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NSW GOVERNMENT

Water dependent native vegetation

Environmental Outcomes Monitoring and Research Program Annual Report 2021-2022

Acknowledgement of Country

The Department of Planning and Environment acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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More information

This work was completed by the Surface Water Science unit of the NSW Department of Planning and Environment. Please visit our website for more information.

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Copyright and disclaimer

Contents

Abbreviations and Acronyms

	Description
Basin Plan	Murray-Darling Basin Plan 2012
DBH	Diameter at Breast height (tree diameter measured at 130 cm above ground)
EHG	Environment and Heritage Group of the Department of Planning and Environment
EOMRP	Environmental Outcomes Monitoring and Research Program
EWRs	Environmental Watering Requirements
HEVAE	High Ecological Value Aquatic Ecosystems
JVM&E	Joint Venture Monitoring and Evaluation
LTWPs	Long Term Water Plans
MDB	Murray-Darling Basin
MDBA	Murray-Darling Basin Authority
NSW	New South Wales
PI	Performance Indicator: is an entity which has properties directly related to water availability that can be quantified. This can be used to directly measure success or failure to achieve the objective sought by a water sharing plan. For example, the condition of water dependent native vegetation.
PU	Planning Unit: 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).
PCT	Plant Community Type (as described in the NSW State Vegetation Type Map)
RCI	River Condition Index
TEC	Threatened Ecological Community under the *NSW Biodiversity Conservation Act 2016*
WRP	Water Resource Plan
WSP	Water Sharing Plan
WM Act	Water Management Act 2000 (NSW)

Monitoring water dependent native vegetation

River red gums in Millewa Forest. Photo credit: Sharon Bowen

Why are we monitoring water dependent native vegetation?

It is important to know how and why water dependent native vegetation respond to changes in the amount of water in our rivers and on our floodplains. This information allows the Department of Planning and Environment — Water (the department) to consider and protect the needs of native vegetation living along our rivers and on our floodplains when we make water management decisions.

Water dependent native vegetation communities depend on riverine flooding for part of their life cycle. They include river red gum, coolibah and black box forests and woodlands, lignum shrublands and wetlands of billabongs and channels. These communities are critical components of healthy riverine environments. In the NSW Murray Darling Basin (MDB), the Basin Plan (2012) and water sharing plans developed under the NSW Water Management Act (2000) (WM Act) guide river management. These documents provide for the sustainable management of rivers and set out how water is shared between people and the environment. Water sharing plans establish access rules and ensure the long–term sustainability of resources by requiring water users to hold licences to take water.

We are monitoring the health of vegetation communities of floodplains and wetlands to better understand how managed and natural river flows and flooding patterns influence the condition and structure of these communities. This ongoing research will build upon a body of knowledge about river environments and will help the department to better understand how water management affects the health of water dependent vegetation. This will allow the department to report on native vegetation condition when evaluating water sharing plans and to report on expected outcomes of the Basin Plan and related water resource plans. Future work for this theme will include comparing vegetation condition against historical flood events. Mapping of flood footprints will improve our understanding of what river flows are needed (environmental water requirements) for healthy native water dependent vegetation and allow the department to identify ecologically important flow patterns needed when making water management decisions.

The condition of water dependent vegetation communities is driven by patterns of water availability. Understanding this relationship is important for water management to sustain the dependent ecosystems. Many areas of NSW have little data on the condition of these communities. This work under the the Environmental Outcomes Monitoring and Research Program (EOMRP) native vegetation theme, is the first time the department has had a program of data collection and analysis to build a comprehensive baseline data set of tree and community condition across water sharing plan areas. This baseline will allow the department to report on environmental outcomes of water sharing plans and the Basin Plan, and to make informed decisions about water management in NSW.

Report purpose

The 2021-22 Annual Report for the water dependent native vegetation theme (this document) outlines completed works and their findings (including testing of methods and the baseline (current) condition of water dependent vegetation communities in the lower Namoi and lower Gwydir) under the EOMRP between 1 July 2021 and 30 June 2022.

This annual report is one of a set of 5 different themes for the EOMRP. The themes are:

1. Floodplain connectivity and inundation
2. Ecological processes
3. Water dependent fauna
4. Water dependent vegetation (this document)
5. Groundwater dependent ecosystems.

The EOMRP delivers information annually to meet several requirements. These include NSW reporting obligations under the Basin Plan Schedule 12, water sharing plan performance indicator research, data collection and analysis to inform and evaluate water sharing plans and floodplain management plans. The EOMRP will also provide data for the NSW River Condition Index (RCI) tool, the High Ecological Value Aquatic Ecosystems (HEVAE) spatial layer, and the NSW State of the Environment Reports.

The EOMRP projects are staged over several years, building knowledge about water dependent ecosystems and their responses to water management plans, actions and decisions. For further information about the EOMR program see the EOMRP website. Technical reports for each research project will be published separately and made available on the department's website.

The EOMRP was designed to implement the NSW Water Management Monitoring, Evaluation and Reporting framework (DPIE Water 2020) which addressed Basin Plan requirements. The EOMRP was extended in 2022 to cover coastal and other non-Basin areas.

A new framework designed specifically for the evaluation of all NSW water sharing plans is in development. The department is completing this work in response to the Natural Resources Commission findings and recommendations to improve the way we monitor, evaluate, and report information about water sharing plan outcomes.

Report structure

This report focuses on determining the baseline condition of key water dependent woody vegetation communities in the lower Namoi and the lower Gwydir. Work was undertaken in the Namoi and Gwydir water sharing plan areas so reporting is limited to these catchments, items labelled 9 and 10 in Figure 1.

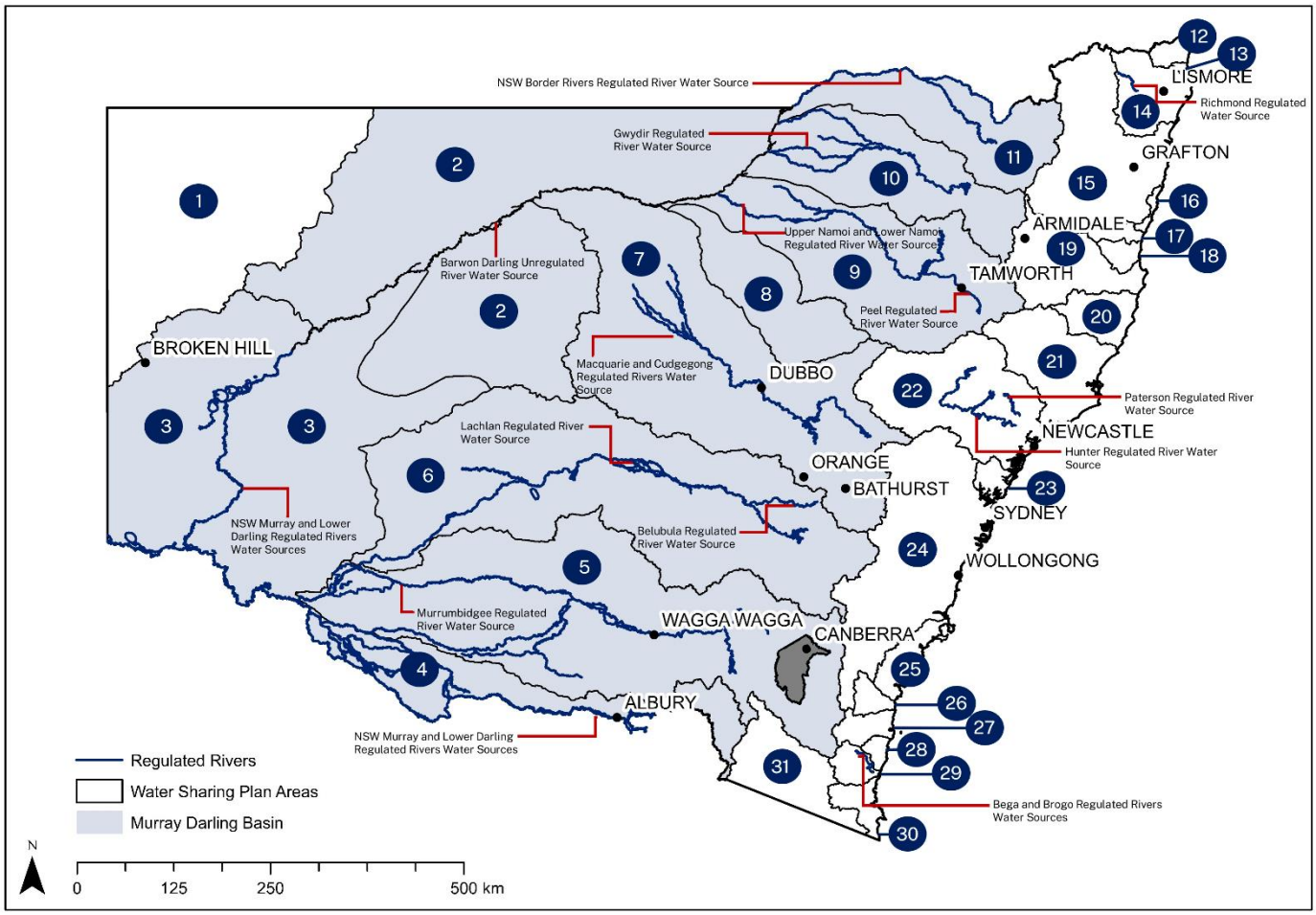

Figure 1. Map of NSW showing the Murray-Darling Basin boundaries, regulated rivers, and the NSW water sharing plan boundaries.

Water Sharing Plan Legend:

1. North Western Unregulated and Fractured Rock Water Sources
2. Intersecting Streams Unregulated River Water Sources
3. Lower Murray-Darling Unregulated River Water Source
4. Murray Unregulated River Water Sources
5. Murrumbidgee Unregulated River Water Sources
6. Lachlan Unregulated River Water Sources
7. Macquarie Bogan Unregulated Water Sources
8. Castlereagh Unregulated Water Sources
9. Namoi and Peel Unregulated Water Sources
10. Gwydir Unregulated Water Sources
11. NSW Border Rivers Unregulated River Water Sources
12. Tweed River Area Unregulated and Alluvial Water Sources
13. Brunswick Unregulated and Alluvial Water Sources
14. Richmond River Area Unregulated, Regulated and Alluvial Water Sources
15. Clarence River Unregulated and Alluvial Water Sources
16. Coast Harbour Area Unregulated and Alluvial Water Sources
17. Bellinger River Area Unregulated and Alluvial Water Sources
18. Nambucca Unregulated and Alluvial Water Sources
19. Macleay Unregulated and Alluvial Water Sources
20. Hastings Unregulated and Alluvial Water Sources
21. Lower North Coast Unregulated Water and Alluvial Water Sources
22. Hunter Unregulated Water and Alluvial Water Sources
23. Central Coast Unregulated Water and Alluvial Water Sources
24. Greater Metropolitan Unregulated River and Alluvial Water Sources
25. Clyde River Unregulated and Alluvial Water Sources
26. Deua River Unregulated and Alluvial Water Sources
27. Tuross River Unregulated and Alluvial Water Sources
28. Murrah-Wallaga Area Unregulated and Alluvial Water Sources
29. Bega and Brogo Rivers Area Regulated, Unregulated and Alluvial Water Sources
30. Towamba River Unregulated and Alluvial Water Sources
31. Snowy Genoa Unregulated and Alluvial Water Sources

Drivers of environmental outcomes

River regulation and extraction for consumptive use has altered river flows and the typical patterns of flooding on floodplains. The timing of flows may also have been seasonally altered. Extended, longer periods of drought can affect water dependent vegetation communities in several ways. These include reducing opportunities for recruitment (adding new individuals to the population) of trees (for example, river red gum, black box and coolibah woodlands), a shift in the types of understorey species present, from aquatic or flood responders to terrestrial species, an increase in non-native weeds, reduced opportunities for vegetative growth of plant species due to reduction in soil moisture and nutrients.

Many rivers now have a reduced volume, frequency, and duration of some types of flows. River flows can be broken into broad flow categories, which include low flows, bankfull, and overbank flows (Figure 2). Each flow category can influence a range of habitats for vegetation communities. Water management within NSW aims to ensure adequate flows of each type are provided to water dependent vegetation to meet their environmental water requirements. This report focuses on the environmental outcomes that are influenced by river flow, especially to achieve overbank flows, Overbank flows will support life history traits and regeneration of some components of the ecosystem that are not supported by bank full flows, such as floodplain vegetation recruitment (CSIRO 2012).

Flow driven lateral bank recharge is an important mechanism in the maintenance of vegetation condition along rivers (Figure 2). For example, in the Murray River, researchers found that higher in-channel irrigation water delivery during summer months (bank full flows) were critical to the survival of trees on the riverbank during drought. They recommended release of environmental flows once every 3 to 5 years to create bankfull flow or preferably overbank flows. Overbank flows increase hydrological connectivity between riverbanks, wetlands and riparian zones, providing positive ecological benefits to river red gum communities and other floodplain and aquatic ecological assets (Doody et al. 2015).

Health of floodplain trees is also supported by groundwater reserves. Overbank flows recharge soil water and groundwater through groundwater recharge (Figure 2), and this reservoir provides access to water for trees for extended periods after the flood has receded. Once groundwater levels fall below the root zone, tree health declines. Regular flooding of the floodplain is required to freshen salty groundwater and to raise deep groundwater closer to the root zone to mitigate the dieback of floodplain forests (Cunningham et al. 2011).

Many floodplain woodland communities are quite hardy under dry conditions but require flooding for recruitment of young trees into the population (Figure 2). For example, lack of recruitment has been apparent in many black box woodlands in the southern MDB (Roberts and Marston, 2011). The long-term ecological consequences of extended periods of inadequate flooding from overbank flows are likely to be an excess of mortality over recruitment (net loss), leading to a reduction in extent of river red gum and black box woodland on the higher floodplain, and a transition from flood-dependent vegetation communities to fully terrestrial ones (CSIRO, 2012).

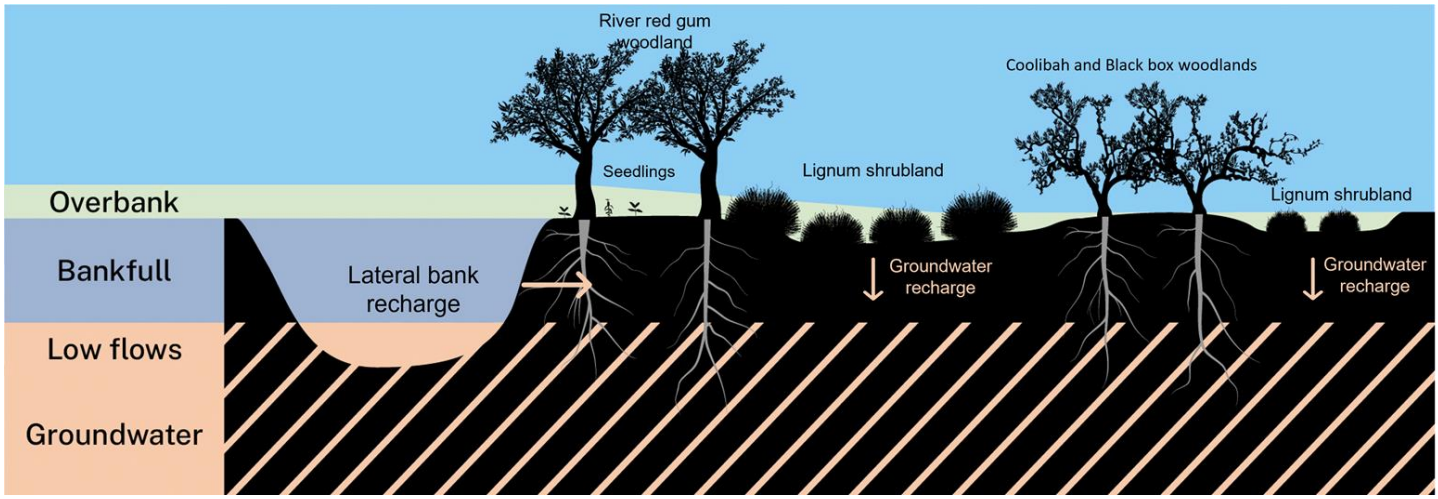

Figure 2 Conceptual model of the main flow categories and what areas of a river floodplain they influence.

Determining the baseline (current) condition of key water dependent woody vegetation communities in the lower Namoi and the lower Gwydir

Project Team

Sharon Bowen, Kelly Marsland, Anna Helfensdorfer, Jay Van Den Broek and Jodie Dabovic.

Project collaborators

This project is led by the department, consulting with Local Land Services and the Environment and Heritage Group of the Department of Planning and Environment.

Project aims

The aim of the project is to develop a current baseline condition of key water dependent native vegetation communities in the lower Namoi and lower Gwydir regulated and unregulated water sharing plan areas. Establishing a baseline allows for future comparisons to be made. Determining the condition of water dependent native vegetation requires an assessment of the condition of the existing trees (tree stand), the condition of the community (structure and species composition) and tree population health (demographic condition).

To explain the different ecological outcomes in response to water management activities, the relationship between condition, flow and inundation regime patterns is required. In 2021-22, we trialled the use of the Environmental Water Requirement dashboard and the Tool developed by the Environment and Heritage Group of the Department of Planning and Environment (EHG) and the MDBA, as a measure of the flow regime history of the survey sites. The flow regime history was reported, however testing the relationship between the environmental water requirements and inundation extent was out of scope of this year of the project.

The project aims relate to the following questions and water management activities:

Key project questions

Tree stand condition

- What is the current tree stand condition of key water dependent woody vegetation communities?

Vegetation community condition

- What is the community condition of key water dependent woody vegetation communities in parts of the water sharing plan area that does not have this data?

Tree population health - demographic condition

- What is the current population (demographic) condition of key water dependent woody vegetation communities in parts of the water sharing plan area that does not have this data?

Relationship between water dependent vegetation condition and flow and inundation regime patterns

- What percentage of the time were overbank flow environmental water requirements listed in LTWPs met for these sites in the 20 last years?

Link to water management activities - General

- Provide data for the ongoing monitoring and evaluation of the Basin Plan under Schedule 12, Matter 8, specifically the vegetation themes in each of the Schedule J MER plans for the northern basin water resource plans.
- Improved evidence of flow requirements for water dependent native vegetation communities will refine end of system, wetland and overbank flow protections in water sharing plans and provide evidence to evaluate water sharing plans and to report on Matter 8 under Schedule 12 of the Murray-Darling Basin Plan.
- Inform the effectiveness of Environmental Watering Requirements and inform the development of environmental watering requirements in the Namoi and Gwydir water sharing plan areas in collaboration with water managers.

Link to water management activities - Gwydir

- Linking flow to vegetation condition will refine delivery and evaluate the effectiveness of the Gwydir Environmental Contingency Allowance *

*The Environmental Contingency Allowance is a volume of water set aside for environmental purposes in the Gwydir Regulated water sharing plan.

- Linking flow to vegetation condition will inform the effectiveness of the Gwydir 3 Tributary rule* and supplementary flow protection in the Gwydir.

*The Gwydir 3 Tributary rule protects combined flows (up to 500 ML/d) coming from the Horton River, Myall Creek and Halls Creek tributaries into the Gwydir Regulated River. This water is protected until it reaches the Gwydir Wetlands.

Link to water management activities – Namoi

- Linking flow to vegetation condition will refine delivery and evaluate the effectiveness of the Namoi Environmental Contingency Allowance.
- Linking flow to vegetation condition will inform the effectiveness of the supplementary flow protection in the Namoi.

Methods

Site Selection

This project builds upon previous programs that have focussed on collecting floodplain and wetland vegetation condition information across the NSW MDB, including: the NSW Murray Darling Basin Authority (MDBA) Joint Venture for Monitoring and Evaluation (JVM&E) Program Stand and Condition Tool development project (Bowen et al. 2019), and monitoring undertaken by NSW Department of Planning and Environment (DPE) Environmental and Heritage Group, formerly NSW Office of Environment and Heritage (OEH) and the Commonwealth Environmental Water Office. These programs have collected data across the NSW MDB for the past decade (e.g. Dyer et al. 2015).

The 2021/2022 project focussed on establishing new survey sites in the lower Gwydir and lower Namoi. An assessment of the existing data on vegetation community type and location of priority vegetation environmental assets was initially undertaken to identify key knowledge gaps.

From the results of the gap analysis, survey sites were selected by determining the location of key communities characterised in the Namoi and Gwydir Long term Watering Plans (LTWPs) (NSW DPIE 2020a, 2020b) and Namoi and Gwydir risk assessments (NSW DoI 2018, NSW DPE 2019).

Areas most likely to be affected by rules and settings of the relevant water sharing plans were also determined. Once these target areas were identified, final sites were chosen if they were publicly accessible. Accessing some sites in the Northern NSW MDB in 2021-22 was restricted due to significant rain events and/or riverine flooding. Figure shows the location of new and existing survey sites in the lower Namoi. Figure 4 shows the location of new and existing survey sites in the lower Gwydir.

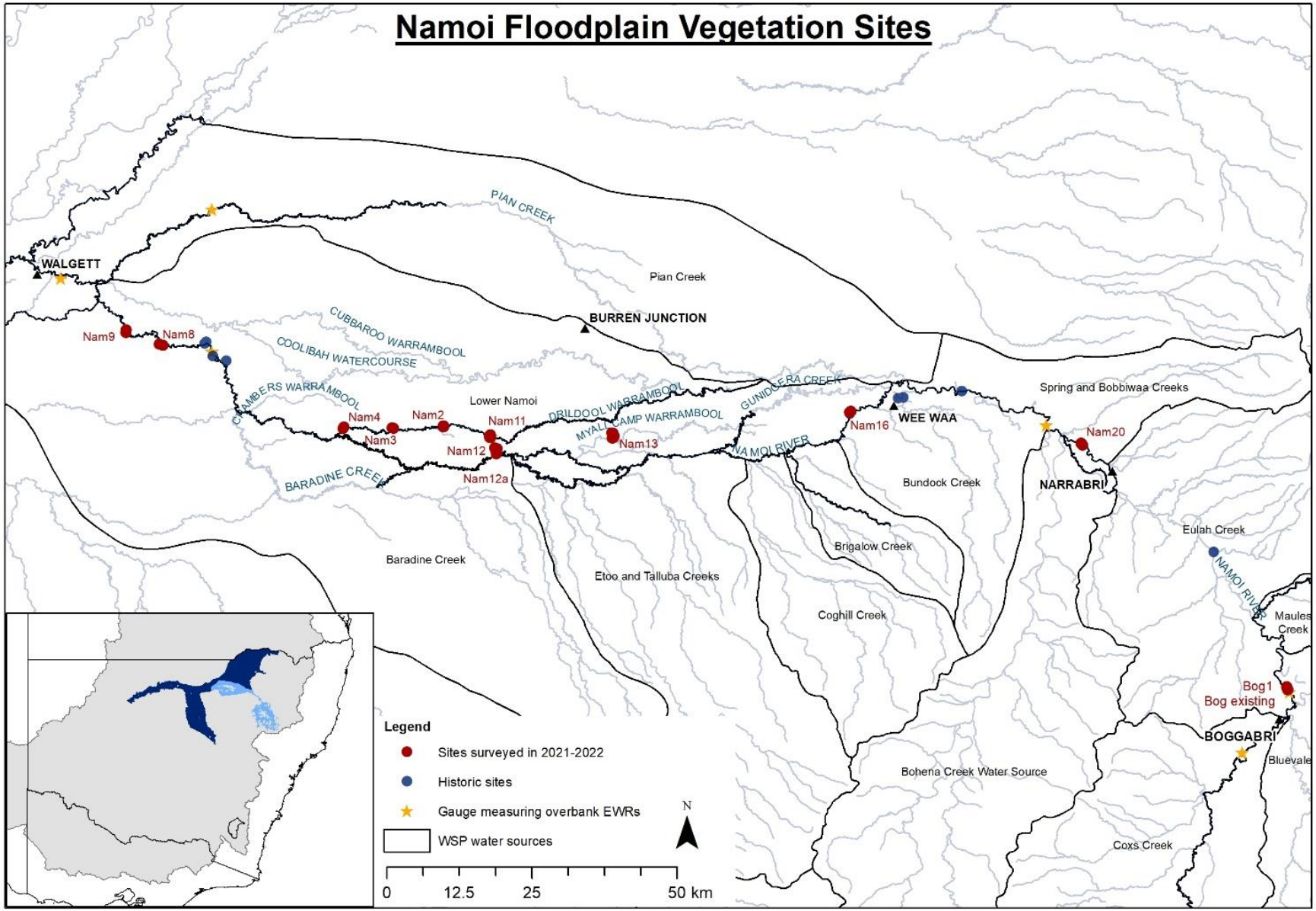

Figure 3. Floodplain vegetation sites in the Namoi floodplain. Sites surveyed in 2021-2022 are shown in red, historic sites are shown in blue. Inset: The Northern MDB floodplains of the Border Rivers, Barwon-Darling, Gwydir, and Macquarie are shown in dark blue, with the Namoi floodplain shown in light blue.

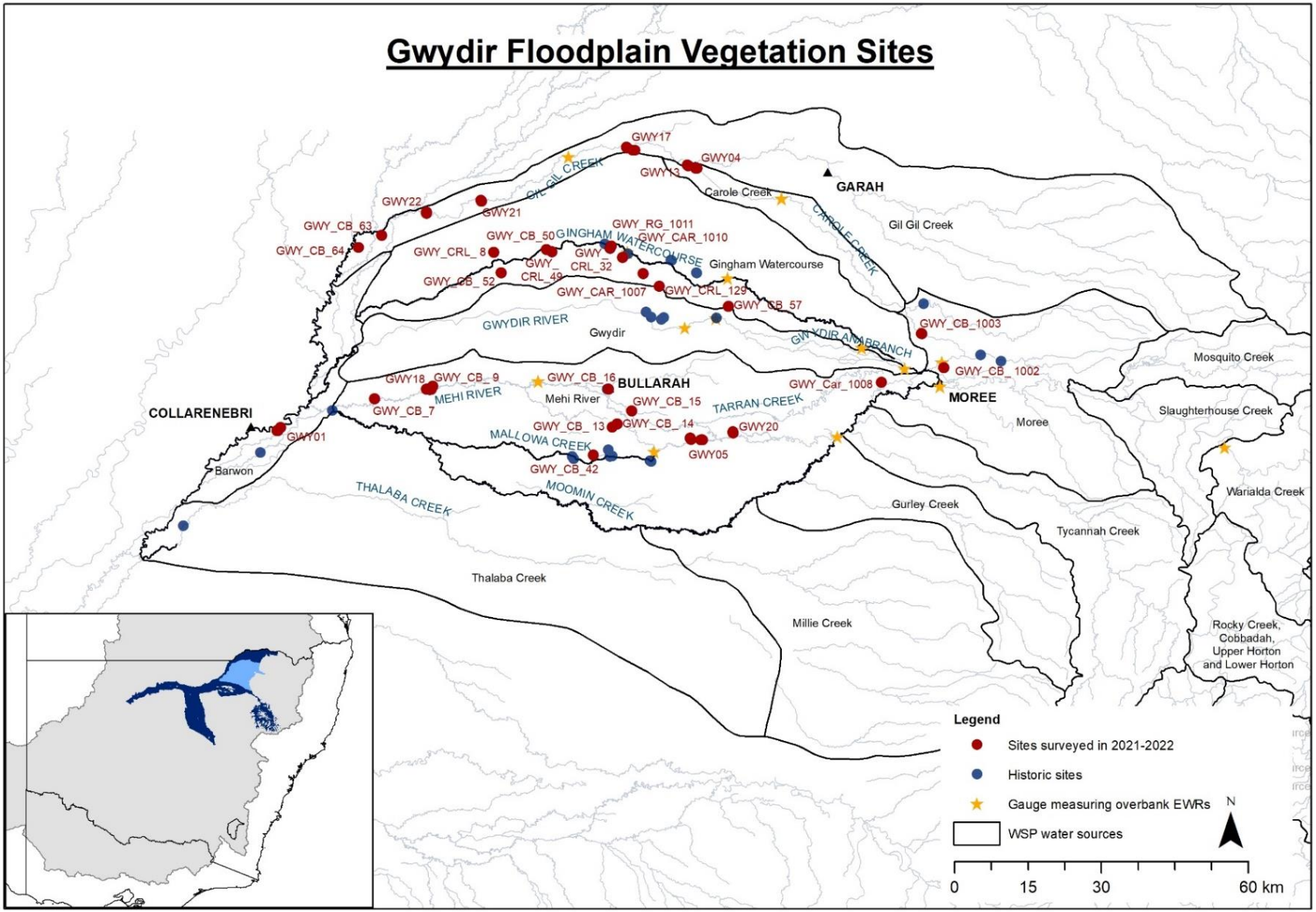

Figure 4. Floodplain vegetation sites in the Gwydir valley. Sites surveyed in 2021-2022 are shown in red, existing sites are shown in blue. Inset: The Northern MDB floodplains of the Border Rivers, Barwon-Darling, Gwydir, Macquarie, Namoi are shown in dark blue, with the Gwydir floodplain shown in light blue.

Vegetation communities surveyed

Plant Community Types (PCTs) are the community-level descriptions used in NSW planning and assessment tools and vegetation mapping and management programs. The Plant Community Type classification is maintained in the BioNet Vegetation Classification application (NSW DPE 2023). The key plant community types identified in the Namoi and Gwydir Long Term Watering Plans (NSW DPIE 2020a, 2020b, 2020c) and Namoi and Gwydir risk assessments (NSW DoI 2018, NSW DPE 2019) were surveyed in this project. They are; river red gum woodland and forest (PCT 36) which occur in riparian zones and more frequently inundated water courses, river red gum grassy woodlands (PCTs 78 and 454), that occur in riparian zones and adjoining floodplains, coolibah wetland woodlands (PCT 39) that occur in channel and gilgai (depression) country adjacent to rivers, coolibah grassy woodlands (PCT 40) and Blackbox woodlands (PCT 37), that occur on the alluvial plains of rivers and carbeen open forests (PCT 71) that occur on the riverine plains of the Mehi and Gwydir river on siliceous sands, earthy sands and clayey sands (Figure 5 and Figure 6).

River red gum woodland PCT 36

River red gum grassy woodland PCT 78

Coolibah grassy woodland PCT 40

Coolibah wetland woodland PCT 39

Figure 5 Water dependent native vegetation communities surveyed in the lower Namoi. Photo credit DPEW.

Figure 6 Water dependent native vegetation communities surveyed in the lower Gwydir. Photo credit: DPEW.

Survey methods

Tree stand and demographic condition

Tree stand condition is a measure of the health of adult trees in a standard area (plot) based on canopy and tree structural health. It does not assess the overall population structure (demographics) or community condition. Demographic condition looks at the proportions of trees in each age class in a population. A healthy population must have sufficient new mature trees to replace each old mature tree before they die to maintain the current structure, and adequate juvenile trees to replace the new mature trees to sustain the population into the future.

At each site, duplicate 0.25 ha tree stand condition plots were established in each plant community type. The diameter at breast height (DBH) of all trees with a DBH greater than 10 cm were recorded. The height of each tree, canopy extent, percent foliage cover[1] (%FC), percent dead limbs (%DL), percent dead canopy (%DC) and status (live or dead) was recorded.

The number of seedlings and saplings (established juvenile trees less than 10 cm DBH) of the dominant tree species were recorded. As grazing pressure can be a limiting factor to seedling survival. the type (native/exotic) and severity of grazing pressure (H, high, M, medium or L, low) was noted at each plot. The full methods are outlined in Bowen (2022).

Community condition

Vegetation community condition is the structure and type of species at the site. Sampling was undertaken in 0.04 ha plots located inside the 0.25 ha tree condition plots for each plant community type. The percentage foliage cover and the number and height of all plant species was recorded within each plot, as well as the cover of bare ground and dead plant litter. The full methods are outlined in Bowen (2023), Bowen (2022) and Bowen (2019).

Condition classes

The condition classes for both tree stand and community condition are calculated for each site and represent the following scenarios:

Excellent/Benchmark (score of 20/20) indicates that water requirements of the dominant species are being met and community structure is as expected for that plant community type, or where there is little dead canopy, no dead trees and the percent foliage of the dominant species is within the expected range for the plant community type.

Good (score of 18 to 19.9) and intermediate (score of 15 to 17.9) indicates that water requirements of the dominant species are being met, less often than that required to meet the excellent benchmark but the community is still in good health.

Intermediate/poor (score of 12 to 14.9), indicates that water requirements of the dominant species are not often being met and the community contains terrestrial and/or exotic species, or there are

[1] Percent foliage cover (%FC) is the area covered by the leaves and stems of a plant or the area of sky obscured by a trees foliage and small branches

dead trees, dead canopy and/or the percent foliage cover is less than expected for that plant community type.

Poor (score of 9 to 11.9) and very poor (score of 0 to 8.9), indicates that water-dependent species have been partly or totally replaced by terrestrial species, trees are dead or dying and the community is no longer functioning effectively as a water dependent community.

Demographic condition

Assessing current and future population viability

Eucalypt species are hard to age as they don't form annual tree rings annually like northern hemisphere trees, so size is used as a surrogate for age in a population. Each tree was assigned to a 10 cm size class based on the diameter at breast height (DBH).

DBH data was pooled from all plots within each plant community type and the number of trees in each class size per hectare calculated. The distribution of trees per hectare by size class of all live and dead trees was calculated to give a population profile for each plant community type.

Statistical analysis of these population profiles was then undertaken to determine how closely a population fitted a model of an ideal, viable forest/woodland structure; known as the 'reverse J' curve distribution. This is based on the theory that a healthy population of trees has size classes ranging from small to large in a certain ratio (more small, fewer large) and that currently there are enough younger (i.e. smaller) mature trees (10 to 20 cm DBH), present to replace older (larger) trees over time as they die. The ratio of live to dead trees also indicates the mortality rate within each size class that can relate to a period of greater or lesser water stress in the past.

The average number of established juvenile trees (seedlings and saplings less than 10 cm DBH) per hectare was calculated for all sites in each plant community type. For each plant community type, we predicted the number of established juvenile trees required to maintain the current population structure. The number of juvenile trees recorded at each site was then compared to the predicted number required.

Meeting environmental water requirements

An environmental water requirement describes the characteristics of a flow event (e.g., magnitude, duration, timing, frequency, and maximum dry period) at a gauge, that are required to achieve one or multiple environmental objectives. Long term water plans identify the key water dependent assets in each management area (planning unit) and describe the environmental water requirements that are required to support these assets (for example, NSW DPIE 2020b).

Overbank flows provide lateral connectivity with floodplain and wetlands, support nutrient, carbon and sediment exchange between the floodplain and channel, and promote floodplain productivity. These are the flow components that are most important for maintaining the condition of riparian and floodplain plant community types such as river red gum woodlands, coolibah and black box woodlands.

The NSW Long Term Water Plan environmental water requirement dashboard (dashboard V1_beta, EWR tool version v1.0.4) (administered by the Environment and Heritage Group of the Department of

Planning and Environment) uses historical flow data measured at the aligning planning unit gauging station to examine the data and calculate the degree to which an environmental water requirement has been met over the prescribed time period, using a computer program the *EWR_tool* hosted by the Murray Darling Basin Authority (Job et al. 2022).

For this report, the long-term average frequency of environmental water requirements was assessed over a 20-year period (1 July 2002 to 30 June 2022).

Namoi and Gwydir Long Term Water Plan planning units were aligned with water sharing plan management areas (water sources). Where a site is located in a planning unit that does not measure environmental water requirements, we have adopted environmental water requirements from a relevant gauge in the neighbouring planning unit. We have used this approach as these large overbank flows may be likely to inundate the floodplain locations of these sites. This is only assumed at this point in time as no inundation mapping has been used to check this assumption, so the results are to be used with caution.

At this stage of the project, it is not yet possible to directly link the outputs of the Environmental Water Requirement Tool to the condition of the survey sites as more work needs to be done by several departments in NSW to link environmental water requirements to inundation extent. Linking overbank environmental water requirements, inundation extent and vegetation and community condition is a key focus of this theme in the EOMR program for the future.

Results

Namoi

Rainfall and hydrology

River flow data for the 20 years prior to the vegetation surveys showed that the majority of the period was characterised by very low and low flows (Figure 7).

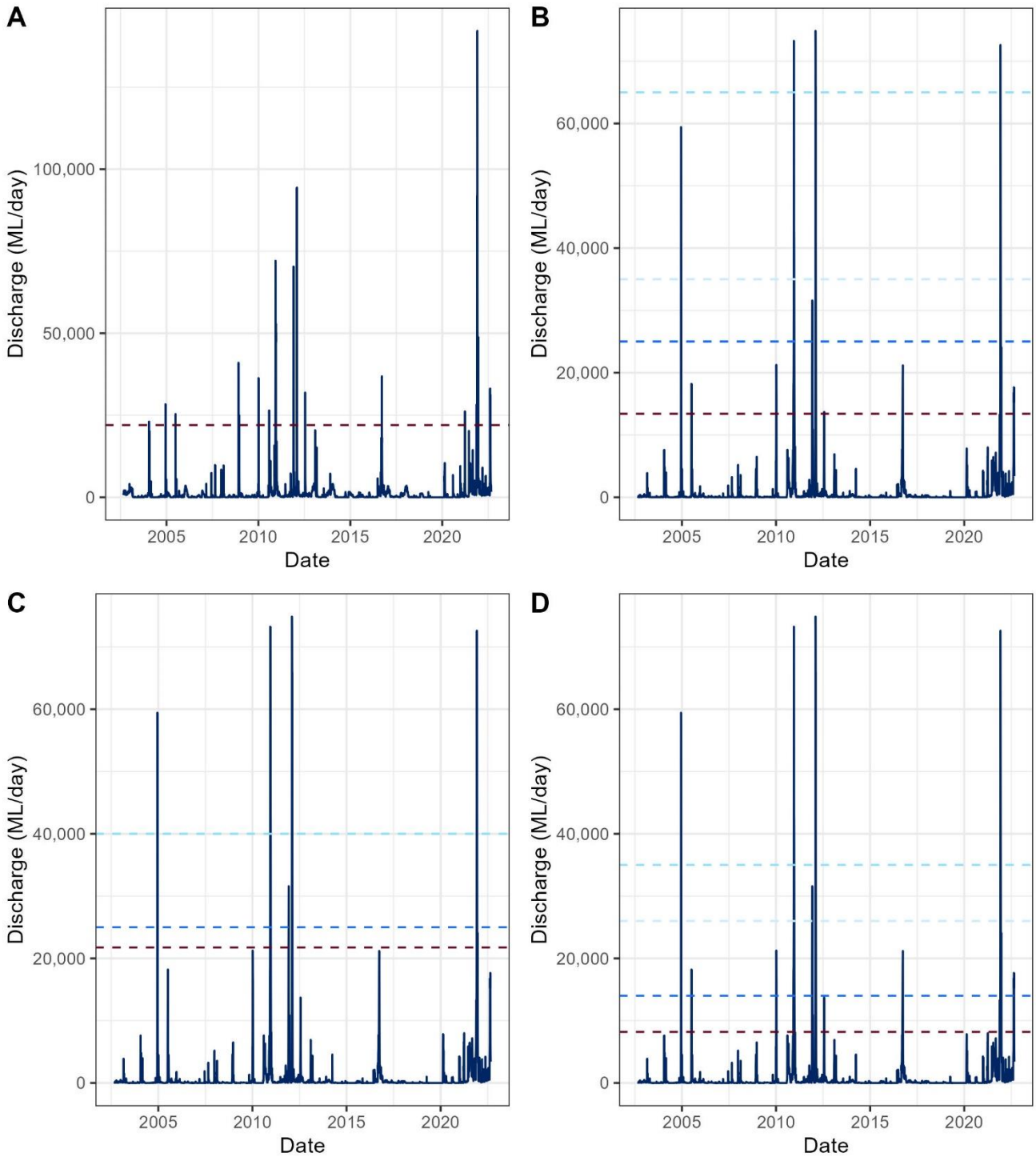

Figure 7 River flow rates (daily discharge ML/day) for the 20 year period preceding sampling at A) Namoi River at Boggabri (419012, 31/08/2002 to 31/08/2022), B) Namoi River at Bugilbone (419021, 31/08/2002 to 31/08/2022), C) Namoi River at Goangra (419026, 30/06/2002 to 30/06/2022) and D) Namoi River at Mollee (419039, 31/08/2002 to 31/08/2022). Small overbank flows are shown by red dashed lines, Large overbank flows are shown by blue dashed lines.

Rainfall in the 12 months prior to the vegetation surveys tended to be above average to very much above average (Figure 8).

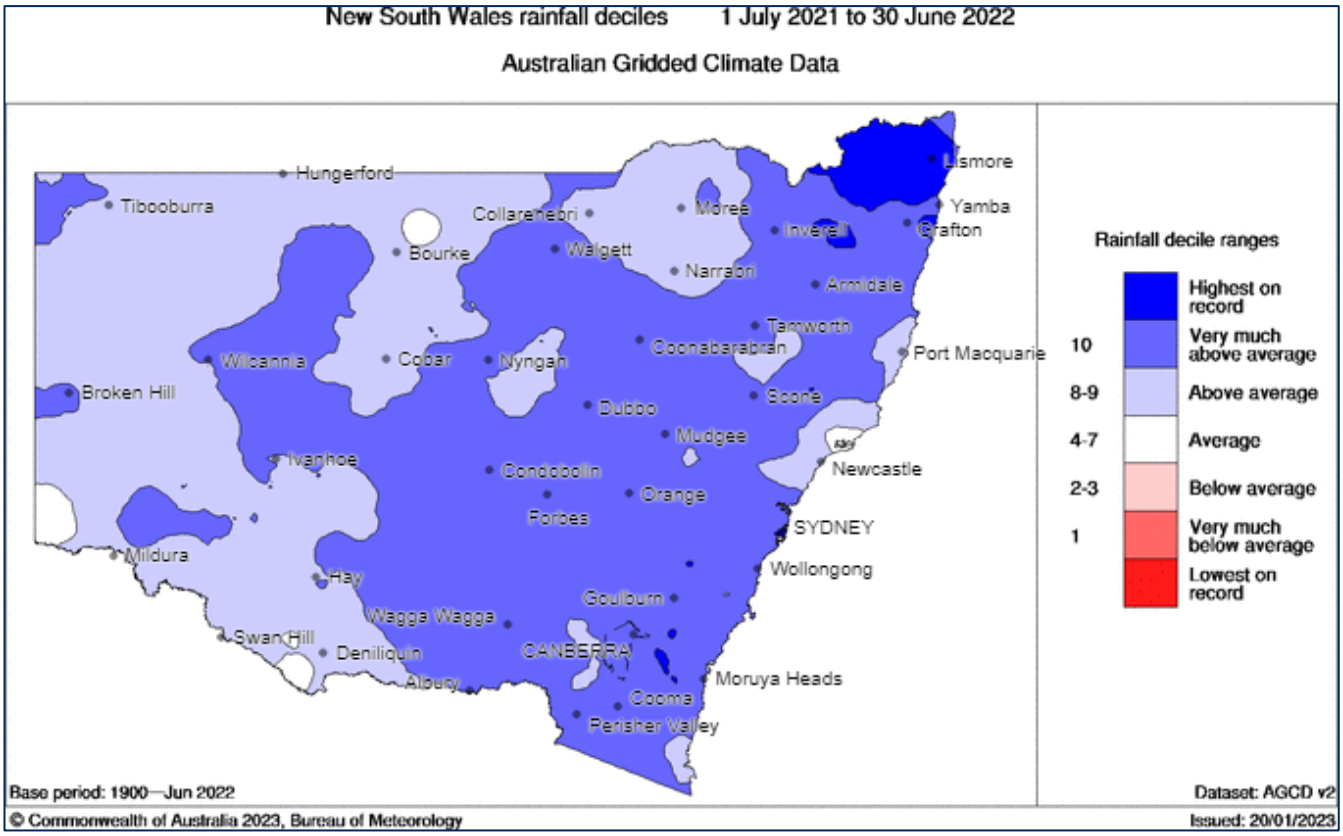

Figure 8 Rainfall decile ranges in NSW in the 12 months preceding the vegetation surveys in the lower Namoi (approximately Narrabri to Walgett). The map shows the region experienced above average and very much above average rainfall from 1 July 2021 to 30 June 2022. Source: Bureau of Meteorology.

Analyses of overbank environmental water requirements indicate that, overall, the flow requirements targeting floodplain vegetation in the lower Namoi were not met over the 20 year period preceding the surveys (Table 1). The large overbank environmental water requirement 5 (OB5) was only met 35% of the time. The large infrequent overbank environmental water requirement (OB4) was met in most water sources in the 20 year period.

These large overbank flows are for coolibah and black box and are only required to be met once in 10 years. This is probably the minimum requirement to meet the maintenance needs of mature trees. The large overbank 3 (OB3) environmental water requirement was met a maximum of 60-65% of the time in the Spring and Bobbiwaa Creek and Baradine Creek water sources, but 10% of the time or less in the lower Namoi unregulated water source. OB3 is targeted for river red gum communities and should occur every 3 to 5 years in 10 (Table 1).

Table 1. Environmental water requirement analysis for relevant planning units (PUs) in the lower Namoi for the last 20 water years (1 July 2002 to 30 June 2022). The values represent the number of water years the environmental water requirement long-term average frequency was met. The value in brackets expresses this result as a percentage over the 20 year period assessed.

Water Source	Planning Unit	Gauge	Small Overbank1	Small Overbank2	Small Overbank3	Large Overbank4	Large Overbank5
			OB1 4-5 years in 10	OB2 3-5 years in 10	OB3 3-5 years in 10	OB4 1 year in 10	OB5 1-4 years in 10
Baradine Creek	Wee Waa to Barwon River (PU 3)	419021	0 (0%)	8 (40%)	2 (10%)	20 (100%)	7 (35%)
Baradine Creek	Wee Waa to Barwon River (PU 3)	419026	0 (0%)	15 (75%)	12 (60%)	20 (100%)	7 (35%)
Eulah Creek	Boggabri to Wee Waa (PU 2)	419012	3 (15%)	8 (40%)	0 (0%)		
lower Namoi Unregulated	Wee Waa to Barwon River (PU 3)	419021	0 (0%)	8 (40%)	2 (10%)	20 (100%)	7 (35%)
lower Namoi Unregulated	Lower Namoi (PU 4)*	419021	0 (0%)	8 (40%)	2 (10%)	20 (100%)	7 (35%)
lower Namoi Unregulated	Gunidgera Creek and Duncan's Warranbool (PU 5)*	419021	0 (0%)	8 (40%)	2 (10%)	20 (100%)	7 (35%)
Spring and Bobbiwaa Creeks	Spring and Bobbiwaa Creeks (PU 30)^	419039	14 (70%)	4-5 years in 10 16 (80%)	13 (65%)	3-5 years in 10 2 (10%)	

*Values are for neighbouring planning unit Wee Waa to Barwon River (PU 3), ^Values are for neighbouring planning unit Boggabri to Wee Waa (PU 2).

Legend

0%
1-50%
51-70%
71-99%
100%

Vegetation condition and current and future population viability

A total of 33 plots across 13 sites were sampled on the Namoi floodplain in July and August 2022. The number of plots per site ranged between 2 and 6. There were 24 plots across 9 sites sampling coolibah woodlands (PCTs 39 and 40) and 9 plots across 5 sites sampling river red gum woodlands (PCTs 36 and 78). As very few sites were surveyed within each of the plant community types in the lower Namoi, care must be taken when interpreting the condition results. Results for each site are in Figure 9.

River red gum communities were in excellent to intermediate/poor tree stand condition and in Intermediate community condition. Coolibah grassy woodlands sites were in excellent to intermediate tree stand condition and intermediate/poor community condition. The population viability analysis indicated that river red gum and coolibah grassy woodland communities may currently have viable population structures, but no sites in the river red gum communities and only one site in the coolibah grassy woodland had sufficient juvenile trees present to indicate that the population was viable in the longer term. Grazing pressure at most sites surveyed was nil or low at the time of sampling.

Coolibah wetland woodlands were in intermediate and good tree stand condition and intermediate/poor community condition. Population viability analysis results found that the populations sampled were not viable using the current viability model. No coolibah wetland woodland sites had sufficient juvenile trees recorded at the time of survey so little can be said at this stage about the future maintenance of population viability. Grazing pressure at most sites surveyed was nil or low at the time of sampling.

Generally tree stand condition was better than community condition at most sites in most water sources, and there were few juvenile trees or sites with very young seedlings even though there had been higher than average rainfall in the catchment for the 12 months prior to the surveys and grazing pressure was nil or low in most sites.

More sites and repeated sampling are required in the lower Namoi before links between the tree stand, community and demographic condition of these communities and the frequency of meeting environmental watering requirements can be assessed.

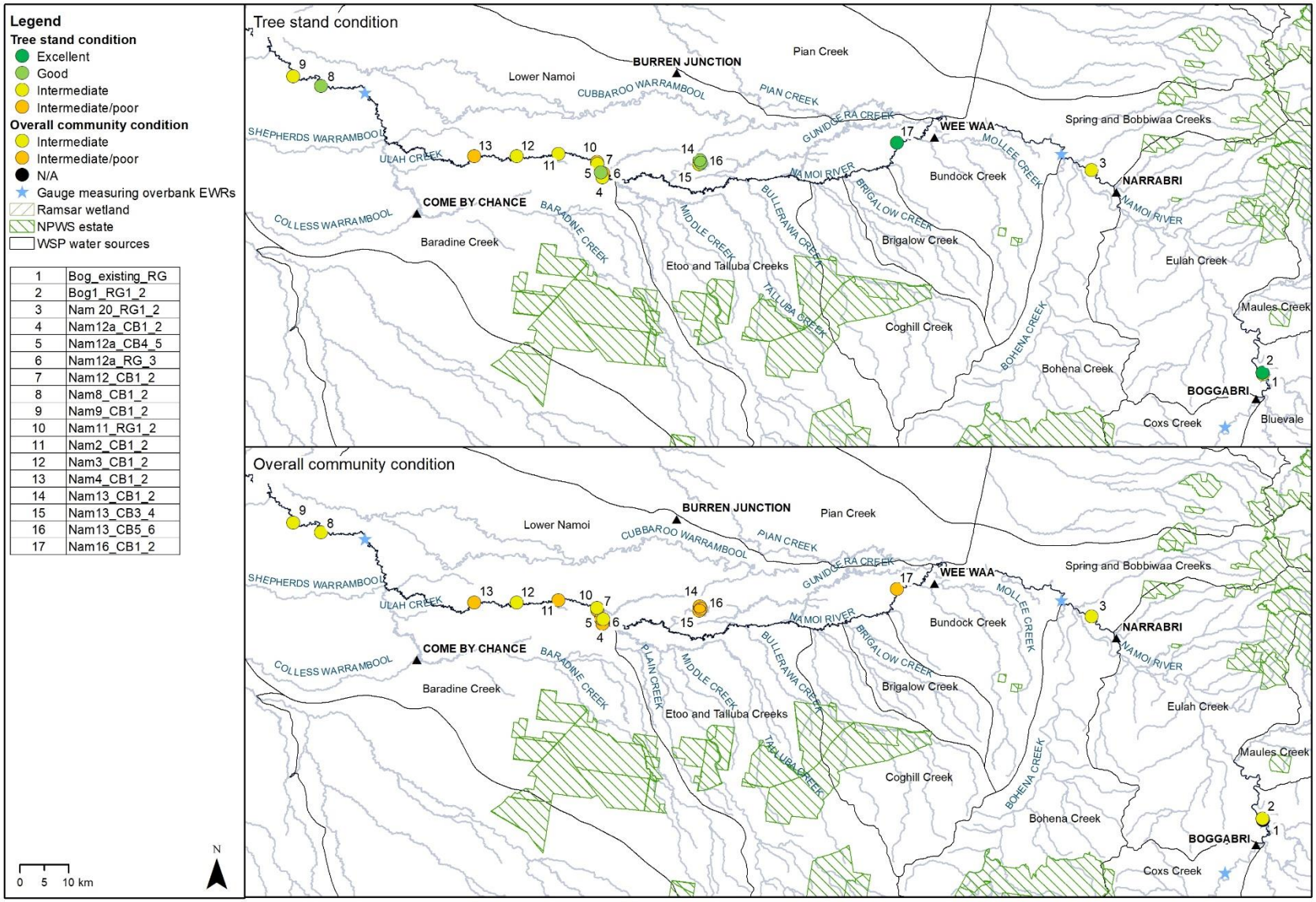

Figure 9 Tree stand condition (top panel) and overall community condition (bottom panel) for sites sampled in the lower Namoi floodplain.

Gwydir

Rainfall and hydrology

Rainfall in the lower Gwydir region in the 12 months prior to the July 2021 and May 2022 vegetation surveys tended to be average to above average (Figure 10).

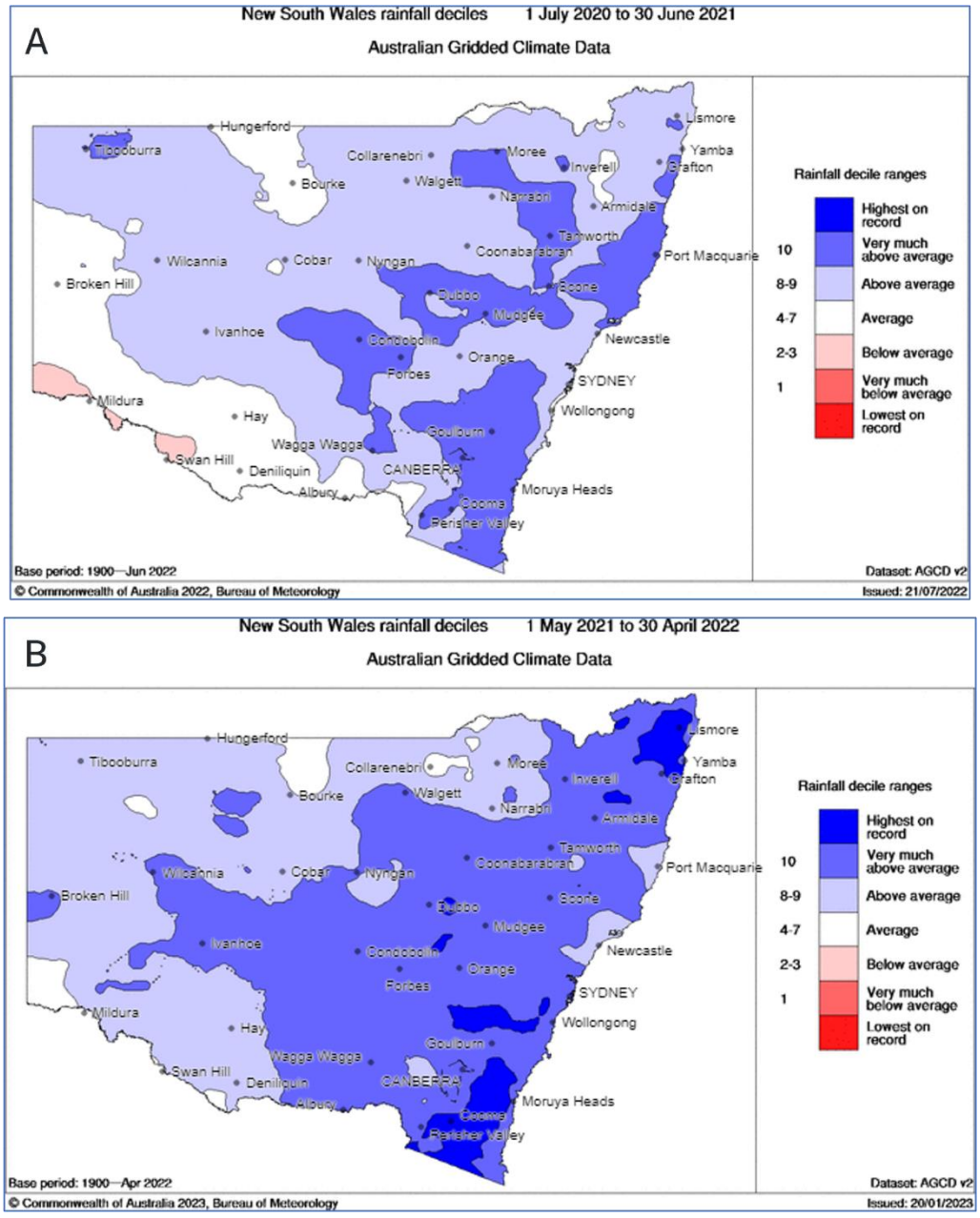

Figure 10 A) Rainfall decile ranges in NSW in the 12 months preceding the July 2021 vegetation surveys in the lower Gwydir (considered broadly between Moree and Collarenebri). The map shows the region experienced above very much to average rainfall from 1 July 2020 to 30 June 2021. B) Rainfall decile ranges in NSW in the 12 months preceding the May 2022 vegetation surveys in the lower Gwydir (considered broadly between Moree and Collarenebri). The map shows the region experienced average to above average rainfall from 1 May 2021 to 30 April 2022. Source: Bureau of Meteorology.

The river flow data for the 20 years from 2001 to 2021 show that this period was a reasonably dry period, with few overbank flows providing connectivity and rejuvenation across the floodplain (Figure 11).

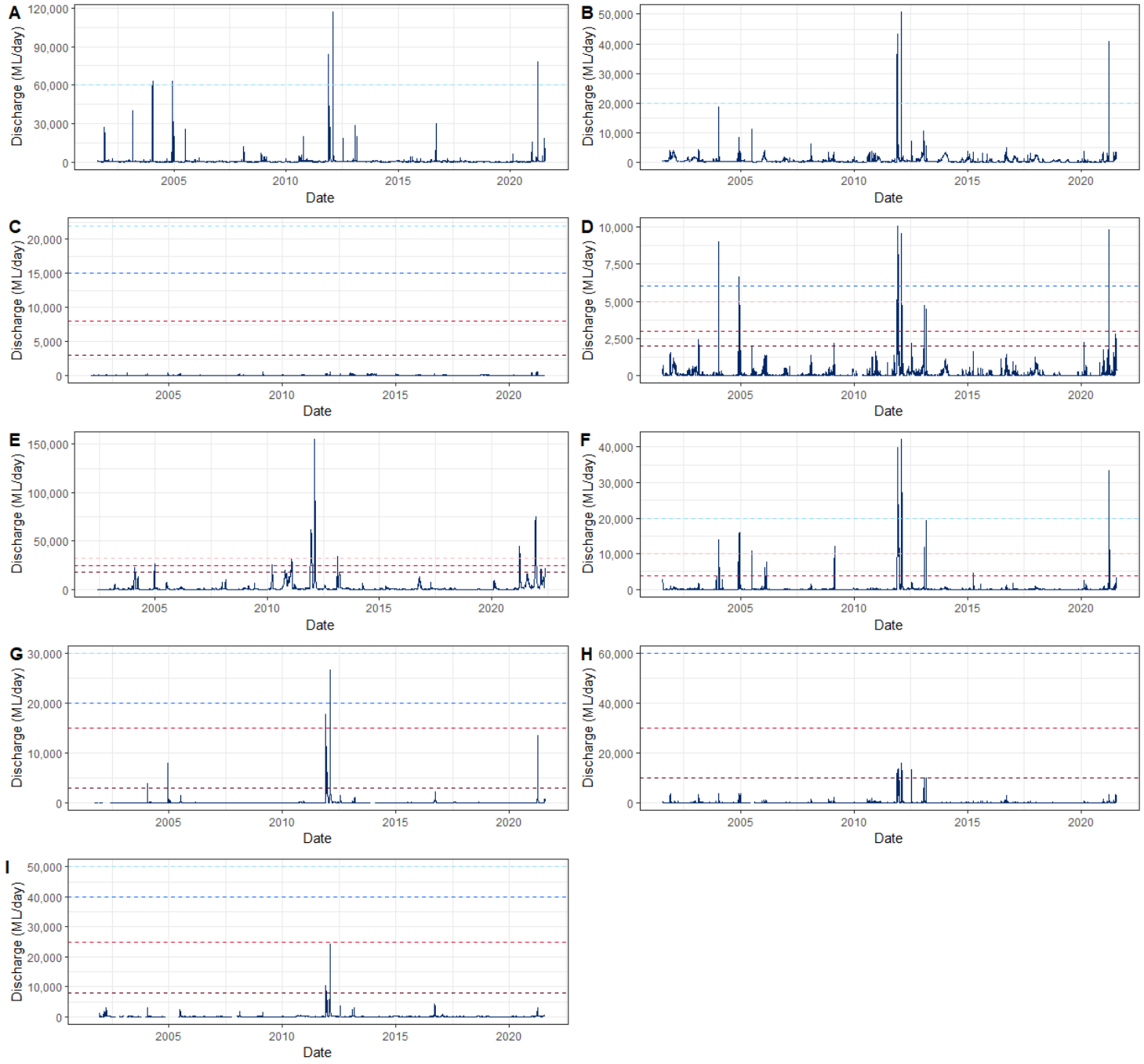

Figure 11 River flow rates (daily discharge, ML/day) for the 20 year period preceding sampling at A) Gwydir River at Yarraman Bridge (418004, 31/07/2001 to 31/07/2021) and B) Mehi River at Moree (418002, 31/07/2001 to 31/07/2021), C) Mallowa Creek at Regulator (418049, 31/07/2001 to 31/07/2021), D) Carole Creek near Garah (418052, 31/07/2001 to 31/07/2021), E) Barwon River at Collarenebri Main Channel (422003, 31/05/2002 to 31/05/2022), F) Gil Creek at Weemelah (416027, 31/07/2001 to 31/07/2021), G) Gingham Channel at Gingham Bridge (418079, 31/07/2001 to 31/07/2021), H) Gwydir River at Allambie Bridge (418078, 31/07/2001 to 31/07/2021) and I) Gingham Channel at Tillaloo Bridge (418076, 31/07/2001 to 31/07/2021). Small Overbank flows are shown by red dashed lines, Large Overbank flows are shown by blue dashed lines.

Environmental water requirement analysis indicates that the flow requirements targeting floodplain vegetation were not met across the lower Gwydir in the 20 year period (Table 2). The large overbank (OB5) environmental water requirement was met most of the period in most water sources but was met only met 50% of the time in the Carole Creek planning unit.

This large infrequent environmental water requirement only needs to occur once in 10 years to be met and is likely to be the minimum requirement for maintaining condition of adult trees (tree stand condition). The small overbank environmental water requirements (OB1, 2 and 3) were not met in most of the water sources assessed in the lower Gwydir except in the Gil Gil Creek and Barwon water sources (Table 2).

Table 2. Environmental watering requirement analysis for relevant planning units (PUs) in the lower Gwydir for the last 20 water years (1 July 2002 to 30 June 2022). The values represent the number of water years the environmental water requirement long-term average frequency was met. The value in brackets expresses this result as a percentage over the 20 year period assessed.

Water Source	Planning Unit	Gauge	Small Overbank	Small Overbank	Small Overbank	Large Overbank	Large Overbank
			OB1	OB2	OB3	OB4	OB5
			7-8 years in 10	4-7 years in 10	3-5 years in 10	2-3 years in 10	1 year in 10
Barwon	Downstream Mogil Mogil to Collarenebri (PU 4)#	422003	20 (100%)	17 (85%)	17 (85%)		
Gil Gil Creek	Gil Gil Creek (PU 19)	416027		12 (60%)	6 (30%)		19 (95%)
Gingham Watercourse	Central Gingham (PU 9)	418076, 418004					20 (100%)
	Lower Gingham (PU 10)	418079, 418004					20 (100%)
Gwydir	Lower Gwydir (PU 4)	418078, 418004	0 (0%)	0 (0%)	0 (0%)		20 (100%)
Mehi River	Goonal Creek (PU 5)	418004					20 (100%)
	Lower Mehi (PU 14)	418002					20 (100%)
	Upper Mehi (PU 12)	418002					20 (100%)
	Central Mehi (PU 13)	418002					20 (100%)
	Mehi Water Source (PU 46)^	418002					20 (100%)
	Mallowa Creek (PU 17)	418002, 418049					20 (100%)
	Tarren Creek (PU 3)	418004					20 (100%)
Moree	Main Gwydir River (PU 2)	418004					20 (100%)
	Carole Creek (PU 18)	418052	0 (0%)	0 (0%)	0 (0%)	6 (30%)	10 (50%)

Planning unit within Barwon-Darling LTWP area. Frequency requirements differ to the Gwydir LTWP, with OB1 2-4 years, OB2 1-3 years and OB3 0.5-1 year in 10. ^Mehi Water Source (PU 46) is in Zone B and does not have environmental water requirements. Values are for neighbouring planning unit lower Mehi (PU 14).

Legend

0%
1-50%
51-70%
71-99%
100%

Vegetation condition and current and future population viability

Twenty-one plots were sampled in the lower Gwydir floodplain in July 2021. A further 26 plots across 9 sites were sampled in May 2022. The number of plots per site ranged between one and 6. Twenty nine plots across 20 sites targeted coolibah grassy woodlands (PCT40), 7 plots across 6 sites targeted coolibah wetland woodland (PCT 39), one plot was surveyed in river red gum woodland (PCT 36), 4 plots across 3 sites targeted river red gum grassy woodlands (PCT 454) and one plot targeted black box woodlands (PCT 37). Care must be taken when interpreting condition as very few sites were surveyed in river red gum and coolibah wetland woodland plant community types in the lower Gwydir in 2021-22. Results for each site are in Figure 12.

River red gum woodland and coolibah grassy woodland sites were mostly in good to intermediate tree stand condition, and intermediate/poor community condition. Coolibah wetland woodlands were in good or excellent tree stand condition and community condition at most sites was poor or intermediate/poor.

River red gum woodland and coolibah wetland woodland populations are not viable populations using the current viability model analysis. One site in river red gum grassy woodland and one site in coolibah wetland woodland had sufficient juvenile trees to maintain viability but as the populations overall were not viable this is inconclusive. However, only 5 sites each were surveyed in river red gum and coolibah wetland woodland plant community types, therefore more sites are required to support these finding. The grazing pressure at the sites surveyed ranged from low to high at river red gum sites and grazing pressure was low at all sites sampled in coolibah wetland woodland.

Coolibah grassy woodland did appear to have a viable population structure. However, even though 21 sites were surveyed, very few sites had sufficient juvenile trees to maintain the current population structure in river red gum or coolibah plant community types. The level of grazing was low to medium at all sites at the time of sampling. Some sites surveyed in July 2021 had higher levels of grazing (medium) and evidence of cattle occupation and had no seedlings or saplings present, so grazing may be a factor in the lack of small juvenile trees at some sites.

Carbeen open forest sites were in intermediate and excellent tree stand condition and in intermediate/poor and poor community condition, and currently have a viable population structure Only one of the 4 sites had sufficient juvenile trees to maintain the population structure. All sites had low grazing pressure.

Generally tree stand condition was better than community condition at most sites in most water sources, and there were few juvenile trees or sites with very young seedlings even though there had been higher than average rainfall in the catchment for the 12 months prior to the surveys. More sites are required in the lower Gwydir before links between the tree stand, community and demographic condition of these communities and the frequency of meeting environmental watering requirements can be assessed.

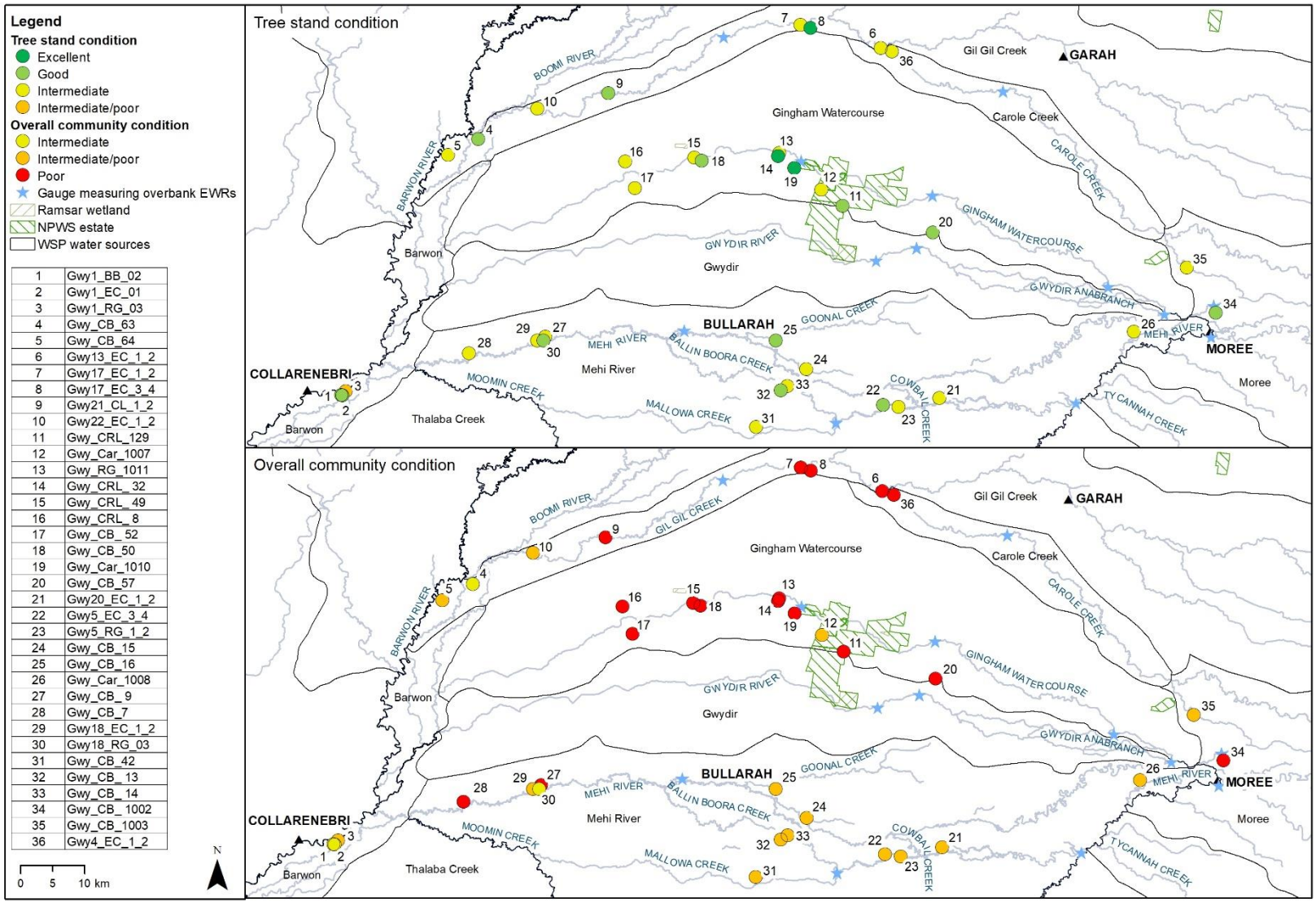

Figure 12 Tree stand condition (top panel) and overall community condition (bottom panel) for each site sampled in the lower Gwydir floodplain.

Conclusions

The findings of this project are valuable for water sharing plan evaluation and for reporting on condition of these water dependent communities under the Basin plan. A method for assessing the current and future viability of woodlands was trialled successfully. These results will be expanded in subsequent years of the EOMR program to build understanding of the links between environmental water and floodplain vegetation condition.

Next steps

- In 2022-23 baseline data will be collected from the lower Border Rivers floodplain and more sites will be sampled in the lower Namoi.
- As a number of the plant community types sampled in the Namoi and Gwydir 2021-22 were not considered viable using the accepted viability model, comparative analysis of different distribution models will be undertaken.
- Using the larger dataset from the lower Gwydir, we will further define the relationship between woody vegetation condition and inundation regime patterns. Results for tree stand condition and community condition for each plant community type, and the demographic condition at the plant community level, will be compared against inundation regime patterns, applying the long-term average frequency and duration requirements of overbank environmental water requirements as a proxy for inundation regime. The impact of external factors such as grazing pressure and climate will be investigated.
- A technical report with further information is available on the EOMRP website.

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