Carroll (gauge 419006)[34]

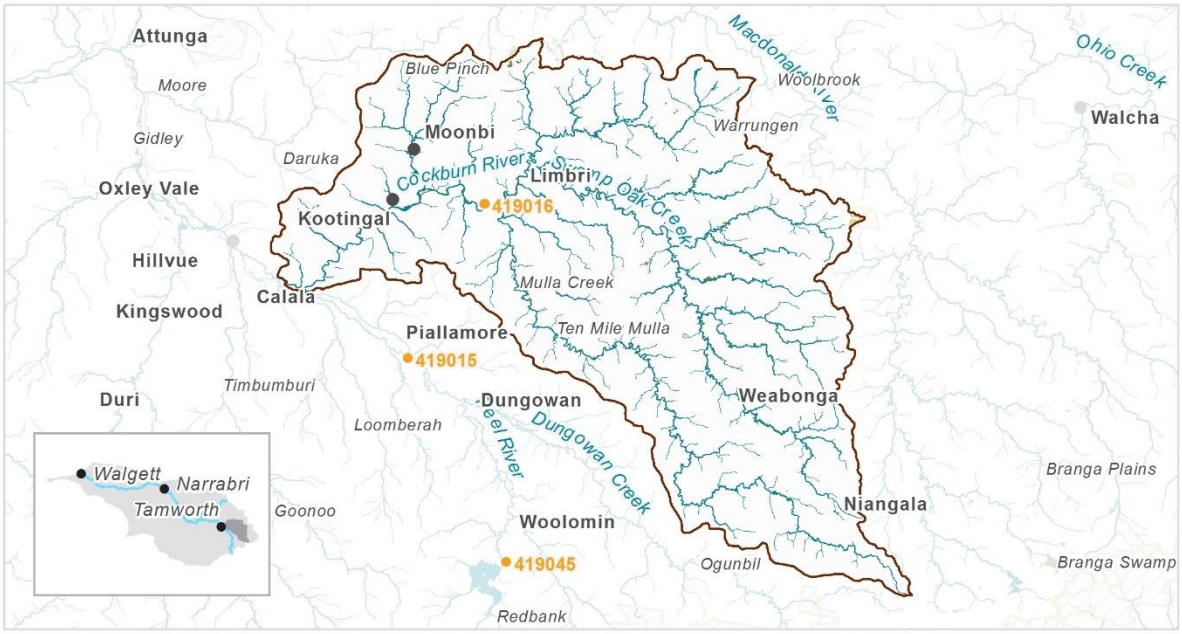
Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically Jan to June	Typical CtF events should be around 3 days. CtF events should not persist for longer than 14 days	Should occur in no more than 5% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	365 days minimum (or 342 days minimum in very dry years)	Annually	14 days	
Baseflow	BF1	> 100 ML/d	Any time	241 days minimum (or 76 days minimum in very dry years)	Annually	100 days	
	BF2	> 100 ML/d	Sept to Mar	152 days minimum (or 42 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 300 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annually	1 year	
	SF2	300–3900 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (75% LTA)	2 years	
Large fresh	LF1	> 3900 ML/d	July to Sept (but can occur any time)	2 days minimum	5–10 years in 10 (75% LTA)	2 years	

[34] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
	LF2	> 3900 ML/d	Oct to Apr	3 days minimum (ideally >5 days[35])	3–5 years in 10 (40% LTA)	4 years	
Bankfull	BK1	> 13,500 ML/d	Sep to Apr	1 day minimum	4 years in 10 (40% LTA)	4 years	
	BK2	> 13,500 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (40% LTA)	5 years	
Large overbank	OB1	> 40,000 ML/d	Sep to Apr	1 day minimum	2 years in 10 (20% LTA)	6 years	
	OB2	> 40,000 ML/d	Sep to Feb (but can occur any time)	1 day minimum	2–5 years in 10 (25% LTA)	6 years	At this location, this EWR will also provide for river red gum woodland (OB3)

[35] Ideally flows should be above the flow threshold for 5 days or longer to support spawning of flow pulse specialist native fish. Shorter duration flows (<5 days) at this gauge may contribute to longer duration flows and associated improved spawning outcomes at downstream locations

PU9: Cockburn River



Priority environmental assets and values

Cockburn River:

- Upper reaches (above Limbri) have low hydrologic disturbance
- Provides vital habitat for native fish by supporting their dispersal, migration & movement & can support freshwater catfish (endangered) & purple-spotted gudgeon (endangered) (predicted)
- Areas of flood-dependent forest & woodland can support threatened species

Cockburn River tributaries:

- Have low hydrologic disturbance
- Provides vital habitat for native fish by supporting their dispersal, migration & movement
- Mulla Creek is capable of supporting significant levels of native biodiversity

Other rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

	• Black Springs • Bungendore Creek • Callaghans Creek • Cauborn Creek	• Fairy Ground Creek • Jamiesons Creek • Moonbi Creek • Mulla Mulla Creek	• Robsons Gully • Shearins Creek • Swamp Oak Creek
Native fish	• unspecked hardyhead • Northern river blackfish • mountain galaxias • obscure galaxias • spangled perch • Darling River hardyhead	• Murray–Darling rainbowfish • Australian smelt • golden perch • carp gudgeon	• Murray cod • freshwater catfish • purple-spotted gudgeon
Birds	23 water-dependent bird species recorded, including eastern great egret		

Native vegetation	7 water-dependent plant community types, including: • river red gum woodland • river oak forest • river oak woodland • montane bogs • tea-tree shrubland • sedgeland fends wetland
Registered cultural assets	• modified trees

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, Australian smelt, mountain galaxias, spangled perch, golden perch, Murray cod, river blackfish, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias, mountain galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, river blackfish, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish, river blackfish

Hydrology

Gauge: 419016	**80th percentile**: 5 ML/d	**50th percentile**: 40 ML/d	**20th percentile**: 214 ML/d
	1.5 ARI: 8822 ML/d	**2.5 ARI**: 12,504 ML/d	**5 ARI**: 18,242 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- cease-to-flow periods have been highly altered & occur more frequently
- low flows & baseflows have been highly altered & occur less frequently
- freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 88 unregulated WALs in this water source, equating to 4485 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown **Cockburn River MZ**: CtP when flows ≤ 0.25 m height at gauge 419099 or no visible flow at Evergreen rock bar 700 M upstream of Peel River confluence.					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

- consider reviewing the CtP threshold to help relieve unnatural CtF periods & support more ecologically relevant low flow/baseflows
- consider installing water level gauges at or near extraction sites
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL/TDEL).

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

High ecological values, including migratory native fish, are located amongst extraction licences. The current surface water CtP rule is under review in the lower Cockburn River management zone, due to high connectivity between surface & groundwater, to ensure protection of native fish pool habitat / refugia. Material risk is therefore likely to match the risk assessment, hence the need to review access rules.

Table 14 Environmental watering requirements for the Cockburn River at Mulla Crossing (gauge 419016)[36]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season June - Dec	Typically CtF events should be around 8 days – CtF events should not persist for longer than 71 days	Should occur in no more than 61% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	332 days minimum (or 201 days minimum in very dry years)	Annually	71 days	
Baseflow	BF1	> 163 ML/d	Any time	65 days minimum (or 16 days minimum in very dry years)	98% of years	135 days	
	BF2	> 163 ML/d	Sept to Mar	36 days minimum (or 22 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 455 ML/d	Oct to Apr (but can occur any time)	2 days minimum	Annually	1 year	
	SF2	455–2330 ML/d	Sept to Apr	3 days minimum (ideally >14 days[37])	5–10 years in 10 (75% LTA)	2 years	

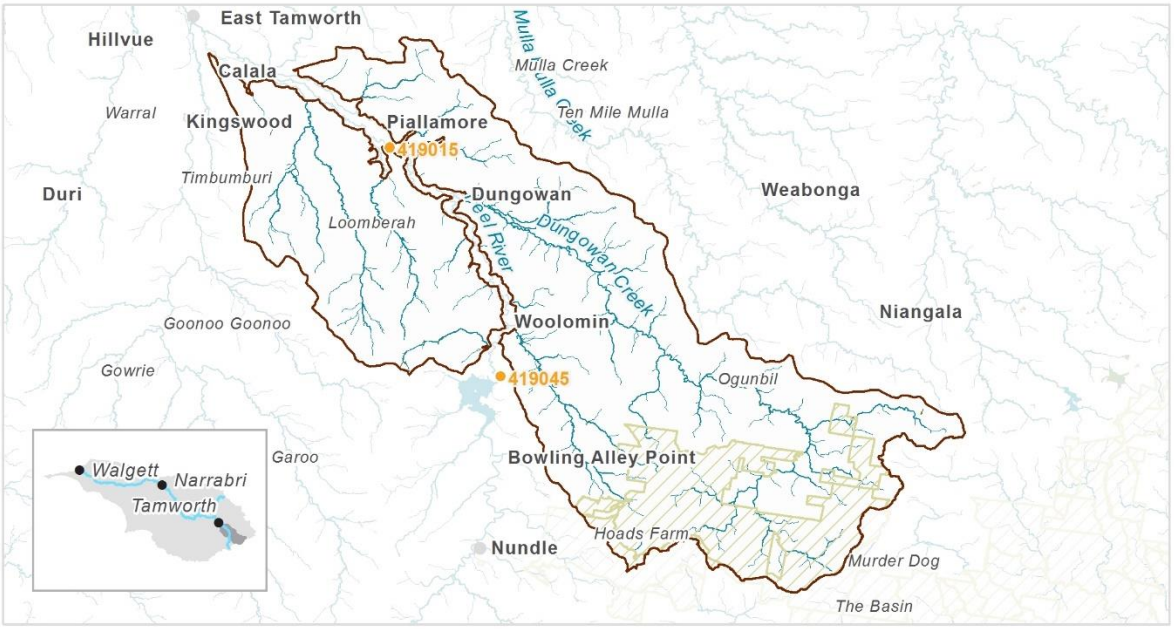
[36] Refer to Glossary for definitions of terms and explanatory text for EWRs.

[37] Ideally flows should be within the flow range for 14 days or longer to support spawning of riverine specialist (e.g. Murray cod and freshwater catfish) and generalist native fish. Shorter duration flows (<14 days) at this gauge may support longer duration flows and associated improved spawning outcomes at downstream locations.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Large fresh	LF1	> 2330 ML/d	July to Sept (but can occur any time)	1 day minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	> 2330 ML/d	Oct to Apr	3 days minimum (ideally >5 days[38])	3–5 years in 10 (40% LTA)	4 years	
Bankfull	BK1	> 6169 ML/d	Sep to Apr	1 day minimum	4 years in 10 (40% LTA)	4 years	
	BK2	> 6169 ML/d	Sept to Feb (but can occur any time)	1 day minimum	3–5 years in 10 (40% LTA)	5 years	
Overbank	OB1	> 18,700 ML/d	Oct to Apr	1 day minimum	1 year in 10 (10% LTA)	10 years	
	OB2	> 18,700 ML/d	Sept to Feb (but can occur any time)	1 day minimum	1 year in 10 (10% LTA)	10 years	

[38] Ideally flows should be above the flow rate threshold for 5 days or longer to support spawning of flow pulse specialist native fish (e.g. golden perch and silver perch). Shorter duration flows (<5 days) at this gauge may contribute to longer duration flows and associated improved spawning outcomes at downstream locations.

PU10: Upper Peel River tributaries



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Calala Creek, Copes Creek, Duncan's Creek, Dungowan Creek, Georges Gully, Junction Creek, Reedy Creek, Sandy Creek
- Duncans Creek & Dungowan Creeks:
  - Dungowan Dam, which provides important waterbird habitat
  - Upper reaches have low hydrologic disturbance
  - Provides vital habitat for native fish & can support freshwater catfish (endangered) & purple-spotted gudgeon (endangered) (predicted)

Native fish	• unspecked hardyhead • northern River blackfish • mountain galaxias • Australian smelt	• Murray–Darling rainbowfish • golden perch • carp gudgeon	• obscure galaxias • Murray cod • freshwater catfish • purple-spotted gudgeon
Birds	26 water-dependent bird species recorded, including: • Latham's snipe, J K • eastern great egret, J	• Australasian darter • great cormorant	• Australasian grebe
Native vegetation	4 water-dependent plant community types, including: • river red gum woodland • sedgeland fens wetland sedgeland fens wetland	• river oak, rough barked apple, red gum forest	• river oak forest

Registered cultural assets	No water-dependent cultural assets were found in the known site data[39]

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, Australian smelt, mountain galaxias, golden perch, Murray cod, river Blackfish, freshwater catfish, purple-spotted gudgeon
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias, mountain galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, river blackfish, freshwater catfish, purple-spotted gudgeon
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish, river blackfish

Hydrology			
Gauge: Dungowan inflows	**80th percentile**: 14.9 ML/d	**50th percentile**: 39.2 ML/d	**20th percentile**: 121 ML/d
	1.5 ARI: 3328 ML/d	**2.5 ARI**: 4639 ML/d	**5 ARI**: 6390 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- cease-to-flow periods have been highly altered, & occur more frequently
- low flows & baseflows have been highly altered, & occur less frequently
- freshes have undergone medium alteration occurring less frequently
- higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 66 unregulated WALs in this water source, equating to 9545 ML.

	Cease-to-flow	**Low flows & Baseflow**	**Freshes**	**High & infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration	H^+	H^-	M^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade not permitted between MZs Trade permitted within MZs, subject to assessment **Dungowan Creek MZ:** CtP no visible flow at Thortons Road Bridge ***Duncans Creek & other tributaries MZ**: CtP when no visible flow at pump site*					

[39] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources & beliefs that are important to Aboriginal people as part of their continuing culture may be present.

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

- consider introducing a CtP rule above no visible flow (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider implementing a commence-to-pump threshold that is higher than the CtP threshold to protect freshes and allow water quality to improve, & provide movement and breeding opportunities for native fish and other aquatic biota
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL)

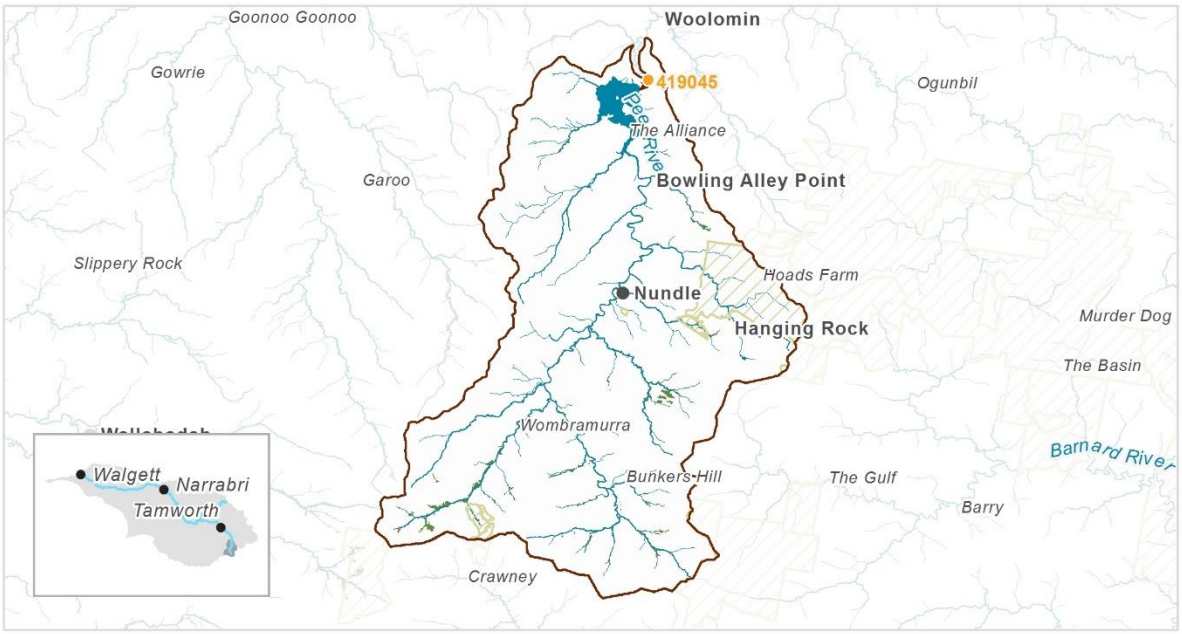
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand and review access rules if usage increases or if the pattern of use changes

Consider development of a works approval to release water from Dungowan Dam to mitigate risks for low flow categories

PU11: Chaffey



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Back Creek, Burrows Creek, Canns Creek, Fitzpatricks Gully, Folly Creek, Nundle Creek, Peel River, Wombramurra Creek, Woodleys Creek

Peel River channel:

- can support migratory bird species
- upper reaches have low hydrologic disturbance
- provides vital habitat for native fish & can support freshwater catfish (endangered) & purple-spotted gudgeon (endangered) (predicted)
- capable of supporting significant levels of native biodiversity

Peel River tributaries:

- significant upland sections have low hydrologic disturbance
- provides vital habitat for native fish & can support freshwater catfish (endangered) & purple-spotted gudgeon (endangered) (predicted)
- capable of supporting significant levels of native biodiversity

Native fish	• northern river blackfish • mountain galaxias • carp gudgeon	• Australian smelt • golden perch • Murray cod	• freshwater catfish • purple-spotted gudgeon
Birds	36 water-dependent bird species recorded, including: • curlew sandpiper, CE, C J K • eastern great egret	• Latham's snipe, J K • blue-billed duck, V	• royal spoonbill
Native vegetation	3 water-dependent plant community types, including: • river oak forest	• river oak woodland	• tea-tree riparian shrubland wetland

Registered cultural assets	No water-dependent cultural assets were found in the known site data[40]

Hydrology

Gauge: simulated inflows	**80th percentile**: 9.6 ML/d	**50th percentile**: 27.2 ML/d	**20th percentile**: 82.4 ML/d
	1.5 ARI: 4243 ML/d	**2.5 ARI**: 7191 ML/d	**5 ARI**: 8716 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been altered, & occur more frequently
- low flows & baseflows have been altered, & occur less frequently
- freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 12 unregulated WALs in this water source, equating to 388.5 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	M^+	M^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown **Chaffey tributaries MZ**: CtP when no visible flow at pump site **Peel River MZ**: CtP at 2 ML/d at gauge 419081					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

- consider reviewing the CtP threshold to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider introducing a CtP rule above no visible flow (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL).

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

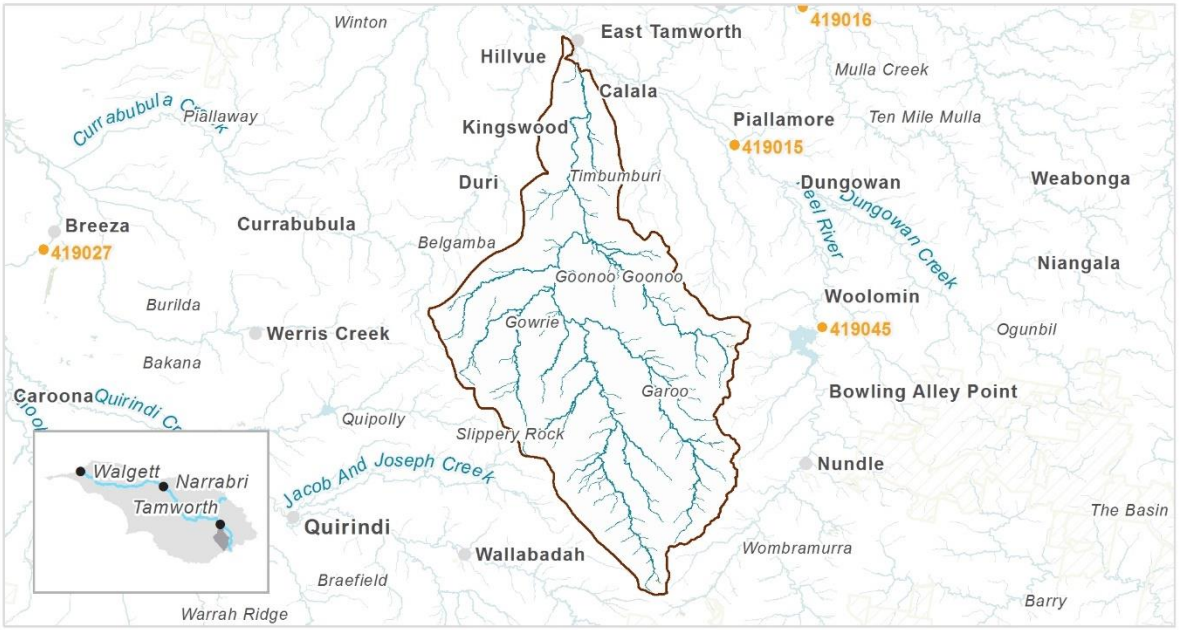
Ensure compliance with water access licence conditions including through metering of all licensed extraction

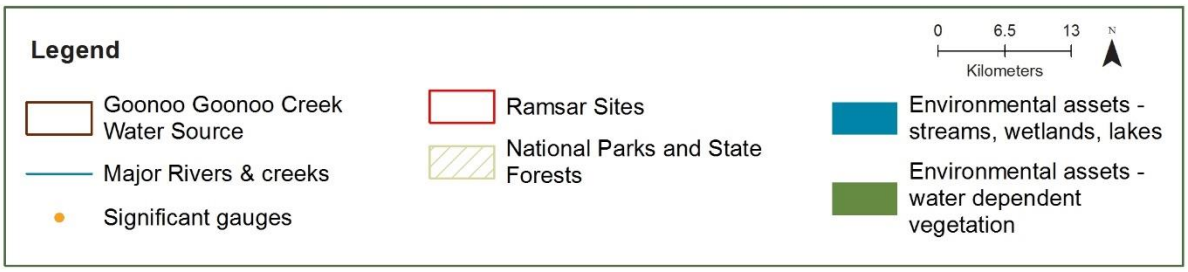
Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

Note: High & very high value reaches are upstream of extraction points. When a CtP scenario was in place the risk to the zero flows category went from ‘high’ to ‘medium’.

[40] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources & beliefs that are important to Aboriginal people as part of their continuing culture may be present.

PU12: Goonoo Goonoo





Priority environmental assets and values

Goonoo Goonoo Creek:

- upper reaches have low hydrologic disturbance
- provides vital habitat for native fish & can support freshwater catfish (endangered) & purple-spotted gudgeon (endangered) (predicted)
- downstream reach capable of supporting significant levels of native biodiversity

Goonoo Goonoo Creek tributaries:

- provides vital habitat for native fish & can support freshwater catfish (endangered) & purple-spotted gudgeon (endangered) (predicted)

Other rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Benama Creek and Swamp, Boiling Down Creek, Goonoo Goonoo Creek, Middlebrook Creek, Sandy Creek, Spring Creek, Sugarloaf Creek, Swamp Creek, Warrimoo Creek.

Native fish	• unspecked hardyhead • carp gudgeon • Australian smelt	• golden perch • Murray cod • obscure galaxias • spangled perch	• freshwater catfish • purple-spotted gudgeon
Birds	27 water-dependent bird species recorded, including: • eastern great egret, J	• white-faced heron	• royal spoonbill
Native vegetation	3 water-dependent plant community types, including: • river oak, rough barked apple forest	• river oak forest	• river red gum woodland

Registered cultural assets	No water-dependent cultural assets were found in the known site data[41]*

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Australian smelt, golden perch, spangled perch, Murray cod, freshwater catfish, purple-spotted gudgeon

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, unspecked hardyhead, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419035	**80th percentile**: 3.3 ML/d	**50th percentile**: 12 ML/d	**20th percentile**: 44.9 ML/d
	1.5 ARI: 2898 ML/d	**2.5 ARI**: 4053 ML/d	**5 ARI**: 6862 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been highly altered, occurring more frequently
- low flows & baseflows have been highly altered, occurring less frequently
- freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 20 unregulated WALs in this water source, equating to 1055 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H+	H^-	L^-	L^-	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown **Downstream Boiling Down Creek MZ**: CtP no visible flow at Timbumburri gauge & upstream Calala Lane Bridge **Upstream Boiling Down Creek & tributaries MZ**: CtP no visible flow in vicinity of pump site					

[41] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources & beliefs that are important to Aboriginal people as part of their continuing culture may be present.

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

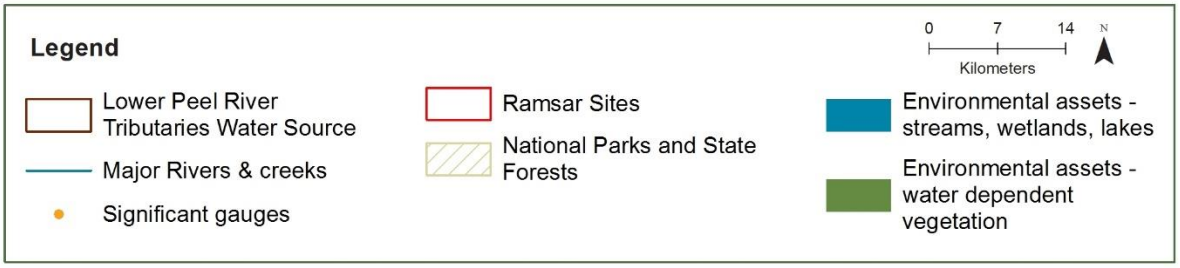
- consider introducing a CtP rule above no visible flow (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL).

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU13: Lower Peel River tributaries



Priority environmental assets and values

Timbumburri Creek:

- provides vital habitat for native fish by supporting their dispersal, migration & movement
- downstream reach capable of supporting significant levels of native biodiversity

All other Peel River tributaries:

- Horse Arm Creek can support migratory bird species
- provides vital habitat for native fish & can support purple-spotted gudgeon (endangered) (predicted)
- downstream reaches of Tangaratta Creek, Springs Gully, Brown Springs Gully are capable of supporting significant levels of native biodiversity

Other rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Attunga Creek, Boltons Creek, Boundary Gully, Browns Springs Creek and Gully, Catong Gully, Clay Creek and waterhole, Donnelly's Springs Creek, Dry Creek, Heifer Creek, Jeffries Gully, Limestone Gully, Moore Creek, Mountain Creek, Tangaratta Creek, Horse Arm Creek, Timbumburi Creek, Willow tree Creek, Yellow Gully.

Native fish	• unspecked hardyhead • obscure galaxias • carp gudgeon • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • Murray cod	• freshwater catfish • purple-spotted gudgeon • silver perch
Birds	36 water-dependent bird species recorded, including:		
	• Australasian bittern, E	• eastern great egret, J	• Latham's snipe, J K

Native vegetation	5 water-dependent plant community types, including:		
	• river red gum woodland	• river oak, rough barked apple, red gum forest	• tea-tree riparian shrubland wetland
Registered cultural assets	• Aboriginal resource & gathering • modified trees	• burials, modified tree • place of ceremony	• artefacts, habitation structure

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, silver perch, Murray cod, freshwater catfish, purple-spotted gudgeon
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): purple-spotted gudgeon
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Hydrology			
Gauge: 419035	**80th percentile**: 5.6 ML/d	**50th percentile**: 20.7 ML/d	**20th percentile**: 77 ML/d
	1.5 ARI: 5006 ML/d	**2.5 ARI**: 6963 ML/d	**5 ARI**: 11,790 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been highly altered, & occur more frequently
- low flows & baseflows been highly altered, & occur less frequently
- freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 60 unregulated WALs in this water source, equating to 2497 ML.

	Cease-to-flow	**Low flows & Baseflow**	**Freshes**	**High & infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration	H+	H-	L^-	L^0	L^0	L^0
Relevant rules	Trade limits or prohibitions between surface water plan areas, water sources, & management zones to manage growth in use. Cease / commence to pump rules for streams: *Moore Creek & Lower Peel tributaries MZ CtP based on no visible flows. Users must not CtP during the first 24-hr of visible flow at Moore Creek at Slippery Rock.* Cease / commence to pump rules for instream & off-river pools. Restrict construction of in-river dams on 3rd order or higher streams					

Potential management strategies
Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years: • consider reviewing CtP rule above no visible flow (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows • consider installing water level gauges at or near extraction sites • consider installing a river flow gauge • consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL) As a minimum, maintain existing rules in the WSP to maintain priority environmental assets Ensure compliance with water access licence conditions including through metering of all licensed extraction Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

3. Upper Namoi management area

The major tributaries in the Upper Namoi management area include the Manilla and Macdonald Rivers. The Manilla River flows through the town of Barraba and is regulated by Split Rock Dam, built in the 1980s. The Macdonald River starts at around 1330 metres elevation, upstream of Warrabah National Park and flows off the Great Dividing Range, becoming the Namoi River. At Manilla the Namoi and Manilla Rivers join at around 300 metres elevation.

Unregulated zones are located upstream of the regulated PUs and cannot be managed with HEW. Instead, they rely on natural inflows and PEW from upstream PUs to meet the water needs of the priority assets and functions they support. There are five PUs in this management area.

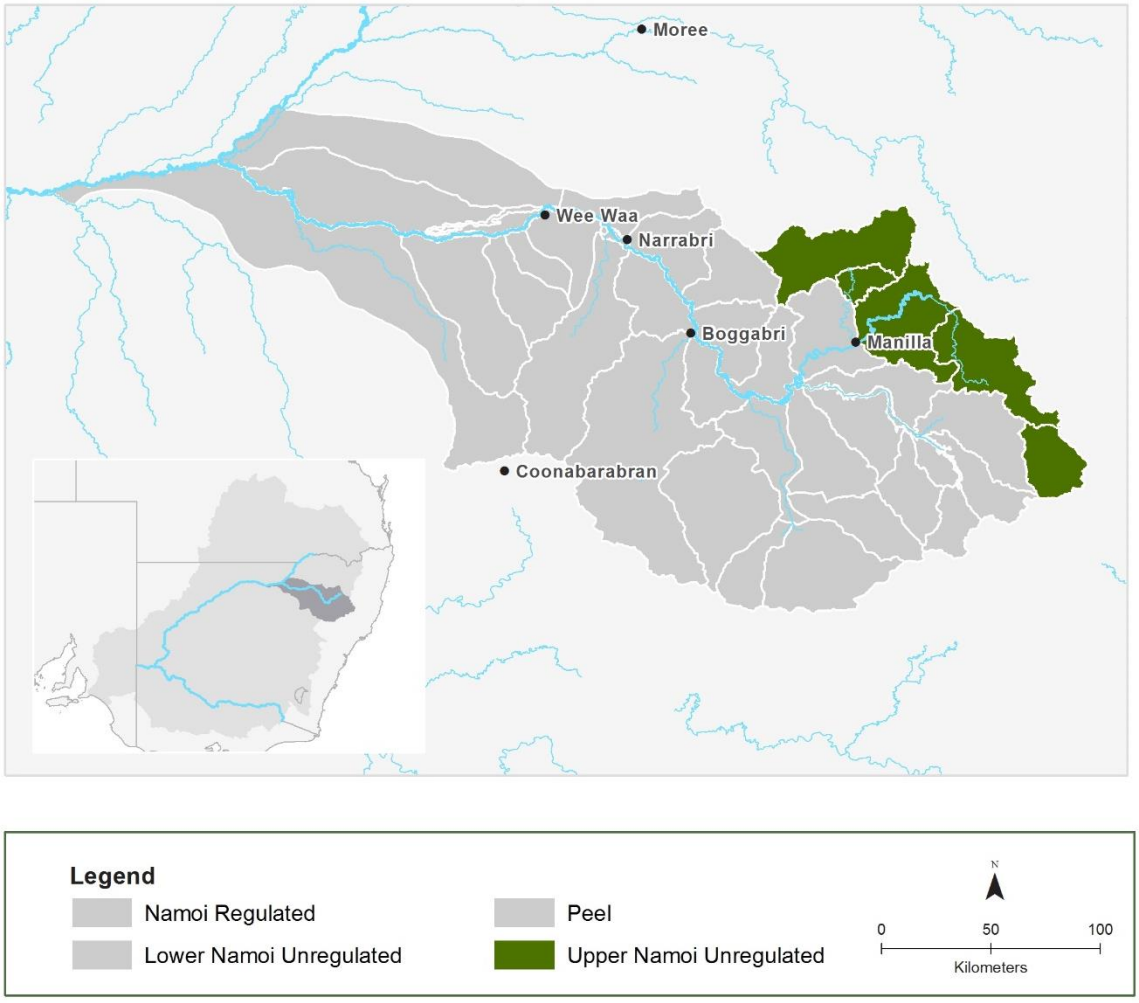
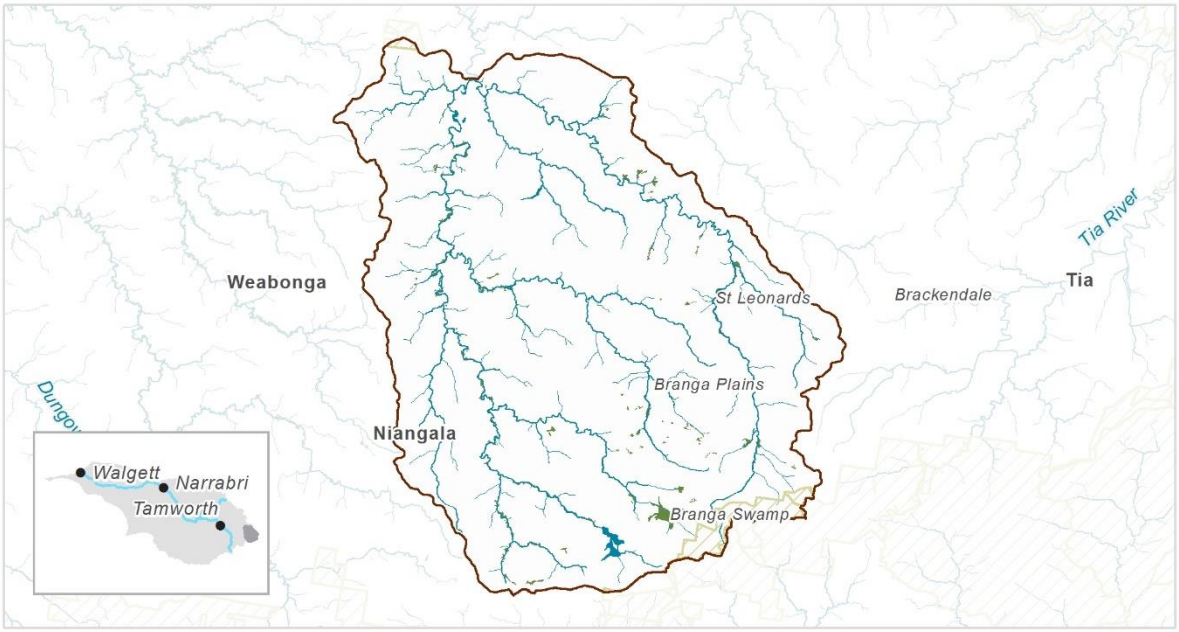


Figure 5 Map of the Upper Namoi management area

PU14: Upper Macdonald River



Priority environmental assets

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Cobrabald River, Halls Creek, Ingleba Creek, Macdonald River, Reedy Creek, Shingle Hut Creek, Smiths Creek, Swamp Oak Creek, Taylors Creek, Three-mile Creek.

Macdonald River channel:

- its headwaters can support migratory bird species
- significant sections have low hydrologic disturbance
- provides vital habitat for native fish by supporting their dispersal, migration & movement
- supports a threatened water-dependent species (Bell's Turtle - vulnerable)

All Macdonald River tributaries:

- provide vital habitat for native fish by supporting their dispersal, migration & movement
- the Cobrabald River supports a threatened water-dependent species (Bell's Turtle - vulnerable)

Native fish	• northern river blackfish	• obscure galaxias	• mountain galaxias
Birds	21 water-dependent bird species recorded, including Latham's snipe, J K		
Native vegetation	4 water-dependent plant community types, including:		
	• river oak, rough barked apple, red gum forest	• river oak forest • sedgeland fens wetland	• tea-tree riparian sedgeland

Registered cultural assets	No water-dependent cultural assets were found in the known site data[42]

Native fish objectives

NF1 No loss of native fish species: obscure galaxias, mountain galaxias, Northern river blackfish

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: obscure galaxias, mountain galaxias

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Northern river blackfish

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: Northern river blackfish

Hydrology

Gauge: 419038	**80th percentile**: 8.4 ML/d	**50th percentile**: 136 ML/d	**20th percentile**: 400 ML/d
	1.5 ARI: 5572 ML/d	**2.5 ARI**: 8189 ML/d	**5 ARI**: 10,096 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods, low flows & baseflows, freshes & higher & infrequent flows, have not undergone significant alteration & are similar to the base case.

There is 1 unregulated WALs in this water source, equating to 30 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	L^0	L^0	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade not permitted within the water source No pool drawdown					

Potential management strategies

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

[42] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources & beliefs that are important to Aboriginal people as part of their continuing culture may be present.

PU15: Mid Macdonald River

Priority environmental assets and values

High ecological values, including migratory native fish, are located at the end of this water source.

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Macdonald River channel:
  - significant sections have low hydrologic disturbance
  - provides vital habitat for native water-dependent species & can support freshwater catfish (endangered) (predicted), Murray cod & Bell's Turtle (vulnerable)
  - capable of supporting significant levels of native biodiversity (fish biodiversity >fair downstream of Woolbrook)
- Carlisles Gully, Cobrabald River, Congi Creek, Gibsons Rocky Gully, Macdonald River, Pringles Rocky Creek, Rose Valley Creek, Spitzbergen Creek, Surveyors Creek, Watsons Creek.
- The headwater features of Surveyor's Creek can support migratory bird species
- Watson's Creek: Has low hydrologic disturbance
- All remaining tributaries: Provide vital habitat for native water-dependent species by supporting their dispersal, migration & movement, & are considered valuable habitat for freshwater catfish (endangered)

Native fish	• Northern River blackfish • mountain galaxias • golden perch	• carp gudgeon • Murray cod	• freshwater catfish • obscure galaxias
Birds	24 water-dependent bird species recorded, including:		
	• Latham's snipe, J K	• Australasian grebe	• yellow-billed Spoonbill

Native vegetation	3 water-dependent plant community types, including • river oak, rough barked apple, red gum forest • tea-tree riparian shrubland • sedgeland fens wetland
Registered cultural assets	No water-dependent cultural assets were found in the known site data[43]

Native fish objectives

NF1 No loss of native fish species: mountain galaxias, obscure galaxias, carp gudgeon, golden perch, Murray cod, river blackfish, freshwater catfish

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: carp gudgeon, obscure galaxias, mountain galaxias

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, river blackfish, freshwater catfish

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): river blackfish

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish, river blackfish

Hydrology

Gauge: 419028	**80th percentile**: 36.3 ML/d	**50th percentile**: 166.4 ML/d	**20th percentile**: 570 ML/d
	1.5 ARI: 8474 ML/d	**2.5 ARI**: 13,598 ML/d	**5 ARI**: 16,764 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been altered, occurring more frequently
- Low flows & baseflows have been highly altered, occurring less frequently
- Freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 29 unregulated WALs in this water source, equating to 4342 ML

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	M^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown **Macdonald upstream Woolbrook MZ:** CtP at 10 ML/d at gauge 419010 **Macdonald downstream Woolbrook MZ:** CtP at 10 ML/d at gauge 419028					

[43] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources & beliefs that are important to Aboriginal people as part of their continuing culture may be present.

Potential management strategies
Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years • Consider increasing CtP threshold to 40 ML/d at gauge 419028 (80th percentile) to protect low flows & baseflows & support more ecologically relevant low flow / baseflows • consider installing water level gauges at or near extraction sites
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets
Ensure compliance with water access licence conditions including through metering of all licensed extraction
Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes
Consider increasing CtP to 40 ML/d at gauge 419028 (80th percentile) to protect low flows & baseflows & reduce the duration of CtF periods

Table 15 Environmental watering requirements for the Macdonald River at Retreat (gauge 419028)[44]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically Jan to June	Typically CtF events should be around 23 days - CtF events should not persist for longer than 34 days	Should occur in no more than 12% of years	N/A	
Very-low flow	VF1	>1 ML/d	Any time	365 days minimum (or 295 days minimum in very dry years)	Annually	23 days	
Baseflow	BF1	> 50 ML/d	Any time	236 days minimum (or 105 minimum in very dry years)	Annually	73 days	
	BF2	> 50 ML/d	Sept to Mar	150 days (33 days in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 180 ML/d	Oct to Apr (but can occur any time)	2 days minimum	6–10 years in 10 (60% LTA)	1 year	
	SF2	180–1500 ML/d	Sep to Apr	5 days minimum (ideally >14 days[45])	5–10 years in 10 (55% LTA)	2 years	

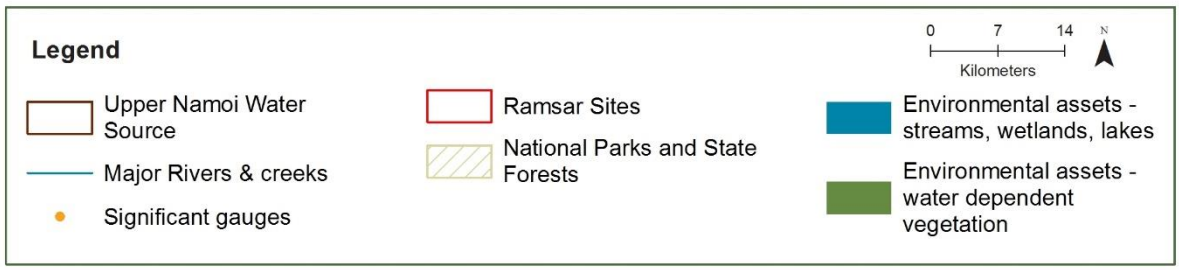
[44] Refer to Glossary for definitions of terms and explanatory text for EWRs.

[45] Ideally flows should be within the flow range for 14 days or longer to support spawning of riverine specialist (e.g. Murray cod and freshwater catfish) and generalist native fish. Shorter duration flows (<14 days) at this gauge may support longer duration flows and associated improved spawning outcomes at downstream locations.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Large fresh	LF1	> 1500 ML/d	July to Sept (but can occur any time)	1 day minimum	4–10 years in 10 (45% LTA)	2 years	
	LF2	> 1500 ML/d	Oct to Apr	3 days minimum (ideally > 5 days[46])	3–5 years in 10 (30% LTA)	4 years	
Bankfull	BK1	> 5570 ML/d	Sep to Apr	1 day minimum	2–3 years in 10 (25% LTA)	4 years	No objectives for floodplain specialist fish in this PU but this EWR should support spawning of floodplain specialists in downstream locations.
	BK2	> 5570 ML/d	Sep to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (35% LTA)	5 years	
Overbank	OB1	> 12,700 ML/d	Oct to Apr	1 day minimum	2 years in 10 (20% LTA)	10 years	See comment for BK1
	OB2	> 12,700 ML/d	Sep to Feb (but can occur any time)	2 days minimum	2 years in 10 (20% LTA)	10 years	

[46] Ideally flows should be above the flow rate threshold for 5 days or longer to support spawning of flow pulse specialist native fish (e.g. golden perch and silver perch). Shorter duration flows (<5 days) at this gauge may contribute to longer duration flows and associated improved spawning outcomes at downstream locations.

PU16: Upper Namoi



Priority environmental assets and values

- Provides vital habitat for native water-dependent species & is considered valuable habitat for freshwater catfish (endangered), purple-spotted gudgeon (endangered) (predicted), Murray cod, silver perch & Bell's Turtle (vulnerable).
- Capable of supporting significant levels of native biodiversity (fish biodiversity is above fair)
- High ecological values, including migratory native fish, are within this water source.
- Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to): Black Gully, Bungendore Creek, Halls Creek, Macdonald River, Manilla River, Mount Lowry Creek, Namoi River, New England Creek, Oaky Creek, Plum pudding Creek, Pretty Gully, Sandy Gully, Spring Creek, Warrabah Creek, Yarramanbully Creek, Yellow Rock Creek.

Native fish	• unspecked hardyhead • Northern River blackfish • mountain galaxias • carp gudgeon	• Murray–Darling rainbowfish • Australian smelt • golden perch • Murray cod • Darling River hardyhead	• freshwater catfish • purple-spotted gudgeon • silver perch • obscure galaxias • bony herring
Birds	37 water-dependent bird species recorded, including: • sharp-tailed sandpiper, C J K	• Pacific black duck	• black-fronted dotterel
	4 water-dependent plant community types, including:		

Native vegetation	• river oak, rough barked apple, red gum forest	• river red gum woodland • sedgeland fens wetland	• tea-tree riparian shrubland
Registered cultural assets	• modified trees		

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, Australian smelt, bony herring, golden perch, silver perch, Murray cod, river blackfish, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, river blackfish, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish, river blackfish

Hydrology

Gauge: 419029 **80th percentile**: 50 ML/d **50th percentile**: 223 ML/d **20th percentile**: 721 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been highly altered, & occur more frequently
- Low flows & baseflows have been highly altered, & occur less frequently
- Freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 78 unregulated WALs in this water source, equating to 9573 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within some MZ, subject to assessment Trade not permitted into Halls Creek & Upper Namoi tributaries MZs No pool drawdown **Halls Creek MZ:** CtP at 1 ML/d at gauge 419029 **Macdonald & Namoi Rivers MZ:** CtP when no visible flow at gauge 419022					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years

- consider reviewing the CtP threshold to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL) to reduce the daily extraction pressure, especially on smaller flows

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

Table 16 Environmental watering requirements for the Namoi River at Manilla (gauge 419022)[47]

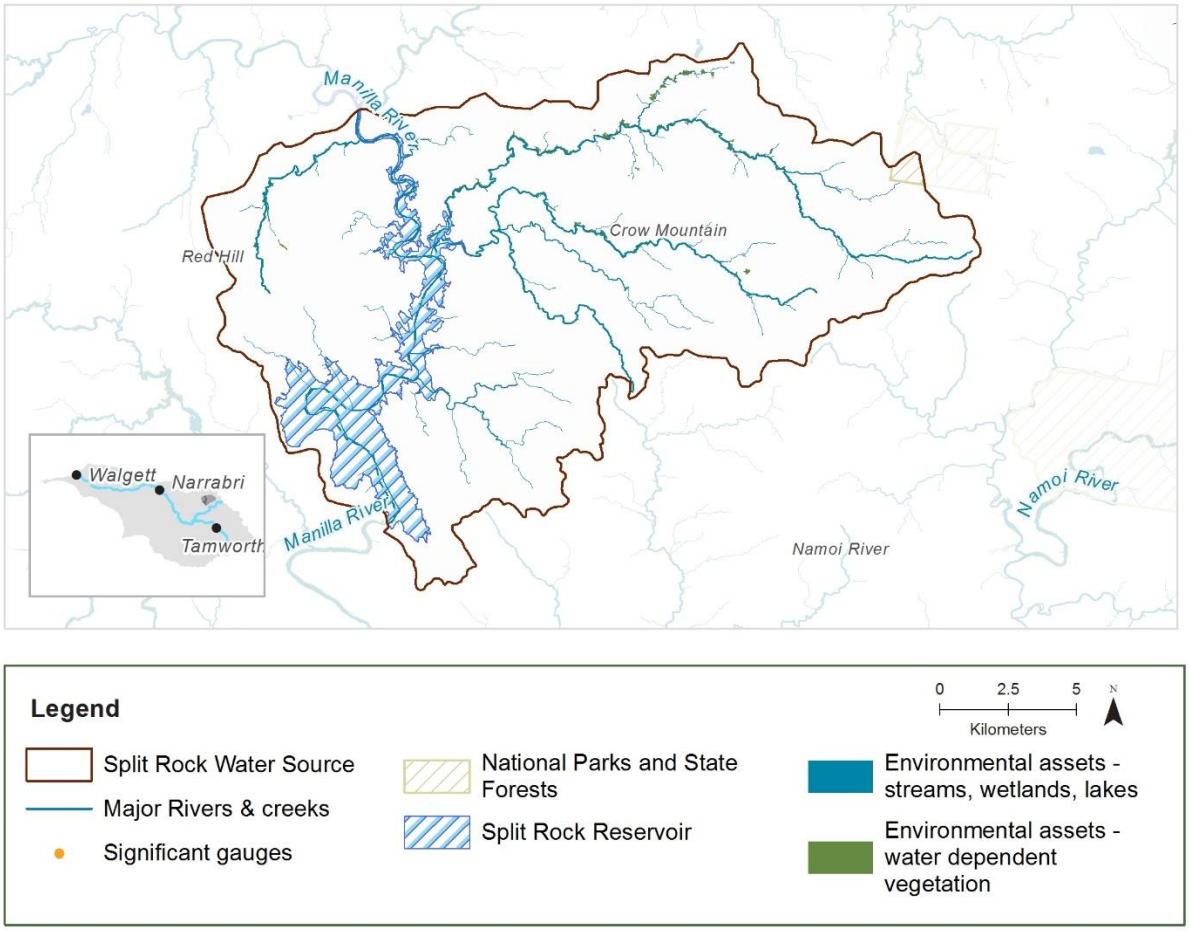
Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season, typically Jan to June	Typically CtF events should be around 2 days. CtF events should not persist for longer than 17 days	Should occur in no more than 22% of years	N/A	
Very-low flow	VF1	> 1 ML/d	Any time	365 days minimum (or 335 days minimum in very dry years)	Annually	17 days	
Baseflow	BF1	> 70 ML/d	Any time	307 days minimum (or 129 days minimum in very dry years)	Annually	70 days	
	BF2	> 70 ML/d	Sept to Mar	180 days minimum (or 55 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 400 ML/d	Oct to Apr (but can occur any time)	10 days minimum	Annual	1 year	
	SF2	400–6800 ML/d	Sept to Apr	14 days minimum	5–10 years in 10 (75% LTA)	2 years	

[47] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Large fresh	LF1	> 6800 ML/d	July to Sept (but can occur any time)	2 days minimum	5–10 years in 10 (60% LTA)	2 years	
	LF2	> 6800 ML/d	Oct to Apr	2 days minimum (ideally >5 days[48])	3–5 years in 10 (40% LTA)	4 years	
Bankfull	BK1	> 19,250 ML/d	Oct to Apr	1 days minimum	4 years in 10 (40% LTA)	5 years	
	BK2	> 19,250 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (40% LTA)	5 years	
Overbank	OB1	> 53,000 ML/d	Oct to Apr	1 day minimum	2 years in 10 (20% LTA)	7 years	
	OB2	> 53,000 ML/d	Sept to Feb (but can occur any time)	1 day minimum	2 years in 10 (25% LTA)	7 years	

[48] Ideally flows should be above the flow rate threshold for 5 days or longer to support spawning of flow pulse specialist native fish (e.g. golden perch and silver perch). Shorter duration flows (<5 days) at this gauge may contribute to longer duration flows and associated improved spawning outcomes at downstream locations.

PU17: Split Rock



Priority environmental assets

Manilla River channel:

- some riparian vegetation stands along the Manilla River & its tributaries are rated as having high to very high ecological value
- provides vital habitat for native water-dependent species by supporting their dispersal, migration & movement, & is considered valuable habitat for freshwater catfish (endangered) & purple-spotted gudgeon (endangered) (predicted)

Split Rock Dam tributaries:

- tributary streams flowing into Split Rock Dam have low hydrologic disturbance
- all rivers & creeks in this PU provide vital habitat for native fish & are considered valuable habitat for freshwater catfish (endangered) & purple-spotted gudgeon (endangered)

Other rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to): Back Creek, Crow Mountain Creek, Eumur Creek, Ironbark Creek, Manilla River, Teatree Creek.

Native fish	• mountain galaxias • carp gudgeon • Australian smelt	• golden perch • Murray cod	• freshwater catfish • purple-spotted gudgeon
Birds	31 water-dependent bird species recorded, including:		
	• sharp-tailed sandpiper, C J K	• eastern great egret, J	• caspian terncaspian tern, J
Native vegetation	2 water-dependent plant community types, including:		
	• river oak, rough barked apple, red gum forest	• sedgeland fens wetland	

Registered cultural assets	No water-dependent cultural assets were found in the known site data[49]

Native fish objectives

NF1 No loss of native fish species: obscure galaxias, carp gudgeon, Australian smelt, golden perch, Murray cod, purple-spotted gudgeon, freshwater catfish

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

No modelled data at this location to illustrate hydrology. No information on WAL.

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- cease-to-flow periods, low flows & baseflows, freshes & higher & infrequent flow have not undergone significant alteration & are similar to the base case.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	L^0	L^0	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade not permitted within the water source No pool drawdown					

Potential management strategies

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

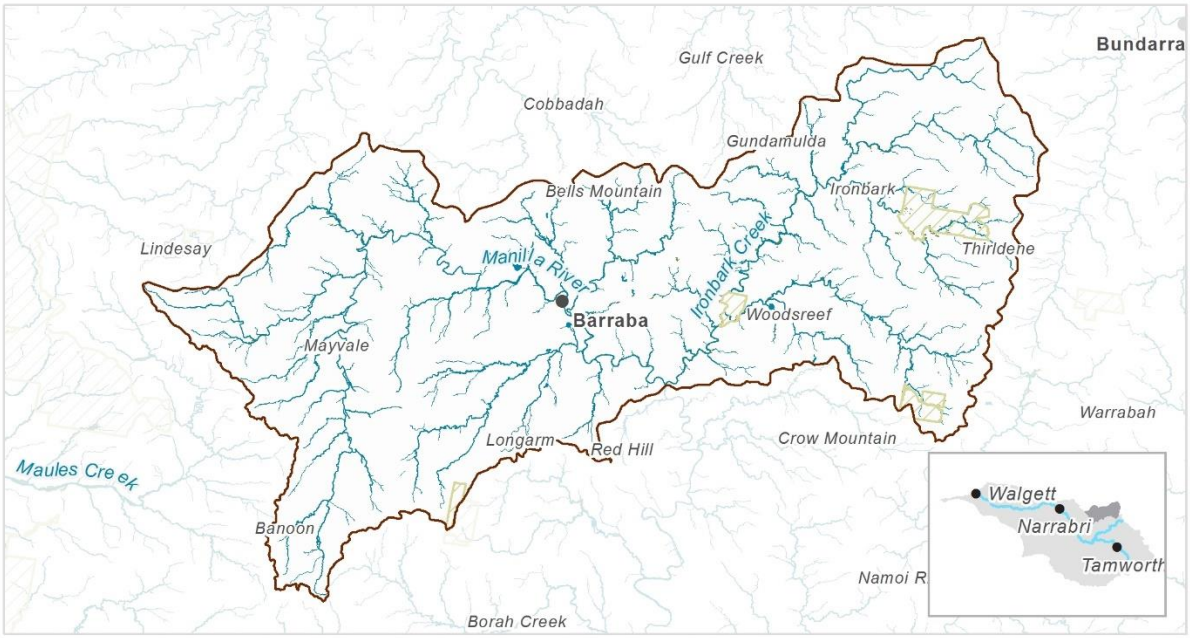
Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

Note: DPI-Fisheries have identified at least three fish barriers (e.g., road crossings) throughout the water source, with at least one barrier identified as a high priority. Patches within this water source have very low geomorphic recovery potential; & also very low percentage cover of native woody riparian vegetation

[49] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources & beliefs that are important to Aboriginal people as part of their continuing culture may be present.

PU18: Upper Manilla



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Bald rock swamp Creek, Barraba Creek, Bobs Creek, Boiling swamp Creek, Chain of ponds Creek, Connors Creek Goat Island Creek, Gulf Gully, Hawkins Creek, Highland Plain Creek, Ironbark Creek, Jericho Creek, Little Creek, Long swamp Creek, Main Camp Gully, Manilla River, Mille Creek, Nangahrah, Oaky Creek, Old Spring Creek, Paling Yard Creek, Sandy Gully, Saveall Creek, Sawyera Creek, Sepulchre Creek, Slaty Gully, Spencers Creek, Spring Creek, Station Creek, Tareela Creek, Teatree Creek, Woolshed Creek
- Has areas of very high naturalness with low hydrologic stress supporting macroinvertebrates, frog species (Booroolong frog & Tusked frog endangered population) & the Bell's turtle

Native fish	• unspecked hardyhead • Northern River blackfish • mountain galaxias • carp gudgeon	• bony herring • obscure galaxias • Australian smelt • golden perch • Murray cod	• freshwater catfish • purple-spotted gudgeon • Darling River hardyhead
Birds	32 water-dependent bird species recorded, including:		
	• Latham's snipe, J K	• eastern great egret, J	• Yellow-billed spoonbill

Native vegetation	4 water-dependent plant community types, including: • shallow freshwater wetland sedgeland • sedgeland fens wetland	• river oak, rough barked apple, red gum forest	• tea-tree riparian shrubland
Registered cultural assets	• modified trees		

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, bony herring, Australian smelt, golden perch, Murray cod, river blackfish, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, unspecked hardyhead, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, river blackfish, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish, river blackfish

Hydrology

Gauge: 419053	**80th percentile**: 4 ML/d	**50th percentile**: 19 ML/d	**20th percentile**: 66 ML/d
	1.5 ARI: 3321 ML/d	**2.5 ARI**: 5224 ML/d	**5 ARI**: 9083 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- cease-to-flow periods have been not been significantly altered
- low flows & baseflows have been altered to a medium extent, & occur less frequently
- freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 32 unregulated WALs in this water source, equating to 1630 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	M^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within some MZs, subject to assessment Trade not permitted within Manilla River tributaries & Ironbark Creek tributaries MZs No pool drawdown **Manilla MZ:** CtP at 3 ML/d at gauge 419053 **Ironbark Creek MZ**: CtP at 3 ML/d at gauge 419047					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

- consider reviewing the CtP threshold to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL) to reduce the daily extraction pressure, especially on smaller flows

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

4. Lower Namoi unregulated management area

The remaining significant portion of the catchment forms the unregulated Lower Namoi management area. There are 19 PUs in this management area. This area starts downstream of Keepit Dam, excluding the regulated portion of the Namoi River (Figure 6). Key tributaries in this area include Quirindi Creek, Mooki River, Cox's Creek and Maules Creek. Other tributaries include Bohena, Coghill, Baradine, Etoo and Talluba Creeks, which deliver substantial volumes of water from the Pilliga into the Namoi River. Lake Goran, south of Gunnedah is also within this management area and is listed in the Directory of Important Wetlands in Australia.

Unregulated zones are located upstream of the regulated PUs and cannot be managed with HEW. Instead, they rely on natural inflows and PEW from upstream PUs to meet the water needs of the priority assets and functions they support.

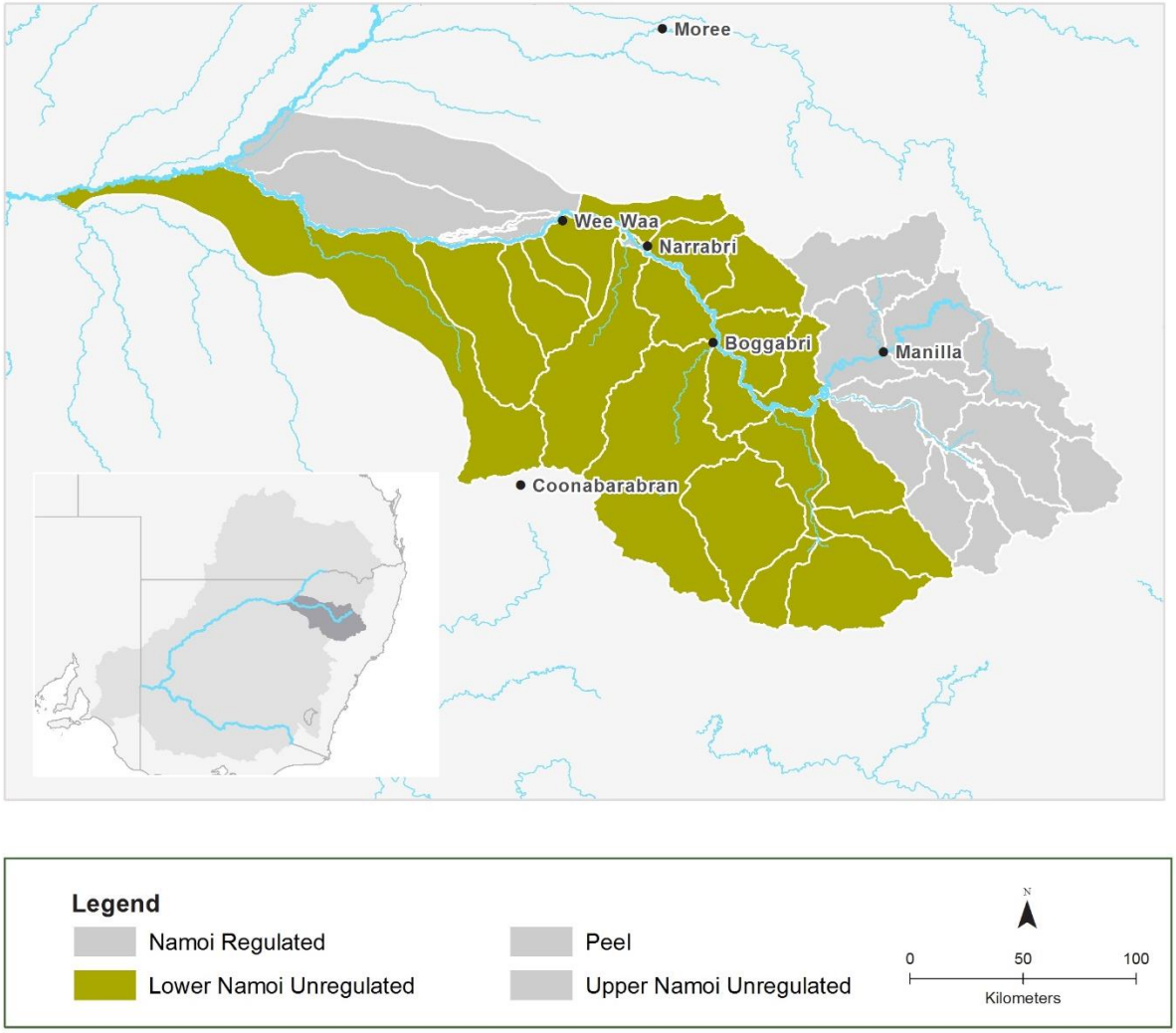
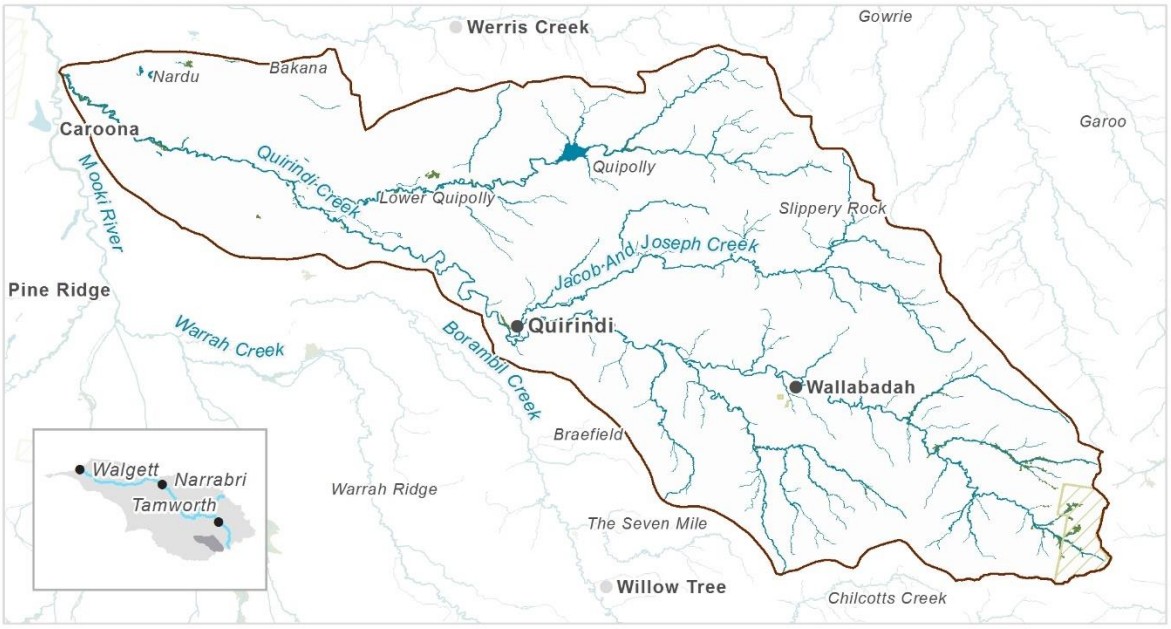


Figure 6 **Lower Namoi Unregulated management area**

PU19: Quirindi Creek



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Back Creek, Basin Creek and Gully, Jacob and Joseph Creek, Kangaroo Creek, Nicholas Ridge Lagoon, Nicholsons Lagoon, Quipolly Creek, Quirindi Creek, Rocky Gully, Spring Creek, Wiles Gully, Yellow woman Creek
- New & old Quipolly dams provide significant bird habitat & drought refuge

Native fish	• unspecked hardyhead • Northern River blackfish • obscure galaxias • carp gudgeon	• spangled perch • Murray–Darling rainbowfish • bony herring • Australian smelt	• golden perch • Murray cod • freshwater catfish • purple-spotted gudgeon • Darling River hardyhead
Birds	42 water-dependent bird species recorded, including:		
	• Latham's snipe, J K	• eastern great egret	• Australasian shoveler
Native vegetation	6 water-dependent plant community types, including:		
	• Shallow freshwater wetland sedgeland	• river red gum woodland	• river oak, rough barked apple, red gum forest

Registered cultural assets	• modified trees

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, Northern river blackfish, Murray cod, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, Northern river blackfish, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish, Northern river blackfish

Hydrology

Gauge: 419098	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 0 ML/d
	1.5 ARI: 1657 ML/d	**2.5 ARI**: 2836 ML/d	**5 ARI**: 5066 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been not been significantly altered, but do occur more frequently
- Low flows & baseflows have been highly altered, & occur less frequently
- Freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration but occur less frequently now.

There are 29 unregulated WALs in this water source, equating to 2496 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	H^-	L^-	L^-	L^-	L^-
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment CtP at 2 ML/d at gauge 419098					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

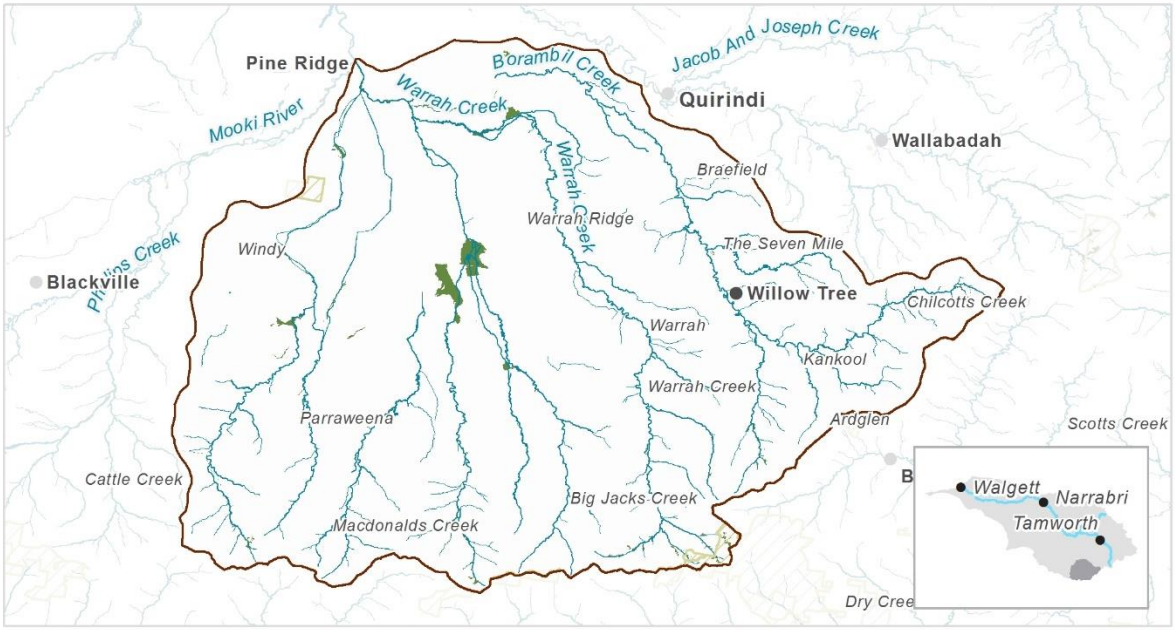
- consider reviewing the CtP threshold to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL) to reduce the daily extraction pressure, especially on smaller flows.

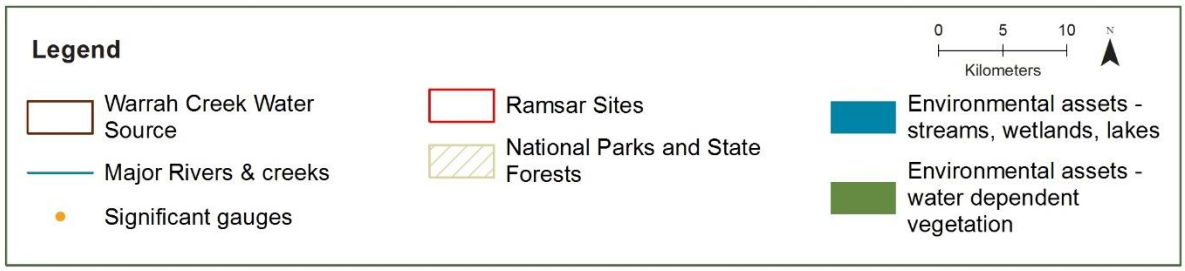
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU20: Warrah Creek





Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Big Jacks Creek, Borambil Creek, Captains Creek, Cedar Brush Creek, Chilcotts Creek, Dry Creek, Four-mile Creek, Gammon Creek, Little Jacks Creek, Little Oaky Creek, Macdonald's Creek, Millers Creek, Pump Station Creek, Spring Creek, Warrah Creek, Yarramanbah Creek.

Native fish	• unspecked hardyhead • mountain galaxias • carp gudgeon • spangled perch • golden perch	• Murray–Darling rainbowfish • bony herring • Australian smelt	• Murray cod • freshwater catfish • purple-spotted gudgeon
Birds	28 water-dependent bird species recorded including: • blue-billed duck, V P	• intermediate egret	• Latham's snipe, J K
Native vegetation	6 water-dependent plant community types, including: • river red gum woodland	• shallow freshwater wetland sedgeland	• river oak, rough-barked apple, red gum forest
Registered cultural assets	• modified trees		

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, spangled perch, golden perch, Murray cod, freshwater catfish, purple-spotted gudgeon
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish, purple-spotted gudgeon
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology			
Gauge: 419034	**80th percentile**: 0.6 ML/d	**50th percentile**: 7.4 ML/d	**20th percentile**: 39.8 ML/d
	1.5 ARI: 4067 ML/d	**2.5 ARI**: 8413 ML/d	**5 ARI**: 33,293 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been highly altered, & occur more frequently
- low flows & baseflows have been highly altered, & occur less frequently
- freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration but are all likely to occur less frequently

There are 6 unregulated WALs in this water source, equating to 265 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^-	L^-	L^-
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment CtP when no visible flow at pump site					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

- consider introducing a CtP rule above no visible flow (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge.

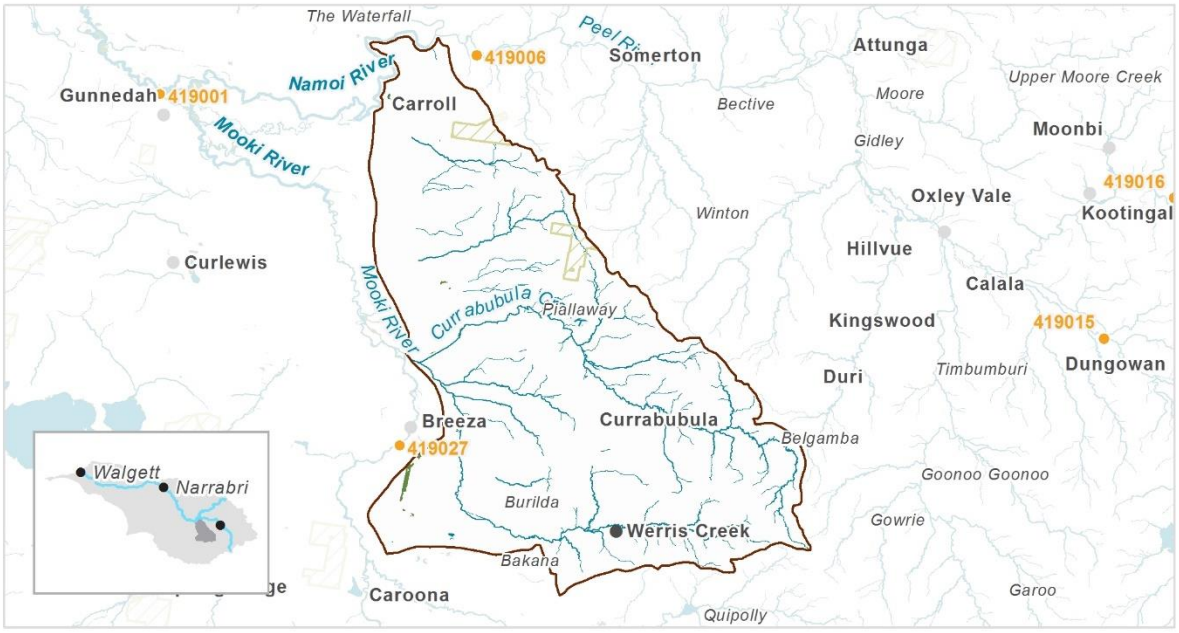
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

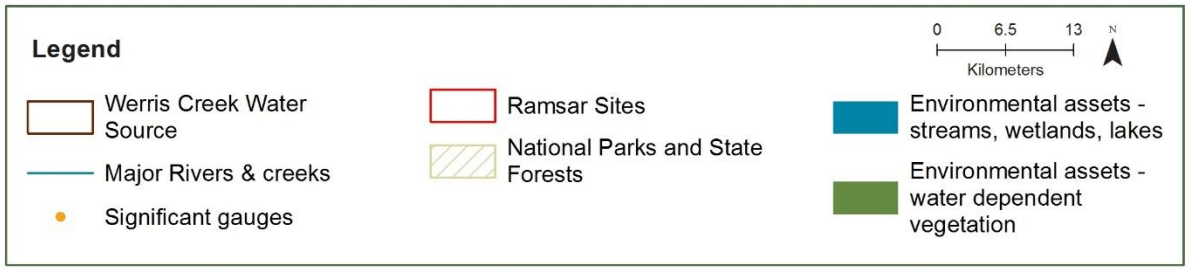
Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

Note from WRPA Risk Assessment: Implementation of a CtP scenario reduced the risk from medium to low for both the zero & base flow categories. Subject to assessment, modification of fish barriers may help reduce hydrological pressure (altered flows) to generate better hydrologic outcomes. Material risk is therefore likely to match the risk assessment, hence the need to review access rules.

PU21: Werris Creek





Priority environmental assets

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Campbells Gully, Chinamans Creek, Currabubula Creek, Duffs Gully, Duri Creek, Spring Creek, Werris Creek.high ecological values, including migratory native fish, are within this water source
- has areas of very high naturalness with low hydrologic stress supporting macroinvertebrates, frog species (booroolong frog & tusked frog endangered population) & the Bell's turtle

Native fish	• unspecked hardyhead • mountain galaxiasmountain galaxias • carp gudgeon • obscure galaxias • spangled perch • Murray–Darling rainbowfish • bony herring • Australian smelt • freshwater catfish • purple-spotted gudgeon
Birds	24 water-dependent bird species recorded including: • great eastern egret, J • plumed whistling-duck • royal spoonbill
Native vegetation	5 water-dependent plant community types, including: • river red gum woodland • shallow freshwater wetland sedgeland • river oak, rough-barked apple, red gum forest
Registered cultural assets	• modified trees

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, spangled perch, freshwater catfish, purple-spotted gudgeon
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: freshwater catfish, purple-spotted gudgeon
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): purple-spotted gudgeon
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: freshwater catfish

Hydrology			
Gauge: 419098	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 0 ML/d
	1.5 ARI: 883 ML/d	**2.5 ARI**: 1511 ML/d	**5 ARI**: 2699 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been not been significantly altered
- low flows & baseflows have been highly altered & occur less frequently
- freshes have been altered to a medium extent & occur less frequently
- higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 12 unregulated WALs in this water source, equating to 1344 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^{+}	H^{-}	L^{-}	L^{0}	L^{0}	L^{0}
Relevant rules	Trade permitted into the water source, subject to assessment only from surface water discharging downstream of Keepit Dam Trade permitted within the water source is permitted, subject to assessment No pool drawdown CtP when no visible flow at pump site					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

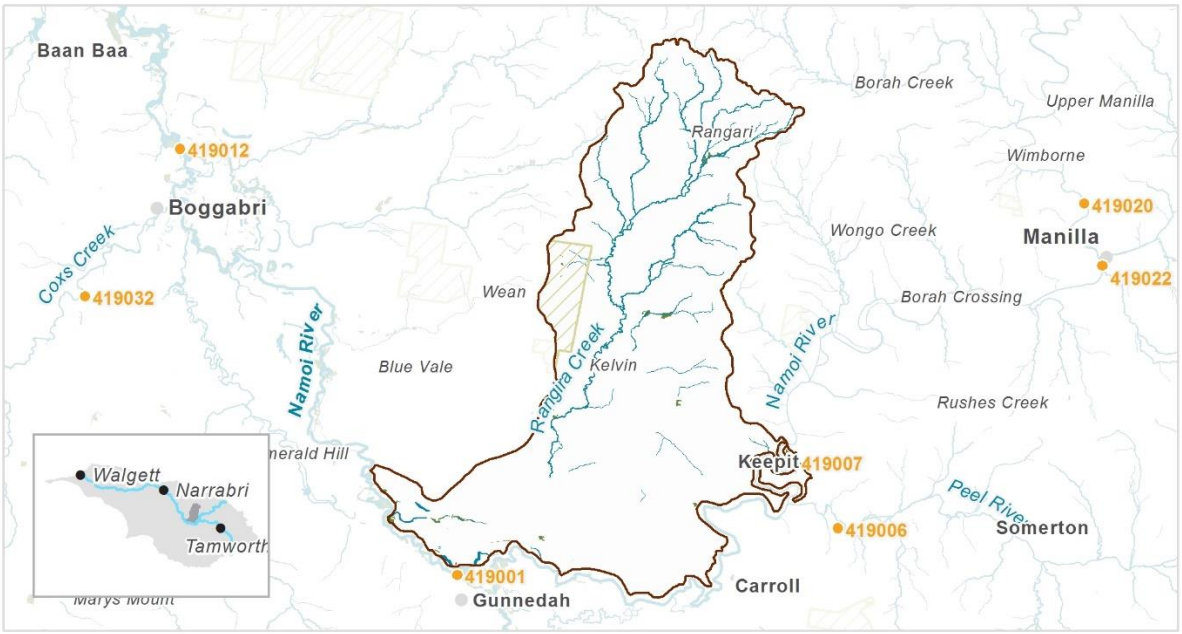
- consider introducing a CtP rule above no visible flow (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider implementing a commence-to-pump threshold that is higher than the CtP threshold to protect freshes & allow water quality to improve, & provide movement & breeding opportunities for native fish & other aquatic biota
- consider installing water level gauges at or near extraction sites
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL) to reduce the daily extraction pressure, especially on smaller flows.

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU22: Rangira Creek



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Rangira Creek, Barneys Gully, Boggy Spring Creek, Buchanans Creek, Conglomerate Creek, Gunnible Lagoon, Horseshoe Lagoon, Landry Lagoon, Namoi River, Orphants Well Creek, Sandy Creek, Watercress Gully

Native fish	• unspecked hardyhead • obscure galaxias • carp gudgeon • spangled perch • olive perchlet	• Murray–Darling rainbowfish • bony herring • Australian smelt • golden perch	• Murray cod • freshwater catfish • purple-spotted gudgeon • silver perch
Birds	30 water-dependent bird species recorded including: • common sandpiper, C J	• eastern great egret, J	• Australian little bittern
Native vegetation	6 water-dependent plant community types, including: • river red gum woodland	• shallow freshwater wetland sedgeland	• river oak, rough-barked apple, red gum forest
Registered cultural assets	• modified trees		

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, silver perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): purple-spotted gudgeon
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Hydrology			
Gauge: 419051	**80th percentile**: 1.3 ML/d	**50th percentile**: 3.6 ML/d	**20th percentile**: 9.5 ML/d
	1.5 ARI: 719 ML/d	**2.5 ARI**: 1138 ML/d	**5 ARI**: 2976 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been not been significantly altered
- Low flows & baseflows, freshes & 1.5 ARI floods have been altered to a medium extent, & occur less frequently
- Higher 2.5- & 5-year ARI flows have not undergone significant alteration but occur less frequently.

There is 1 unregulated WAL in this water source, equating to 1479 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	M^-	M^-	M^-	L^-	L^-
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years

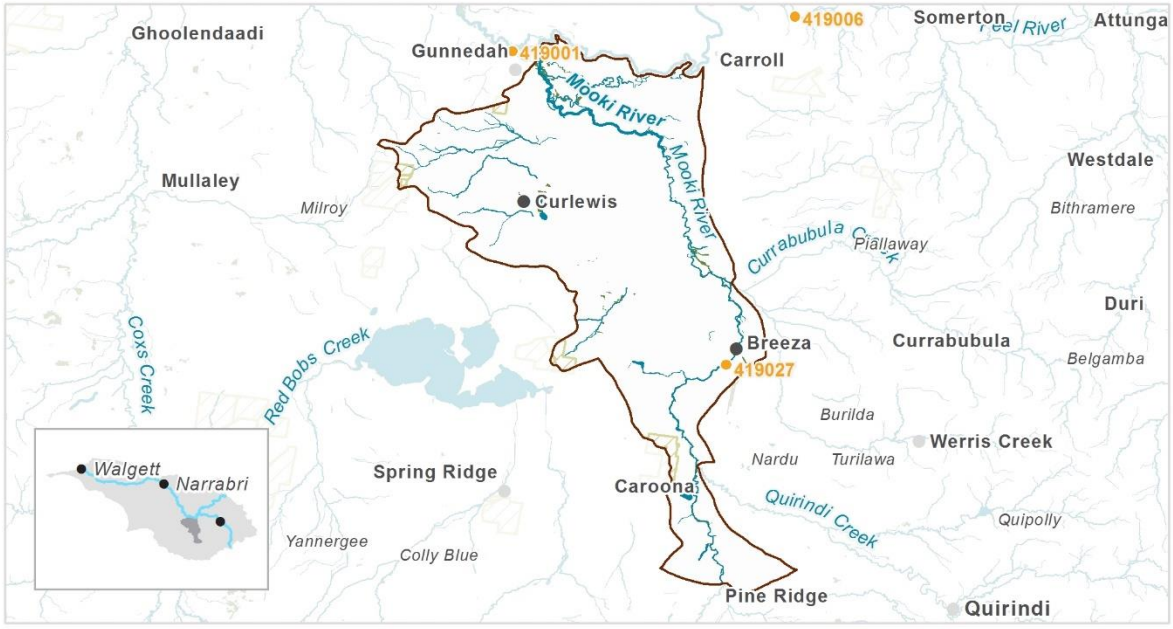
- consider introducing a CtP rule (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider implementing a commence-to-pump threshold that is higher than the CtP threshold to protect freshes & allow water quality to improve, & provide movement & breeding opportunities for native fish & other aquatic biota
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge

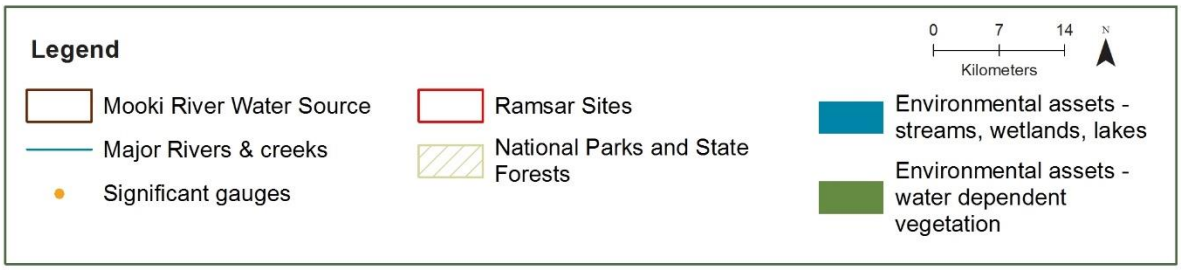
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU23: Mooki River





Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Carroll Creek, Coghill Ponds Creek, Curlewis Swamp, Heads of Red Creek, Mooki River, Native Dog Gully, Peach tree Gully, Quirindi Creek, Turners Gully, Watermark Gully, Werris Creek.

Native fish	• unspecked hardyhead • carp gudgeon • spangled perch • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • Murray cod	• freshwater catfish • purple-spotted gudgeon • silver perch • olive perchlet
Birds	40 water-dependent bird species recorded including: • little curlew, C J K • caspian tern, J	• blue-billed duck, V	• eastern great egret, J
Native vegetation	8 water-dependent plant community types, including: • river red gum woodland • shallow freshwater wetland sedgeland	• river oak, rough-barked apple, red gum forest • water couch marsh grassland wetland	• river coobah swamp wetland on the floodplains • lignum shrubland wetland
Registered cultural assets	• modified trees	• Aboriginal Ceremony & Dreaming, burials	

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, silver perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish, olive perchlet
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Hydrology			
Gauge: 419027	**80th percentile**: 0.8 ML/d	**50th percentile**: 12.8 ML/d	**20th percentile**: 81 ML/d
	1.5 ARI: 7557 ML/d	**2.5 ARI**: 16,151 ML/d	**5 ARI**: 49,111 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been not been significantly altered, but occur more frequently
- Low flows & baseflows have been altered to a medium extent, & occur less frequently
- Freshes have been highly altered, occurring less frequently
- Higher & infrequent flows, like smaller floods, have not undergone significant alteration but are less likely to occur

There are 29 unregulated WALs in this water source, equating to 40177 ML. This is one of the most developed water sources in terms of extraction.

	Cease-to-flow	**Low flows & Baseflow**	**Freshes**	**High & infrequent flows**		
				1.5 ARI	**2.5 ARI**	**5 ARI**
Hydrological alteration	L^+	M^-	H^-	L^-	L^-	L^-
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown CtP at 50 ML/d & commence to pump at 100 ML/d at gauge 419027					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years

- consider reviewing the CtP threshold to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider reviewing the commence-to-pump threshold to protect freshes & allow water quality to improve, & provide movement & breeding opportunities for native fish & other aquatic biota
- consider installing water level gauges at or near extraction sites
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL) to reduce the daily extraction pressure, especially on smaller flows

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

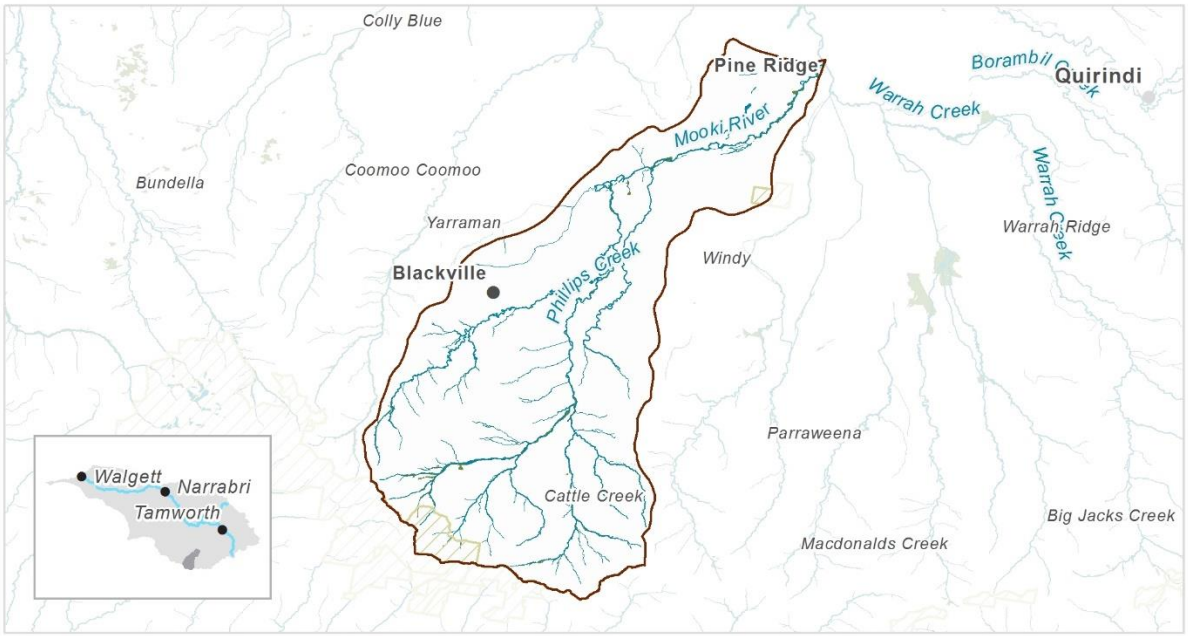
Table 17 Environmental water requirements for Mooki River at Breeza (gauge 419027)[50]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0-3 ML/d	In line with historical low flow season, typically Jan to June	Typically CtF events should be around 2 days. CtF events should not persist for longer than 146 days	Should occur in no more than 63% of years	N/A	
Very-low flow	VF1	> 3 ML/d	Any time	250 days minimum (or 42 days minimum in very dry years)	Annually	146 days	
Baseflow	BF1	> 200 ML/d	Any time	28 days minimum (or 3 days in very dry years)	93% of years	340 days	
	BF2	> 200 ML/d	Sept to Mar	15 days minimum	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 400 ML/d	Oct to Apr (but can occur any time)	2 days minimum	Annually (90% LTA)	1 year	Contributing to longer duration flows for riverine specialist native fish recruitment in downstream reaches
	SF2	400–1150 ML/d	Sept to Apr	2 days minimum	5–10 years in 10 (70% LTA)	2 years	

[50] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Large fresh	LF1	> 1150 ML/d	July to Sept (but can occur any time)	5 days minimum	5–10 years in 10 (50% LTA)	2 years	
	LF2	> 1150 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (35% LTA)	4 years	
Bankfull	BK1	> 3050 ML/d	Oct to Apr	2 days minimum	5 years in 10 (50% LTA)	4 years	
	BK2	> 3050 ML/d	Sept to Feb (but can occur any time)	4 days minimum	3–5 years in 10 (40% LTA)	5 years	
Small overbank	OB1	> 7600 ML/d	Oct to Apr	1 day minimum	4 years in 10 (40% LTA)	4 years	
	OB2	> 7600 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (40% LTA)	5 years	
Large overbank	OB3	> 10,000 ML/d	Aug to Feb (but can occur any time)	1 day minimum 1–4 months (habitat inundated)	3–5 years in 10 (40% LTA)	5 years	River red gum woodland

PU24: Phillips Creek



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Phillips Creek, Omaleah Creek, Black ridge Gully, Cattle Creek, Dry Creek, Larry's Creek, Mooki River, Red Ridge Gully, Sawers Creek, Spring Creek, Stockyard Creek, Warrah Creek.

Native fish	• unspecked hardyhead • obscure galaxias • spangled perch • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • carp gudgeon	• Murray cod • freshwater catfish • purple-spotted gudgeon • Darling River hardyhead
Birds	11 water-dependent bird species recorded including: • Australasian grebe • Pacific black duck	• white-faced heron • White-necked heron	• Yellow-billed spoonbill
Native vegetation	5 water-dependent plant community types, including: • river red gum woodland • Shallow freshwater wetland sedgeland	• river oak, rough-barked apple, red gum forest	• River oak moist riparian

Registered cultural assets	No water-dependent cultural assets were found in the known site data[51]

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, bony herring, Murray-Darling rainbowfish, Australian smelt, spangled perch, golden perch, Murray cod, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, Darling River hardyhead

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish, purple-spotted gudgeon

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419034 [52]	**80th percentile**: 0.6 ML/d	**50th percentile**: 7.4 ML/d	**20th percentile**: 39.8 ML/d
	1.5 ARI: 4067 ML/d	**2.5 ARI**: 8413 ML/d	**5 ARI**: 33,293 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF periods have been highly altered & occur more frequently
- low flows & baseflows have been highly altered & occur less frequently
- freshes, & higher & infrequent flows, like smaller floods, have not undergone significant alteration but have been decreased

There are 5 unregulated WALs in this water source, equating to 426 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^-	L^-	L^-
Relevant rules	Trade not permitted into the water source Trade permitted within the water source is permitted, subject to assessment No pool drawdown					

Potential management strategies

[51] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources and beliefs that are important to Aboriginal people as part of their continuing culture may be present.

[52] Data is based on the same gauge used for Warrah PU (thus the information is not as reliable as it is a combination of two water sources).

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years

- consider introducing a CtP rule (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL) to reduce the daily extraction pressure, especially on smaller flows

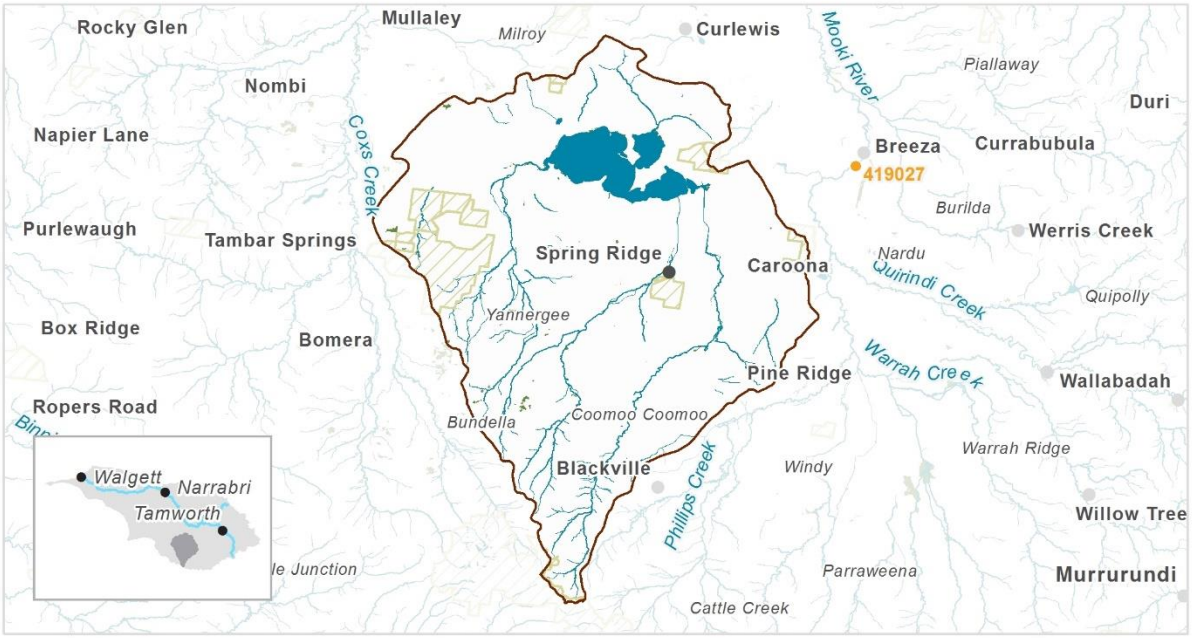
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

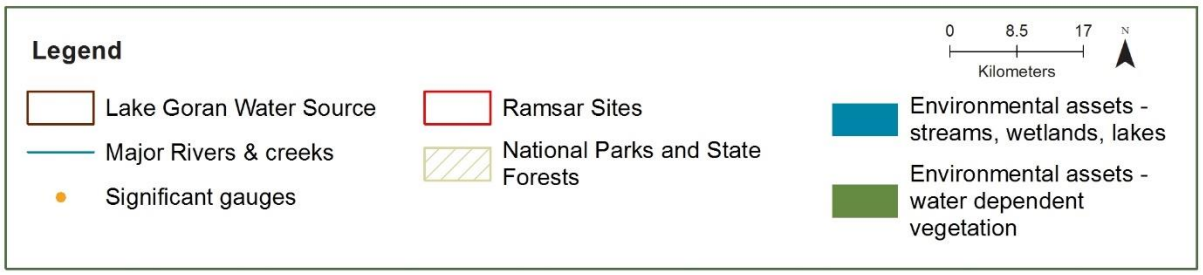
Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

Consider implementing a CtP rule to mitigate hydrological alteration

PU25: Lake Goran





Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Lake Goran – Nationally important wetland which provides important waterbird habitat
- Back Creek, Camerons Creek, Campbells Creek, Coomoo Coomoo Creek, Farrs Creek, Goran swamp, Henrys Creek, Level Gully, Moreduval hut Creek, Red bobs Creek, Wisemans Gully, Yarraman Creek.
- Substantially higher number of water-dependent bird species recorded in this PU

Native fish	• unspecked hardyhead • mountain galaxias • carp gudgeon • spangled perch • olive perchlet	• Murray–Darling rainbowfish • bony herring • dwarf flat-headed gudgeondwarf flat-headed gudgeondwarf flat-headed gudgeon	• Australian smelt • Murray cod • freshwater catfish • purple-spotted gudgeon
Birds	48 water-dependent bird species recorded, including: • curlew sandpiper, E, CE, C J K • freckled duck • common greenshank, C J K	• marsh sandpiper, C J K • Pacific golden plover, C J K • red-necked stint, C J K	• red knot, C J K • sharp-tailed sandpiper, C J K

Native vegetation	12 water-dependent plant community types, including: • river red gum woodland • shallow freshwater wetland sedgeland • red gum - Rough-barked Apple / tea tree sandy creek woodland (wetland) • river coobah swamp wetland • river oak, rough-barked apple, red gum forest
Registered cultural assets	No water-dependent cultural assets were found in the known site data[53]*

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Dwarf Flat-headed gudgeon, Australian smelt, spangled perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, Dwarf Flat-headed gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod: Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): olive perchlet
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: Murray cod, freshwater catfish

Hydrology

- Not modelled – insufficient data
- There are 5 unregulated WALs in this water source, equating to 19,943 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	NA	NA	NA	NA	NA	NA
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment CtP at water level at height of 294.7 m AHD at gauge 419066					

[53] It is acknowledged that unregistered Aboriginal values such as sites, objects, landscapes, resources & beliefs that are important to Aboriginal people as part of their continuing culture may be present.

Potential management strategies
Consider installing water level gauges at or near extraction sites or a river flow gauge to better understand the hydrology & extraction pressure in this water source
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets
Ensure compliance with water access licence conditions including through metering of all licensed extraction
Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU26: Coxs Creek

Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Bara Creek, Bomera Creek, Bullum bulla Creek, Bundella Creek, Cobbolah Lagoon, Creek and Dam, Coxs Creek, Currajong Creek, Curricuroo Creek, Deans Mountain Creek, Dunnadie Creek, Flaggy Creek, Forest Creek, Garrawilla Creek, Kerringle Creek, Little Pian Creek, McPhersons Gully, Mitchells Creek, Mucca Mucca Creek, Nombi Creek, Pamboola watercourse, Pidgery Creek, Saltwater Creek, Sawpit Creek, Washpen Creek.
- Fish status along Coxs Creek is rated fair

Native fish	• unspecked hardyhead • obscure galaxias • mountain galaxias • Murray–Darling rainbowfish • dwarf flat-headed gudgeon	• bony herring • Australian smelt • golden perch • carp gudgeon • spangled perch	• Murray cod • freshwater catfish • olive perchlet • purple-spotted gudgeon
Birds	25 water-dependent bird species recorded, including: • eastern great egret, J	• blue-billed duck, V	
Native vegetation	13 water-dependent plant community types, including: • river red gum woodland • shallow freshwater wetland sedgeland	• river oak, rough-barked apple, red gum forest	• tea tree shrubland, sedgeland

Registered cultural assets	• Aboriginal resource and gathering places, including waterholes • waterholes	• artefacts, grinding grooves, habitation structure • artefacts, habitation structure	• burials, modified tree • habitation structure, waterhole • modified trees

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Dwarf Flat-headed Gudgeon, Australian smelt, golden perch, spangled perch, Murray cod, purple-spotted gudgeon, freshwater catfish, olive perchlet

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, Dwarf Flat-headed gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish, olive perchlet

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419032	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 13 ML/d
	1.5 ARI: 5209 ML/d	**2.5 ARI**: 9429 ML/d	**5 ARI**: 17,685 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF, low flows & baseflows have not been significantly altered but occur less frequently
- Freshes have been highly altered & occur less frequently
- Higher infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 23 unregulated WALs in this water source, equating to 16469 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	L^-	H^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown **Lower Coxs Creek MZ:** CtP at 15 ML/d at gauge 419102 & 11 ML/d at gauge 419032 Mid Coxs Creek MZ: CtP at 17.5 ML/d at gauge 419033 & 15 ML/d at gauge 419102					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years

- consider implementing a commence-to-pump threshold that is higher than the CtP threshold to protect freshes & allow water quality to improve, & provide movement & breeding opportunities for native fish & other aquatic biota
- consider installing water level gauges at or near extraction sites
- consider rostering landholder water access &/or implementing an individual or total daily extraction limit (IDEL / TDEL) to reduce the daily extraction pressure, especially on smaller flows

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

Table 18 Environmental water requirements for Coxs Creek at Boggabri (gauge 419032)[54]

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Cease-to-flow	CF1	0 ML/d	In line with historical low flow season June to Oct	Typically CtF events should be around 25 days – CtF events should not persist for longer than 245 days	Occurs in 100% of years	N/A	
Very-low flow	VF1	>2 ML/d	Any time	89 days minimum (or 15 days minimum in very dry years)	Annually	245 days	
Baseflow	BF1	> 75 ML/d	Any time	21 days minimum (or 5 days minimum in very dry years)	Annually	250 days	
	BF2	> 75 ML/d	Sept to Mar	10 days minimum (or 3 days minimum in very dry years)	5–10 years in 10 (75% LTA)	2 years	
Small fresh	SF1	> 200 ML/d	Oct to Apr (but can occur any time)	2 days minimum	Annual	1 year	
	SF2	200–700 ML/d	Sept to Apr	2 days minimum	5–10 years in 10 (75% LTA)	2 years	
Large fresh	LF1	> 700 ML/d	July to Sept (but can occur any time)	2 days minimum	5–10 years in 10 (75% LTA)	2 years	
	LF2	> 700 ML/d	Oct to Apr	5 days minimum	3–5 years in 10 (40% LTA)	4 years	

[54] Refer to Glossary for definitions of terms and explanatory text for EWRs.

Flow category & EWR code		Flow rate / volume	Timing	Duration	Frequency (Long term average – LTA)	Maximum inter-event period	Additional requirements & comments
Bankfull	BK1	> 1750 ML/d	Oct to Apr	2 days minimum	5 years in 10 (50% LTA)	4 years	
	BK2	> 1750 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (40% LTA)	5 years	
Small overbank	OB1	> 3400 ML/d	Oct to Apr	2 days minimum	5 years in 10 (50% LTA)	4 years	
	OB2	> 3400 ML/d	Sept to Feb (but can occur any time)	2 days minimum	3–5 years in 10 (40% LTA)	5 years	
Large overbank	OB3	> 18000 ML/d	Aug to Feb (but can occur any time)	1 day minimum 1–4 months (habitat inundated)	3-5 years in 10 (40% LTA)	5 years	river red gum woodland

PU27: Bluevale

Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Barber's Lagoon, Barneys Spring Creek, Bayley park Creek, Belar Gully, Bollol Creek, Collygra Creek, Cooboobindi Creek, Coocooboonah Creek, Deadmans Gully, Driggle Draggle Creek, Dripping Rock Creek, Gins Gully, Goonbri Creek, Gulligal Lagoon, Merrygowen Creek, Mehi Creek, Mooki River, Native Cat Creek, Oaky Gully, The Slush Holes, Thompsons Lagoon, Wean Creek.
- Barber's Lagoon & Gulligal Lagoon, are significant for the catchment & provide important drought refugia & waterbird habitat

Native fish	• unspecked hardyhead • carp gudgeon • spangled perch • golden perch	• Murray–Darling rainbowfish • bony herring • Australian smelt • olive perchlet	• Murray cod • freshwater catfish • purple-spotted gudgeon
Birds	34 water-dependent bird species recorded, including: • Latham's snipe, J K	• blue-billed duck, V • eastern great egret, J	• brolga, V
Native vegetation	9 water-dependent plant community types, including: • coolibah - river coobah - lignum woodland wetland	• shallow freshwater wetland sedgeland • river red gum woodland	• water couch marsh grassland

Registered cultural assets	• Aboriginal resource and gathering • artefacts	• Conflict, non-human bone and organic material, potential archaeological deposit, waterhole	• modified trees • burials

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): olive perchlet

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419051	**80th percentile**: 2.3 ML/d	**50th percentile**: 6.2 ML/d	**20th percentile**: 16.3 ML/d
	1.5 ARI: 1234 ML/d	**2.5 ARI**: 1952 ML/d	**5 ARI**: 5104 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF has had low alteration
- Low flows & baseflows have been highly altered & occur less frequently
- Freshes, higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 6 unregulated WALs in this water source, equating to 2804 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source CtP when water level in Gulligal Lagoon is less than 80% full capacity					

Potential management strategies

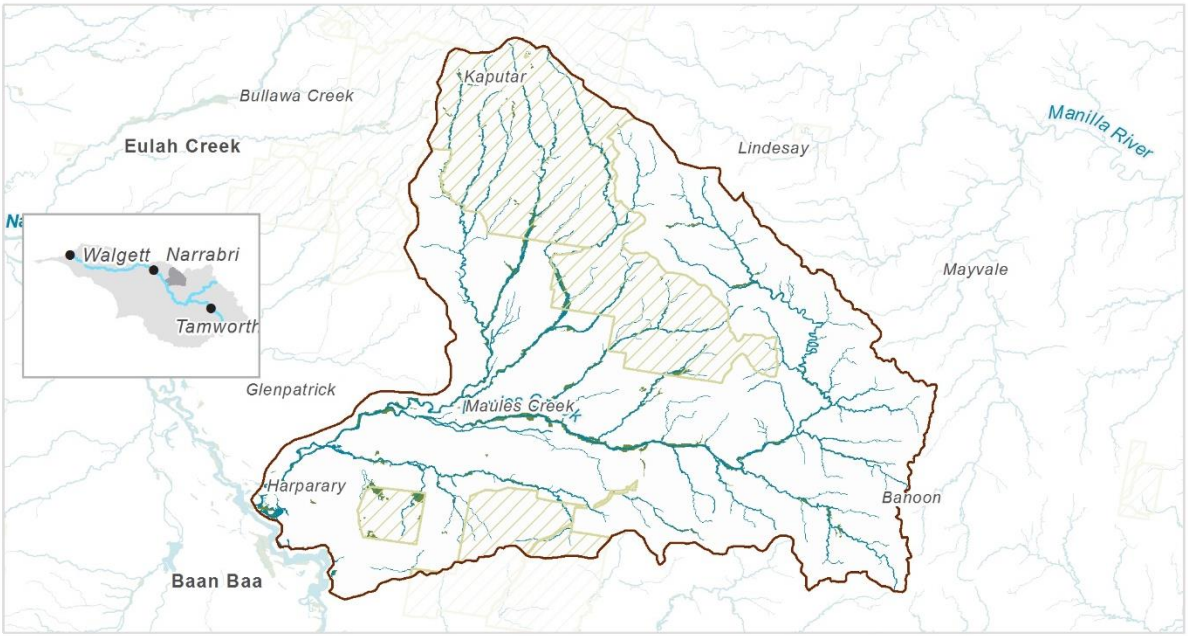
Consider introducing rules that protect HEW & PEW entering unregulated streams & off-channel pools

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU28: Maules Creek



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Back Creek, Basin Creek, Clack Mountain Creek, Boggabri Creek, Connors Creek, Dawsons Springs, Euglah Spring, Horsearm Creek, Jokers Spring, Lindesay Creek, Maules Creek, Middle Creek, Oaky Creek, Pinnacle Creek, Stony Creek, Teatree Creek, Teatree Gully, Whiskey Creek, Willuri Gully, Woolshed Creek.

Native fish	• unspecked hardyhead • mountain galaxias • carp gudgeon • spangled perch • obscure galaxias	• Murray–Darling rainbowfish • bony herring • Australian smelt • purple-spotted gudgeon	• Murray cod • freshwater catfish • olive perchlet • golden perch
Birds	36 water-dependent bird species recorded, including: • Latham's snipe, J K	• eastern great egret, J	
Native vegetation	7 water-dependent plant community types, including: • river red gum woodland • river oak - rough-barked apple - red gum forest	• tea-tree riparian shrubland / heathland wetland	• shallow freshwater wetland sedgeland
Registered cultural assets	• modified trees	• artefacts	

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, Murray cod, purple-spotted gudgeon, freshwater catfish, olive perchlet
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish, purple-spotted gudgeon
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419051	**80th percentile**: 4.8 ML/d	**50th percentile**: 13.2 ML/d	**20th percentile**: 35ML/d
	1.5 ARI: 1234 ML/d	**2.5 ARI**: 1952 ML/d	**5 ARI**: 5104 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF have been highly altered, & occur more frequently
- Low flows & baseflows have not been significantly altered but occur less frequently
- Freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration & are similar to the base case.

There are 6 unregulated WALs in this water source, equating to 1079 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown CtP at 1 ML/d at gauge 419051					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

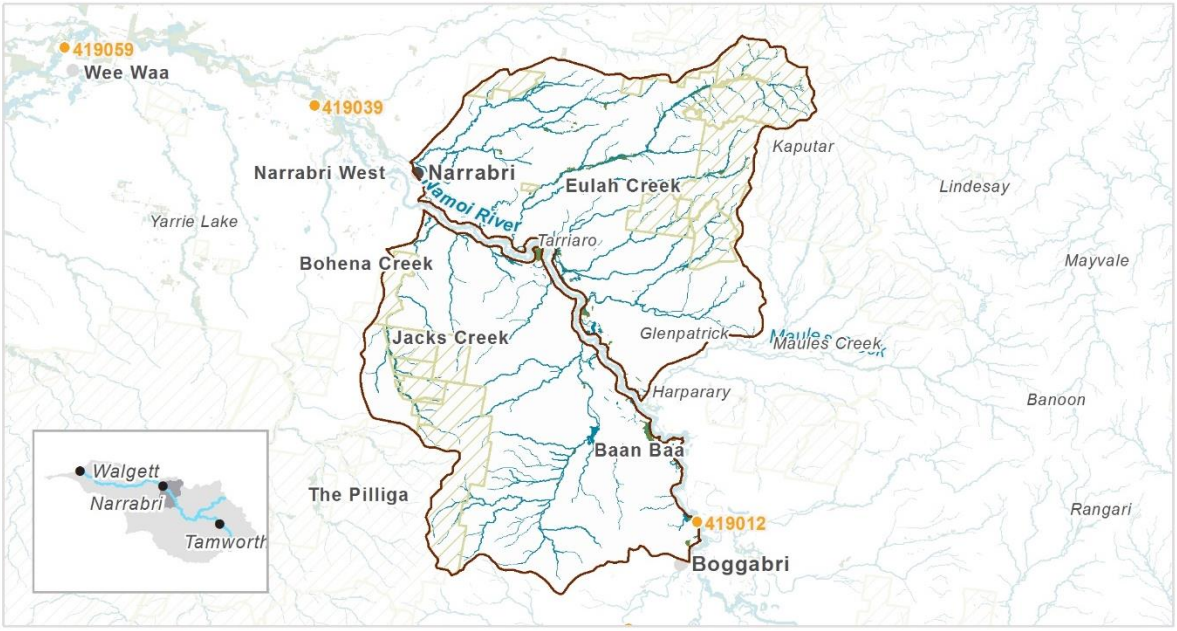
- consider reviewing the CtP threshold to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge

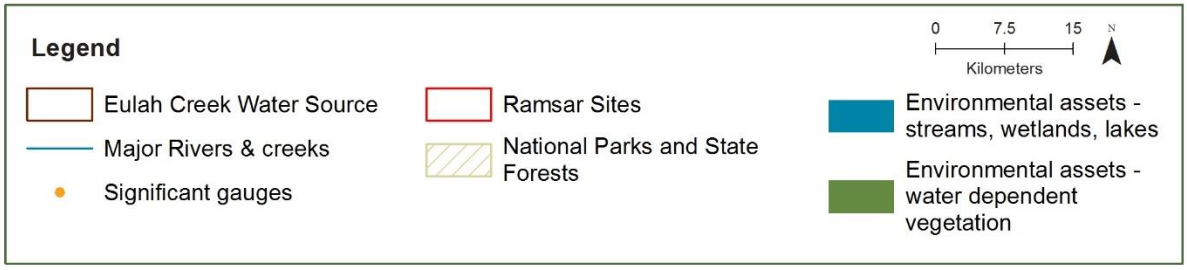
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU29: Eulah Creek





Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Barra Creek, Bibbla Creek, Bullawa Creek, Coolah Creek, Deriah Creek, Eulah Creek, Hartley Creek, Henriendi Lagoon, Horsearm Creek, Jacks Creek, Kurrajong Creek, Lindesay Creek, Mulgate Creek, Narrabri Creek, Oaky Creek, Pine Creek. Sandy Creek, Tulla Mullen Creek.
- Area of high Aboriginal cultural significance

Native fish	• obscure galaxias • carp gudgeon • spangled perch • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • purple-spotted gudgeon • unspecked hardyhead	• Murray cod • freshwater catfish • flathead galaxias • olive perchlet
Birds	41 water-dependent bird species recorded, including: • freckled duck, V • cattle egret, J	• eastern great egret, J	• Australian painted snipe, E
Native vegetation	12 water-dependent plant community types, including: • water couch marsh grassland wetland • river red gum woodland	• river oak - rough-barked apple - red gum forest	• coolibah - river coobah - lignum woodland wetland

Registered cultural assets	• artefacts, non-human bone & organic material, potential archaeological deposit	• Aboriginal resource & gathering • hearth	• shell • waterhole • modified trees

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet, flat-headed galaxias

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, Flat-headed Galaxias, purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419051	**80th percentile**: 3.7 ML/d	**50th percentile**: 10 ML/d	**20th percentile**: 27 ML/d
	1.5 ARI: 1234 ML/d	**2.5 ARI**: 1952 ML/d	**5 ARI**: 5104 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF have been heavily altered
- Low flows & baseflows have been altered & occur less frequently
- Freshes & higher & infrequent flows, like smaller floods, have not undergone significant alteration but have decreased.

There are 9 unregulated WALs in this water source, equating to 3893 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	M^-	L^-	L^-	L^-	L^-
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

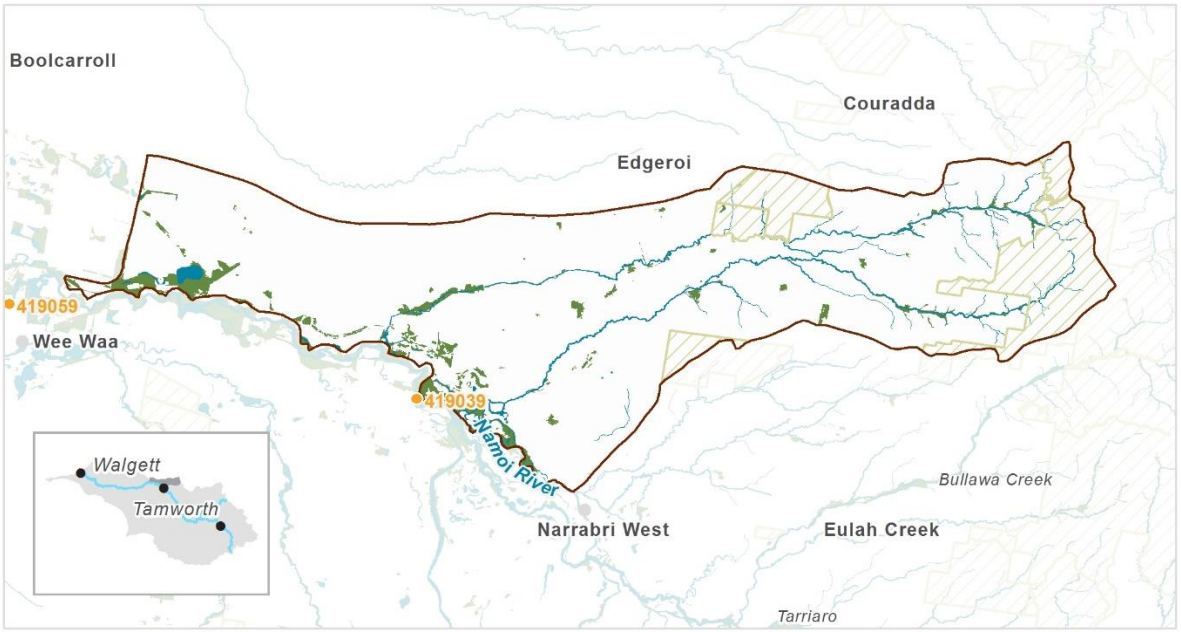
- consider introducing a CtP rule (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge

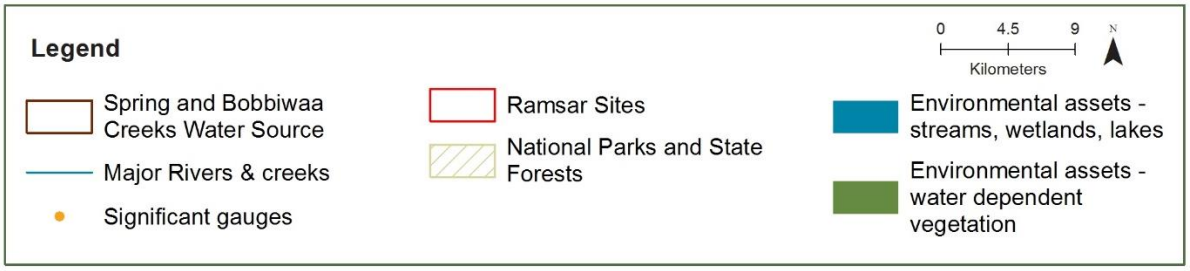
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU30: Spring and Bobbiwah Creeks





Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Black Gully, Bobbiwaa Creek, Horsearm Creek, Locharba Lagoons, Myall Vale channel, Narrabri Creek, Spring Creek, Yarrol Gully

Native fish	• obscure galaxias • carp gudgeon • spangled perch • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • Murray cod • unspecked hardyhead	• freshwater catfish • flathead galaxias • olive perchlet • purple-spotted gudgeon
Birds	28 water-dependent bird species recorded, including: • Latham's snipe, J K	• black-necked stork, E	• eastern great egret, J
Native vegetation	15 water-dependent plant community types, including: • coolibah - river coobah - lignum woodland wetland • black box woodland wetland	• river coobah swamp wetland	• river red gum forest
Registered cultural assets	• habitation structure	• modified trees	

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, Murray cod, purple-spotted gudgeon, freshwater catfish, olive perchlet, flat-headed galaxias

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, Flat-headed Galaxias, purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419083	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 1.4 ML/d
	1.5 ARI: 2247 ML/d	**2.5 ARI**: 5200 ML/d	**5 ARI**: 6691 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF, low flows & baseflows have not been significantly altered
- Freshes & higher & infrequent flows have not undergone significant alteration & are similar to the base case.

There are 3 unregulated WALs in this water source, equating to 981 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	L^-	L^0	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade not permitted within the water source No pool drawdown					

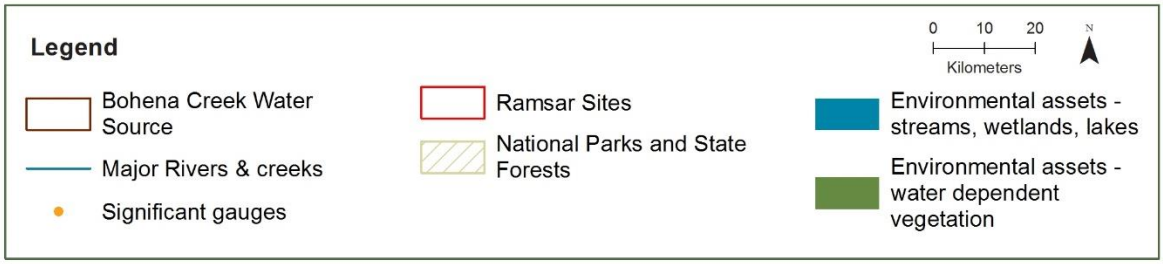
Potential management strategies

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU31: Bohena Creek



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Bibblewindi Creek, Billy Creek, Bohenca Creek, Borah Creek, Cowallah Creek, Flaggy Creek, Horsearm Creek, Narrabri Creek, Sandy Creek, Spring Creek, Station Creek, Timmallallie Creek, Yaminba Creek
- Numerous streams recognised as having good hydro stress & geomorphology that is capable of recovery. Some stretches recognised for proximity to water dependent vegetation primarily in upper catchment near Pilliga State Forest
- High ecological values including migratory native fish

Native fish	• unspecked hardyhead • Murray–Darling rainbowfish • spangled perch • purple-spotted gudgeon	• bony herring • golden perch • Murray cod • carp gudgeon	• freshwater catfish • flathead galaxias • olive perchlet • Australian smelt
Birds	36 water-dependent bird species recorded, including: • Latham's snipe, J K • plumed whistling-duck	• eastern great egret, J	• Australasian bittern, E
Native vegetation	11 water-dependent plant community types, including: • coolibah - river coobah - lignum woodland wetland	• river red gum woodland	• river coobah swamp wetland
Registered cultural assets	• artefacts, grinding grooves, waterhole	• hearth	• modified trees

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, spangled perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet, Flat-headed galaxias
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, Flat-headed galaxias, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): freshwater catfish
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419905	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 0 ML/d
	1.5 ARI: 866 ML/d	**2.5 ARI**: 2375 ML/d	**5 ARI**: 9007 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF, low flows & baseflows have not been significantly altered
- Freshes & higher & infrequent flows have not undergone significant alteration & are similar to the base case.

There are 15 unregulated WALs in this water source, equating to 1173 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^+	L^-	L^0	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown					

Potential management strategies

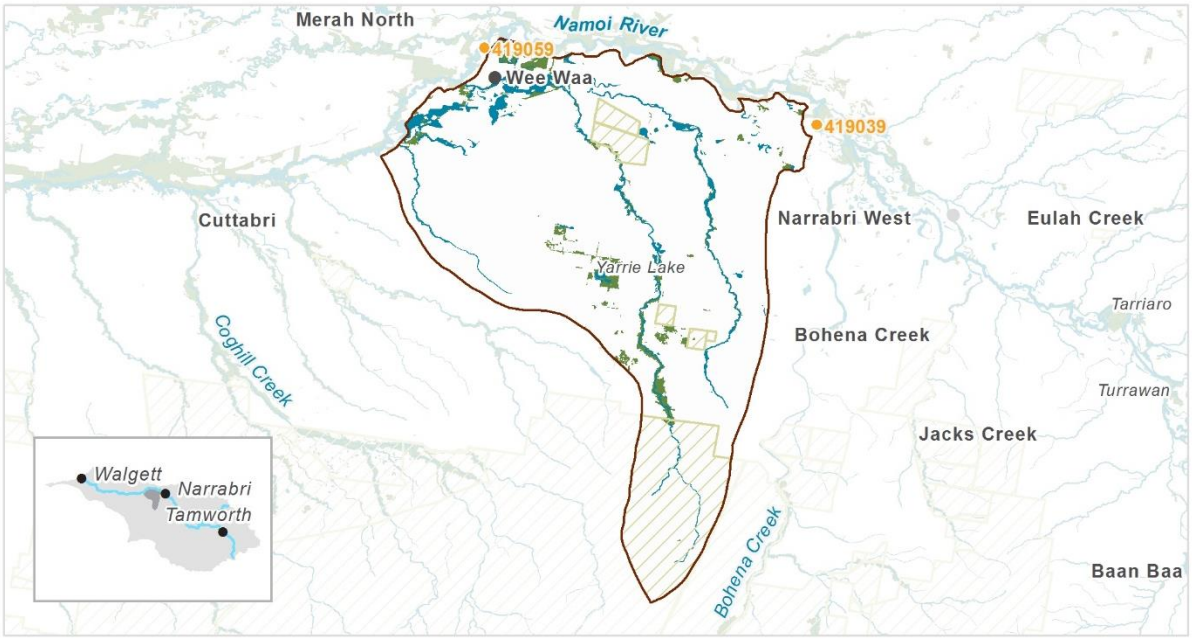
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

Note: High ecological values including migratory native fish, however occurrence appears to be confined to the unregulated Namoi River that receives effluent flows from the regulated system, therefore level of risk may be overstated. As such, consider introducing CtP & commence-to-pump rules (& any associated required amendments to WAL conditions) that protect HEW & water from the EWAs entering unregulated streams & off-channel pools (wetlands).

PU32: Bundock Creek



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Bundock Creek, Gurleigh Lagoon, Illaroo Creek swamp, Jones Lagoon, Mollee Creek, Obriens channel, Quinns billabong, Reedy Lagoon, Round swamp, Wee Waa Gully and Lagoon, Womera Creek, Yarrie lake
- The majority of Bundock Creek & Mollee Creek recognised as having good hydrological stress & geomorphology that is capable of recovery
- Several wetlands identified as dry spell refugia: Jones Lagoon, Yarrie Lake, Round Swamp & a clay pan wetland in lower section of PU (3ai)
- High diversity of water-dependent birds
- High diversity of vegetation communities

Native fish	• unspecked hardyhead • Murray–Darling rainbowfish • purple-spotted gudgeon • carp gudgeon	• bony herring • Australian smelt • carp gudgeon	• golden perch • Murray cod • spangled perch
Birds	55 water-dependent bird species recorded, including: • Latham's snipe, J K • eastern great egret, J	• common greenshank, C J K • sharp-tailed sandpiper, C J K	• marsh sandpiper, C J K
Native vegetation	15 water-dependent plant community types, including: • black box woodland wetland • river red gum forest	• coolibah - river coobah - lignum woodland wetland	• river coobah swamp wetland

Registered cultural assets	• artefacts, grinding grooves, waterhole	• hearth	• modified trees

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, bony herring, Murray-Darling rainbowfish, Australian smelt, golden perch, spangled perch, Murray cod, purple-spotted gudgeon

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, purple-spotted gudgeon

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, Murray cod

Hydrology

Gauge: 419083	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 2.1 ML/d
	1.5 ARI: 3348 ML/d	**2.5 ARI**: 7747 ML/d	**5 ARI**: 9968 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF have been highly altered & occur more frequently
- low flows & baseflows have been highly altered & occur less frequently
- freshes have been somewhat altered, with a decrease in frequency
- high & infrequent flows have not undergone significant alteration & are similar to the base case.

There are 10 unregulated WALs in this water source, equating to 3269 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	H^+	H^-	M^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown CtP when water level in Wee Waa Lagoon is less than 80% full capacity					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

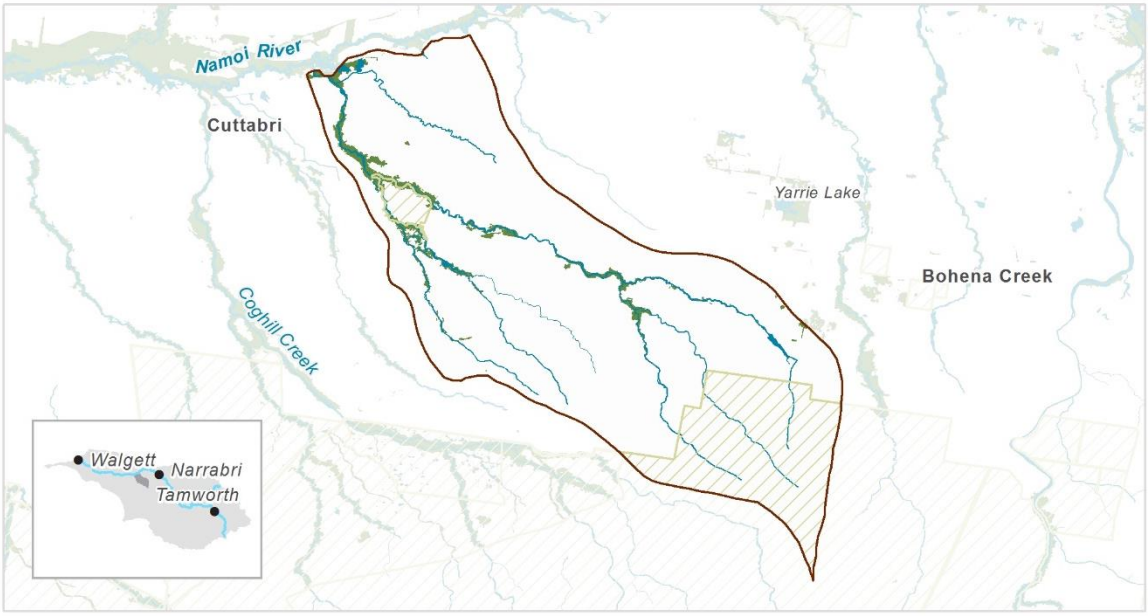
- consider introducing a CtP rule (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider implementing a commence-to-pump threshold that is higher than the CtP threshold to protect freshes & allow water quality to improve, & provide movement & breeding opportunities for native fish & other aquatic biota
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge
- consider introducing rules that protect HEW & PEW entering unregulated streams & off-channel pools

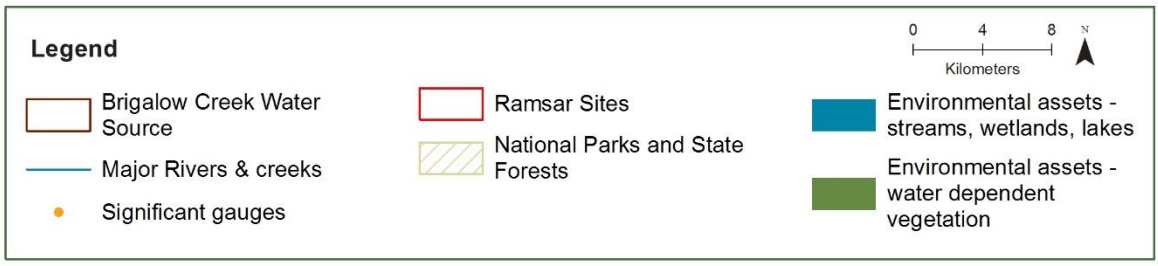
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU33: Brigalow Creek





Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Brigalow Creek, Janewindi Creek, Mosquito Creek, Oakyhole Creek, Waterfall Creek
- Headwaters of Brigalow Creek recognised as a water dependent feature that supports threatened species

Native fish	• carp gudgeon • spangled perch	• Australian smelt	• purple-spotted gudgeon
Birds	24 water-dependent bird species recorded, including:		
	• Australasian bittern, E	• eastern great egret, J	• Yellow-billed spoonbill
Native vegetation	12 water-dependent plant community types, including:		
	• River red gum forest • coolibah - river coobah - lignum woodland wetland	• coolibah open woodland wetland	• Pilliga tank gilgai wetland sedgeland
Registered cultural assets	• modified trees		

Native fish objectives

NF1 No loss of native fish species: carp gudgeon, Australian smelt, spangled perch, purple-spotted gudgeon

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: purple-spotted gudgeon

Hydrology

Gauge: 419083	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 1.6 ML/d
	1.5 ARI: 2609 ML/d	**2.5 ARI**: 6037 ML/d	**5 ARI**: 7767 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case, all flow types have not been altered significantly.

There are 3 unregulated WALs in this water source, equating to 1257 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	L^0	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown **Brigalow Creek MZ:** CtP at 4 ML/d at gauge 419083					

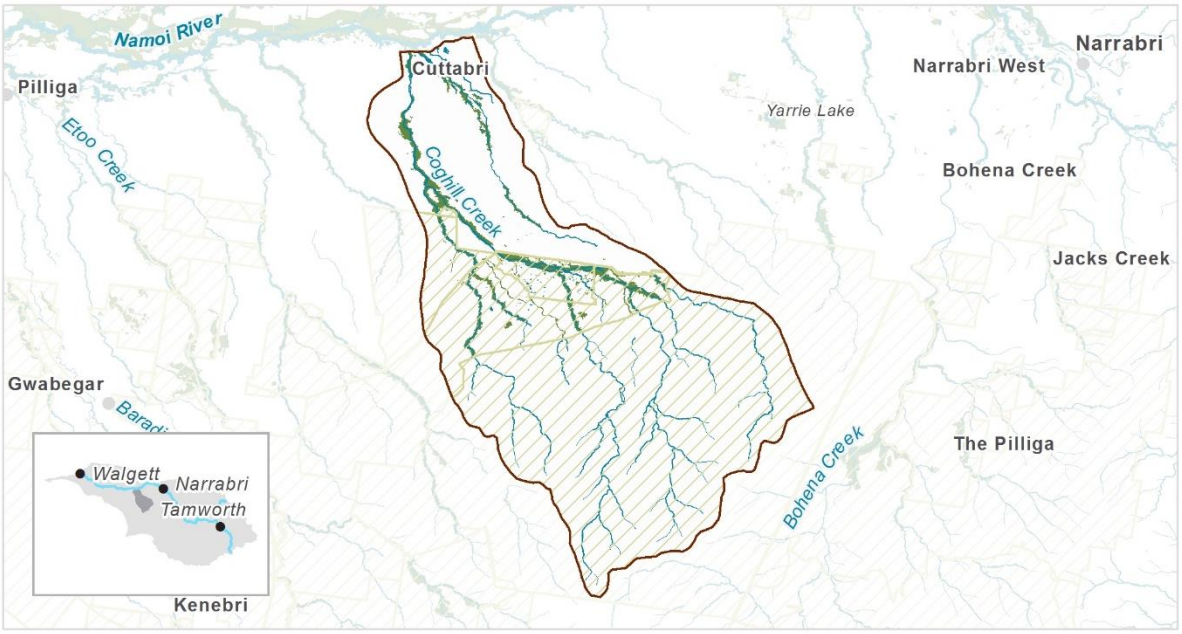
Potential management strategies

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU34: Coghill Creek



Priority environmental assets and values

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Coghill Creek, Goona Creek, Mollieroi Creek, Rocky Creek, Werah Creek
- The majority of Coghill Creek & Werah Creek recognised as having good hydro stress & geomorphology that is capable of recovery - within Pilliga National Park & downstream.
- Area supports a good level of biodiversity

Native fish	• unspecked hardyhead • carp gudgeon	• spangled perch • bony herring	• Australian smelt • purple-spotted gudgeon
Birds	20 water-dependent bird species recorded, including:		
	• Australasian darter	• eastern great egret, J	• yellow-billed spoonbill
Native vegetation	8 water-dependent plant community types, including:		
	• river red gum woodland • shallow freshwater wetland sedgeland	• swamp paper-bark very tall shrubland wetland	• Pilliga tank gilgai wetland sedgeland rushland

Registered cultural assets	• habitation structures	• modified trees	• waterholes

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, bony herring, Australian smelt, spangled perch, Southern purple-spotted gudgeon

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, unspecked hardyhead

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: Southern purple-spotted gudgeon

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Southern purple-spotted gudgeon

Hydrology

Gauge: 419083	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 4.2 ML/d
	1.5 ARI: 6839 ML/d	**2.5 ARI**: 15,823 ML/d	**5 ARI**: 20,358 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- CtF have been altered to a medium extent & occur more frequently
- Low flows & baseflows have been highly altered & occur less frequently
- Freshes have been somewhat altered, with a decrease in frequency
- High & infrequent flows have not undergone significant alteration & are similar to the base case.

There is 1 unregulated WALs in this water source, equating to 600 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	M^+	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown					

Potential management strategies

Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years:

- consider introducing a CtP rule (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows
- consider installing water level gauges at or near extraction sites
- consider installing a river flow gauge

As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU35: Etoo and Talluba Creeks

Priority named environmental assets

Rivers, creeks, wetlands & their associated floodplains & water-dependent native vegetation, including (but not limited to):

- Bevis Creek, Bullerawa Creek, Carbeen Creek, Coomore Creek, Dubbo Creek, Etoo Creek, Friday Creek, Keelimore Creek, Middle Creek, Oaky Creek, Pine Creek, Plain Creek, Rocky Creek, Split rail Creek, Talluba Creek, Teeni Lagoon, Tinegie Creek, Turragulla Creek, Wellyard Gully.
- Headwaters of Rocky Creek, Etoo Creek & Coomore Creek within the State Forest are capable of supporting threatened fish.

Native fish	• unspecked hardyhead • carp gudgeon • spangled perch • Murray–Darling rainbowfish	• bony herring • Australian smelt • golden perch • Murray cod	• freshwater catfish • olive perchlet • silver perch
Birds	30 water-dependent bird species recorded, including: • Australasian darter • eastern great egret, J	• yellow-billed spoonbill	• Latham's snipe, J K
Native vegetation	15 water-dependent plant community types, including: • river red gum forest & woodland • black box woodland wetland	• coolibah - river coobah - lignum woodland wetland	• river coobah swamp wetland

Registered cultural assets	• burials	• modified trees	• artefacts

Native fish objectives

NF1 No loss of native fish species: unspecked hardyhead, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, spangled perch, golden perch, silver perch, Murray cod, freshwater catfish, olive perchlet

NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead

NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet

NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch

NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, olive perchlet

NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod

EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Hydrology

Gauge: 419083	**80th percentile**: 0 ML/d	**50th percentile**: 0 ML/d	**20th percentile**: 2.9 ML/d
	1.5 ARI: 4710 ML/d	**2.5 ARI**: 10,898 ML/d	**5 ARI**: 14,022 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- all flows types remain relatively unaltered

There are 4 unregulated WALs in this water source, equating to 1514 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	L^0	L^-	L^-	L^-	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown					

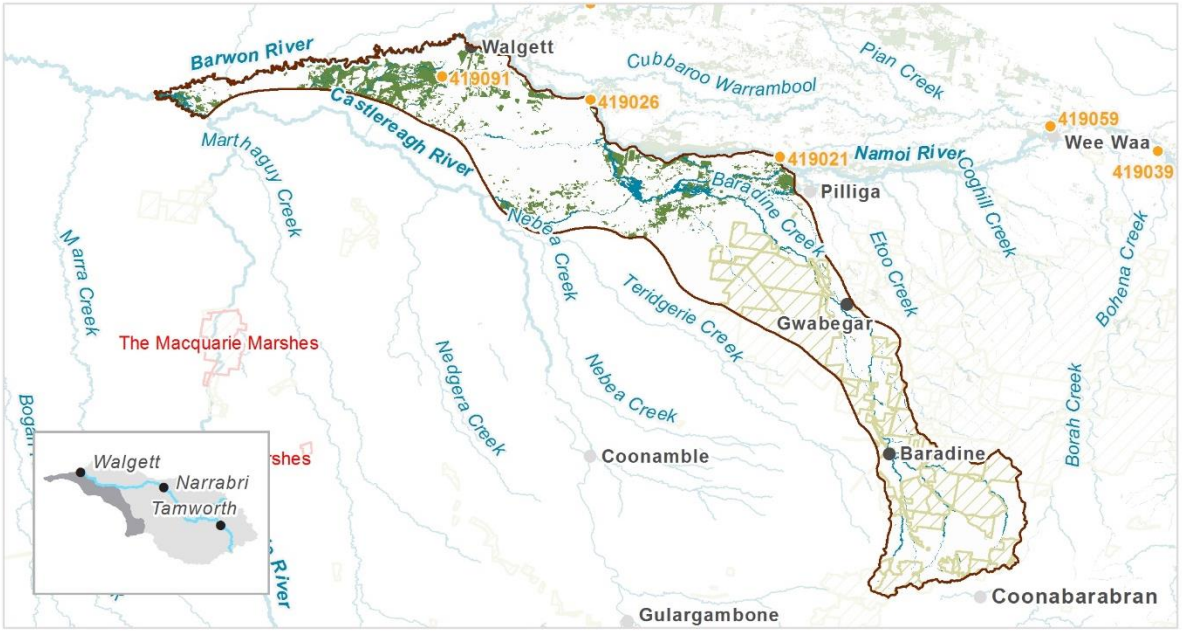
Potential management strategies

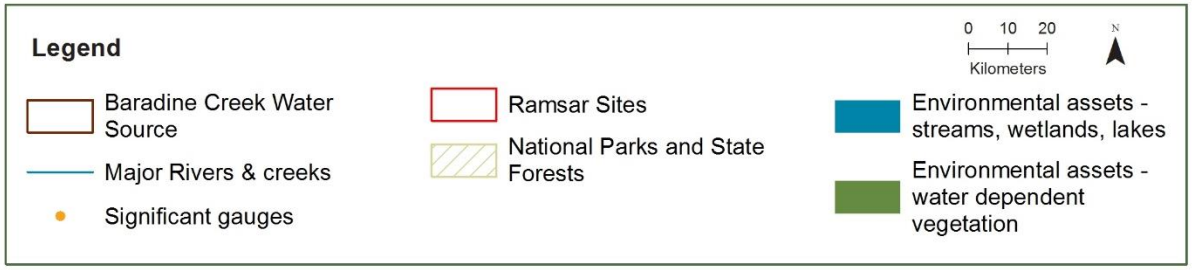
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets

Ensure compliance with water access licence conditions including through metering of all licensed extraction

Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes

PU36: Baradine Creek





Priority environmental assets

- Water dependent feature at downstream end of Baradine Creek identified as being culturally significant.
- All major stream lines identified as pathways for dispersal, migration & movement of native water dependent biota. Includes floodplain zones Healthy floodplain zones A & D.
- Water dependent vegetation within NPWS reserve.

Native fish	• unspecked hardyhead • mountain galaxias • spangled perch • Murray–Darling rainbowfish • obscure galaxias	• bony herring • Australian smelt • golden perch • Murray cod • carp gudgeon	• freshwater catfish • olive perchlet • purple-spotted gudgeon • silver perch
Birds	50 water-dependent bird species recorded, including: • Australasian bittern • eastern great & cattle egrets, J	• yellow-billed spoonbill • Latham's snipe, J K	• black-necked stork, E • marsh & sharped-tailed sandpipers, C J K
Native vegetation	21 water-dependent plant community types, including: • river red gum forest & woodland • black box woodland wetland	• coolibah - river coobah - lignum woodland wetland	• Pilliga tank gilgai wetland sedgeland
Registered cultural assets	• artefacts • burial	• ceremonial ring • habitation structure	• modified trees • waterholes

Native fish objectives
NF1 No loss of native fish species: unspecked hardyhead, obscure galaxias, carp gudgeon, Murray-Darling rainbowfish, bony herring, Australian smelt, golden perch, silver perch, spangled perch, Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF2 Increase the distribution and abundance of short to moderate-lived generalist native fish species: Australian smelt, carp gudgeon, bony herring, Murray-Darling rainbowfish, unspecked hardyhead, obscure galaxias
NF3 Increase the distribution and abundance of short to moderate-lived floodplain specialist native fish species: olive perchlet, purple-spotted gudgeon
NF4 Improve native fish population structure for moderate to long-lived flow pulse specialist native fish species: golden perch, silver perch, spangled perch
NF5 Improve native fish population structure for moderate to long-lived riverine specialist native fish species: Murray cod, freshwater catfish, purple-spotted gudgeon, olive perchlet
NF6 A 25%^ increase in abundance of mature (harvestable sized) golden perch and Murray cod
NF8 Increase the prevalence and/or expand the population of key moderate to long-lived riverine specialist native fish species into new areas (within historical range): olive perchlet
EF3 Provide movement and dispersal opportunities within and between catchments for water-dependent biota to complete lifecycles: golden perch, silver perch, Murray cod, freshwater catfish

Hydrology			
Gauge: 419072	**80th percentile**: 0 ML/d	**50th percentile**: 1.8 ML/d	**20th percentile**: 29.9 ML/d
	1.5 ARI: 1191 ML/d	**2.5 ARI**: 2512 ML/d	**5 ARI**: 5242 ML/d

According to the Namoi WRPA Risk Assessment, the following hydrological alterations have occurred in this water source, when compared to a near-natural base case:

- Cease to flows have not been altered
- Low flows & baseflows have been highly altered & occur less frequently
- Freshes have been somewhat altered, with a decrease in occurrence
- High & infrequent flows have not undergone significant alteration & are similar to the base case.

There are 13 unregulated WALs in this water source, equating to 20567 ML.

	Cease-to-flow	Low flows & Baseflow	Freshes	High & infrequent flows		
				1.5 ARI	2.5 ARI	5 ARI
Hydrological alteration	L^0	H^-	L^-	L^0	L^0	L^0
Relevant rules	Trade not permitted into the water source Trade permitted within the water source, subject to assessment No pool drawdown					

Potential management strategies
Investigate opportunities to reduce extraction pressure on in channel flows in the water source within five years • consider introducing a CtP rule (relating to a flow or water level gauge) to help relieve unnatural CtF periods & support more ecologically relevant low flow / baseflows • consider installing water level gauges at or near extraction sites • consider installing a river flow gauge
Consider introducing rules that protect HEW & PEW entering unregulated streams & off-channel pools
As a minimum, maintain existing rules in the WSP to maintain priority environmental assets
Ensure compliance with water access licence conditions including through metering of all licensed extraction
Monitor for changes in water demand & review access rules if usage increases or if the pattern of use changes