NSW GOVERNMENT

State of the catchments 2010

Riverine ecosystems

Namoi region

State Plan target

By 2015 there is an improvement in the condition of riverine ecosystems.

Background

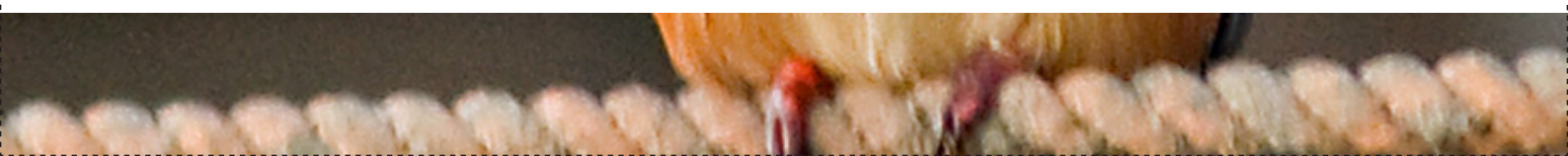
The Namoi River catchment covers approximately 42,000 km^2 and is located in north-western New South Wales (Figure 1). The Namoi River is some 700 km in length and rises in the rugged terrain of the Great Dividing Range, meandering westward onto the riverine plain to join the Barwon River near Walgett. The catchment area is bounded by the Great Divide in the east, the Liverpool and Warrumbungle Ranges in the south, and Mt Kaputar and the Nandewar Ranges in the north.

A number of major tributaries flow into the Namoi River. The Macdonald River (169 km in length) and Peel River (210 km in length) occur in the eastern catchment area. Chaffey Dam is located in the upper sections of the Peel River. The Manilla River (138 km in length) lies in the north-eastern catchment area and flows through Split Rock Dam. The Namoi River has a major storage, which is located upstream of the junction with the Peel River. Coxs Creek (170 km in length) and the Mooki River (128 km in length) occur in the mid-Namoi catchment area, joining the Namoi River near Boggabri. The lower river is characterised by smaller tributaries, anabranches and effluent channels.

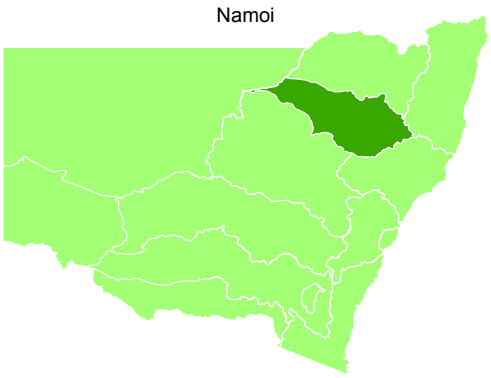
The Namoi River is similar to other inland river catchments in that the river system is heavily regulated, mostly via large dams and several instream regulatory structures. Over-allocation of water for irrigation is a major water management issue in the catchment.

A detailed technical report describes the methods used to derive the information contained in this report. At the time of publication of the *State of the catchments (SOC) 2010* reports, the technical reports were being prepared for public release. When complete, they will be available on the NOW website: www.water.nsw.gov.au.

Note: All data on natural resource condition, pressures and management activity included in this SOC report, as well as the technical report, was collected up to January 2009.



Map of the catchment



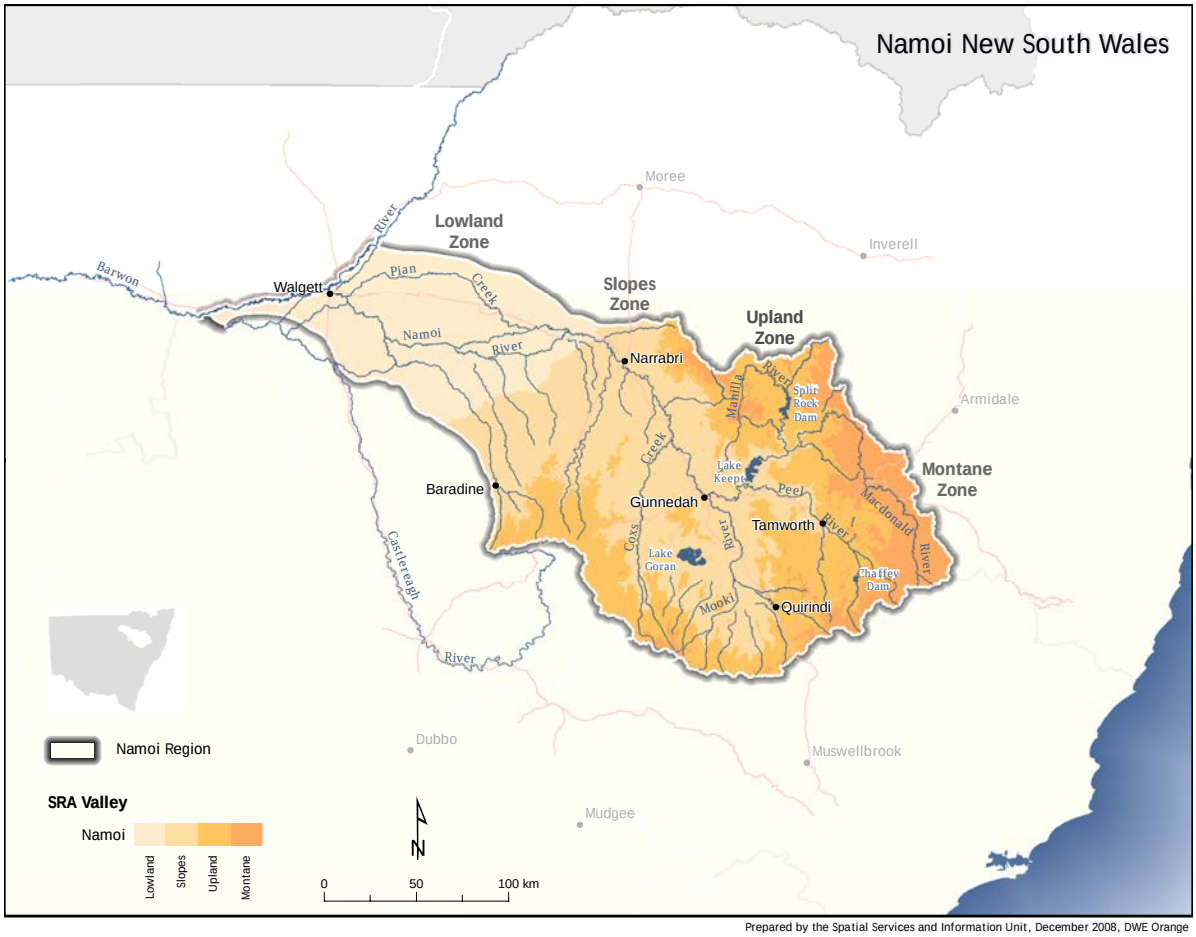


Figure 1 The Namoi region

Assessment

Riverine ecosystem condition has been assessed using water quality, macroinvertebrate, fish and hydrology indicators. Water quality condition is described as the percentage of samples exceeding the ANZECC water quality guidelines for turbidity and total phosphorus (ANZECC & ARMCANZ 2000). Condition for macroinvertebrates, fish and hydrology is based on the Sustainable Rivers Audit (SRA) and is described using a five point scale (Davies et al 2008). Trend information is

provided for the water quality indicators: electrical conductivity, turbidity and temperature.

For macroinvertebrate, fish and hydrology condition indicators, the maps show both an overall condition rating for the entire Namoi region and the condition in greater geographical detail based on SRA within-valley zones.

Condition

Water quality

Condition was determined for the following indicators of water quality in the Namoi region:

- **turbidity**, which is a measure of the effect of suspended sediment on water clarity and a potential indicator of sedimentation and erosion
- **total phosphorus (TP)**, which is a measure of all forms of phosphorus, some of which can occur naturally or via inputs from other factors including erosion, sedimentation and grey water (all non-toilet household wastewater). High levels may cause eutrophication, resulting in excessive growth of aquatic plants.

Data was analysed for the period 2005–2008. For turbidity in inland rivers, the upper limit of the guideline was adopted (ie 25 and 50 nephelometric turbidity units [NTU] for upland and lowland rivers respectively). The guidelines for total phosphorus are <0.02 mg/L for upland rivers and <0.05 mg/L for lowland rivers . Sites were classified as being in upland or lowland river reaches based on stream behaviour, position in the catchment and geomorphology. In general, upland sites were east of Gunnedah.

The map (Figure 2) shows the percentage of water quality samples at each site that exceeded the above guidelines. In general terms, the higher the percentage of exceedance, the higher the priority the site (and its catchment) would be for further investigation.

For water quality condition, data confidence bands were applied based on the degree that data met two criteria: first, the completeness of records over the three-year period of sampling and second, the regularity of sampling intervals. A high confidence rating was given when data satisfied – or nearly satisfied – the ideal situation of a complete three-year sampling period and regular sampling intervals every month. Conversely, a lower rating was given when data departed further from the ideal, with the lowest confidence being for data collected over less than a year and/or with sampling intervals of six months or greater.

Trends (Figure 3) were determined for the following indicators of water quality in the Namoi region:

- **water temperature,** which is affected by altitude, shading, channel width and depth, flow, water impoundment, groundwater discharge and climate
- **electrical conductivity (EC)**, which measures the ability of water to carry an electrical current. This ability depends on a number of factors including the presence and concentration of salts
- **turbidity**, which is a measure of the effect of suspended sediment on water clarity and a potential indicator of sedimentation and erosion.

The period of record ranges from the mid to late 1960s through to the current day for EC; early to mid 1970s through to the current day for temperature; and mid 1970s through to the current day for turbidity.

The NSW discrete water quality data archive (Triton database managed by NSW Office of Water [NOW]) was evaluated using a long-term trend analysis (30–35 years), providing a preliminary understanding of the behaviour of EC, water temperature and turbidity trends within the study

area. This understanding is vital for providing the context for future data collection, analysis and reporting.

To quantify the level of confidence in the trend results, a debit point system was used to assess operational issues, excessive data gaps, data collection and archival issues (NOW in prep.). This provided the basis for applying a low, medium or high data confidence ranking.

There were many water quality monitoring sites in the Namoi River catchment relative to other regions. The percentage of samples that exceeded total phosphorus guidelines was very high across the whole region (Figure 2). Turbidity results ranged greatly across the region, from sites with no exceedances through to sites with many exceedances across the region (Figure 2). Turbidity results were generally (but not always) lower at sites in the upper catchments and downstream of major storages.

Data confidence	Commentary
TP – high	For TP, sites generally have over 26 samples collected during the sample period. Confidence in the degree of representativeness of these data for the period of record is medium.
Turbidity – high	For turbidity, sites generally have over 26 samples collected during the sample period. Confidence in the degree of representativeness of these data for the period of record is high.

Water quality trend

Over half the results showed stable trends in water quality (Figure 3). A few sites had a decreasing trend in surface water temperature, located in the mid and upper catchment. A handful of sites also showed a decreasing trend in electrical conductivity over the last decade; it will be interesting to see how these levels respond during wetter conditions in the future due to climate change. Turbidity results were the least reliable; however, several sites across the region had rising trends.

Data confidence	Commentary
EC – low	Data confidence for EC was diminished mostly due to data collection issues across the catchment and excessive data gaps and archival issues at several sites.
Temp – medium	Data confidence for temperature was diminished mostly due to data collection and archival issues across the catchment and also excessive data gaps at one site.
Turbidity – low	Data confidence for turbidity was diminished mostly due to data collection and archival issues across the catchment and also excessive data gaps at several sites.

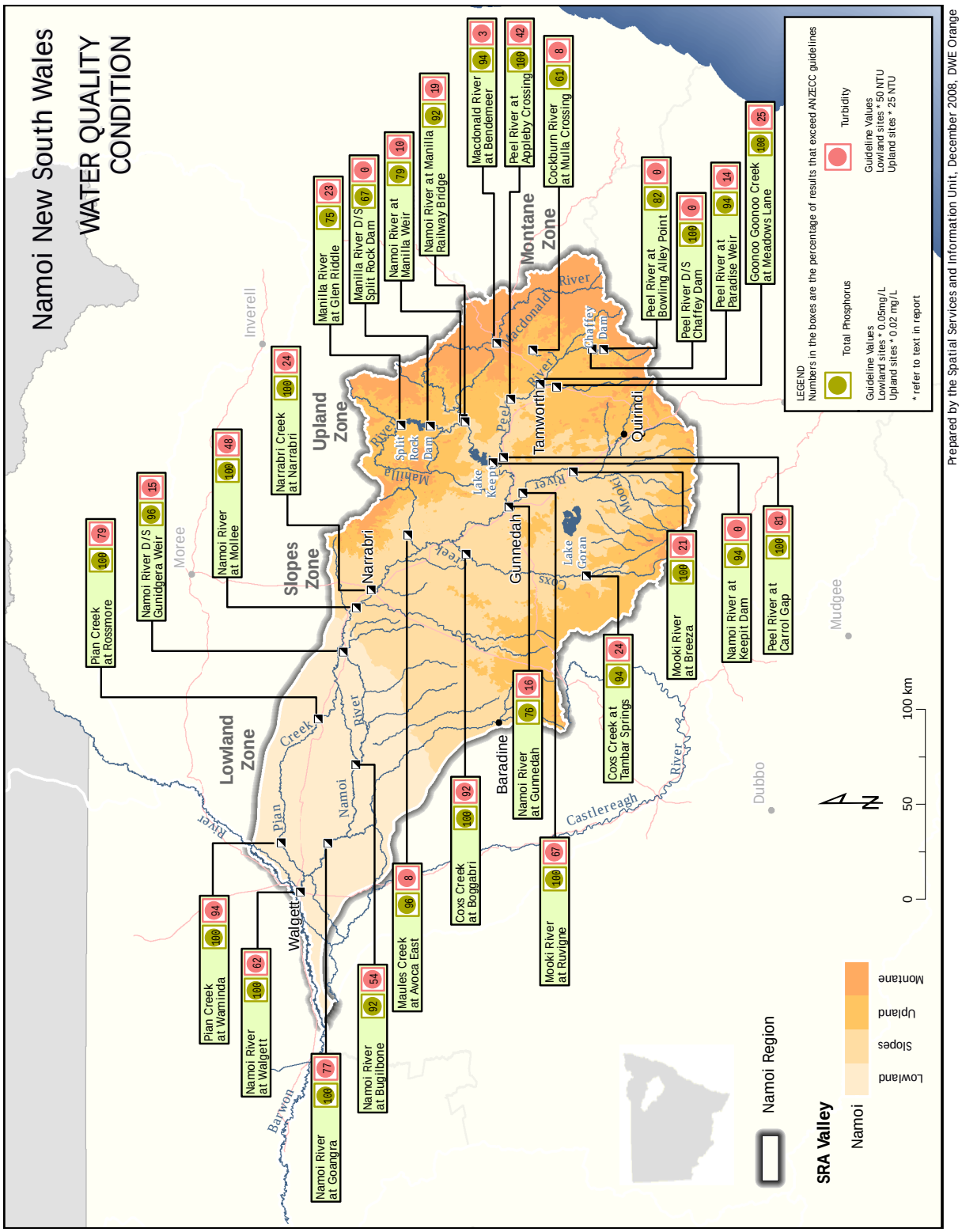


Figure 2 Water quality condition across the Namoi region

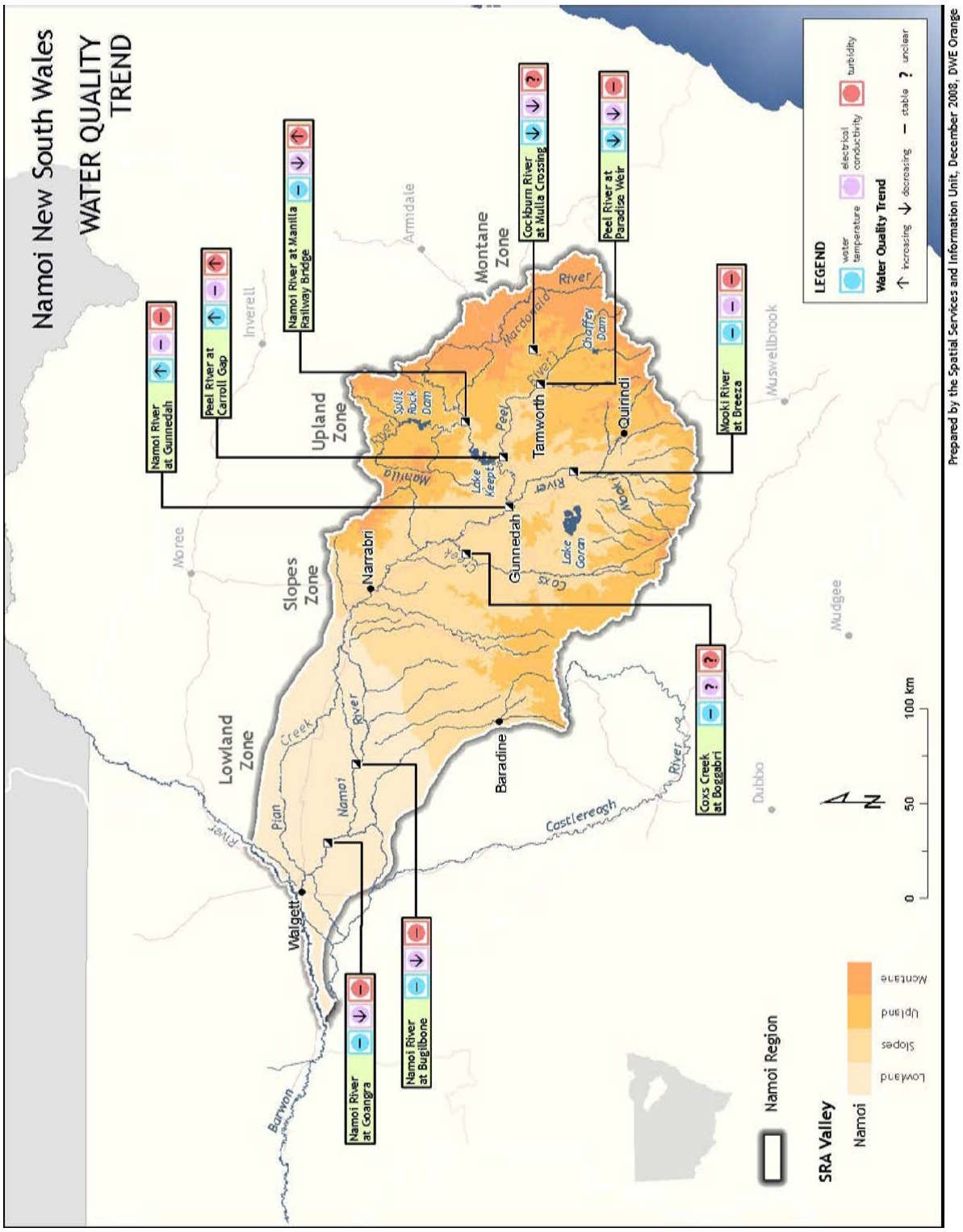


Figure 3 Water quality trends across the Namoi region

Aquatic biota

The condition of aquatic biota was assessed using the following measures of riverine ecosystem health:

- **macroinvertebrate assemblages**, which consist of larval and adult insects, molluscs, worms and crustaceans and are an important component of river ecosystems
- **fish assemblages**, which consist of native and introduced species.

Macroinvertebrate assemblages

The Macroinvertebrate Condition Index (Figure 4) integrates indicators of 'expectedness' (the proportion of expected families found) and the SIGNAL observed/expected (O/E) score (a score based on the sensitivities of families to pollution or other disturbances). For more details on the method see Davies et al (2008).

Fish assemblages

The Fish Condition Index (Figure 5) integrates indicators of 'expectedness' (the actual presence of native species relative to the species expected under the reference condition) and 'nativeness' (proportion of the fish population that is native rather than alien).

The site selection, sampling and analytical procedure used were largely as described in the SRA report (Davies et al 2008).

Although the same analytical procedure was used, there are some slight variations between the results presented here and the results presented in Davies et al (2008). There are several possible reasons for this:

- in many cases, more data was available for this reporting than was used for SRA analysis; the extra samples resulted in slightly different median metrics from those reported by the SRA
- a state-wide stream network (5 ML day Stein stream network version 2.92: Fenner School of Environment and Society, Australian National University, unpublished) was used to weigh zone data when calculating valley and regional statistics. This varies slightly from the stream network used for the SRA.

Data confidence	Commentary
Not assessed	Condition data derived from the Sustainable Rivers Audit (see www.mdbc.gov.au/SRA/river_health_check_-_sra_report_one).

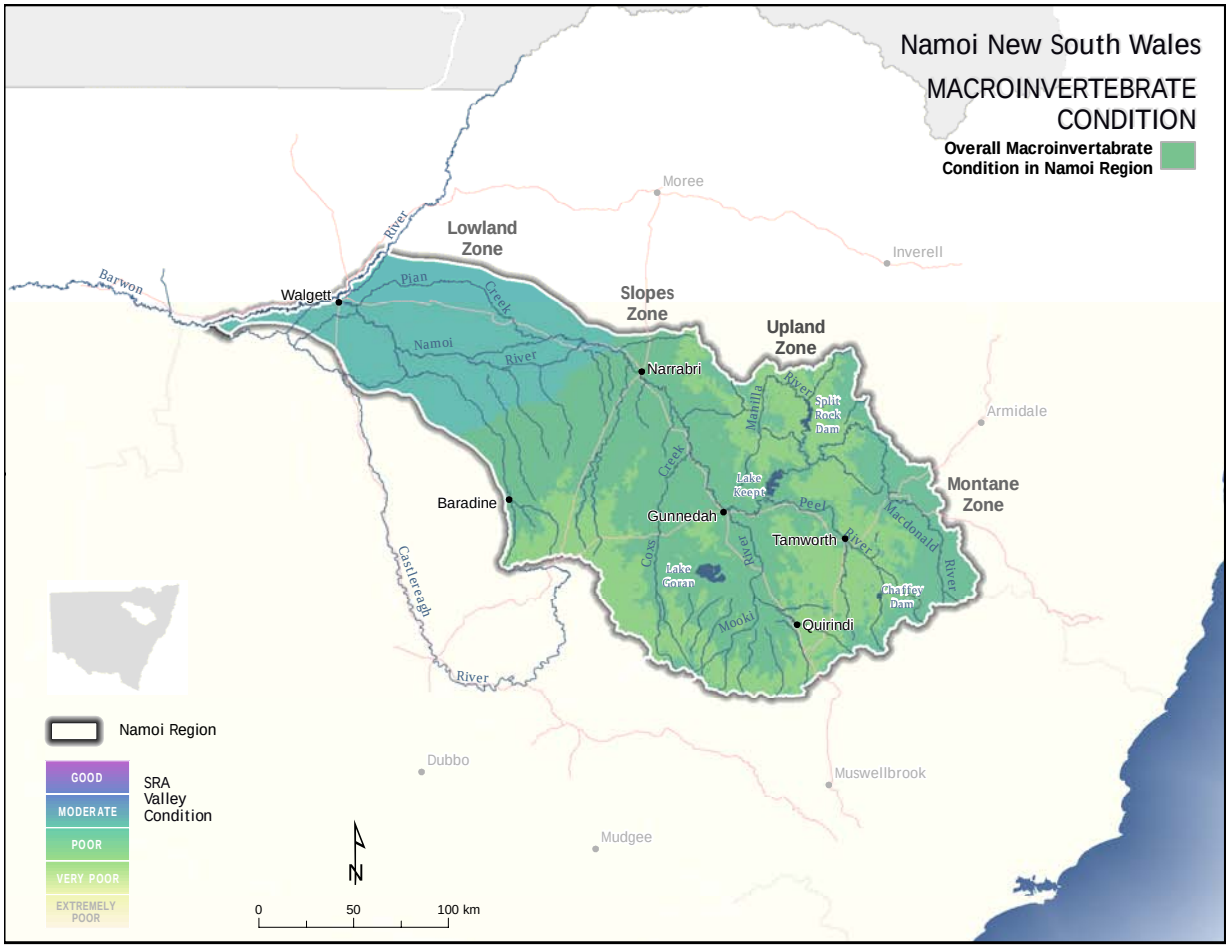


Figure 4 Macroinvertebrate condition across the Namoi region

Fish condition

The overall fish condition was poor (Figure 5), with both nativeness (the proportion of the fish assemblage that is native versus introduced fish) and expectedness (the proportion of species collected during sampling that were expected to have occurred in each basin zone before European colonisation) being poor. Of the individual catchment zones, the uplands and highlands zones were in moderate condition, the slopes zone was in poor condition and the lowlands zone was in very poor condition. Nativeness was moderate in the uplands, but poor in the lowlands, slopes and highland zones. Expectedness was moderate in the slopes, uplands and highlands zones but very poor in the lowlands zone.

Data confidence	Commentary
Medium to high	All data was collected within the three-year period between 1 January 2006 and 31 December 2008. Data confidence within individual altitude zones varies from high in the upland zone where there is limited variability across sites to medium in the remaining four zones where inter-site variability is moderate. Data confidence in the regional scale rating is medium given the generally moderate level of variability in fish condition across the catchment.

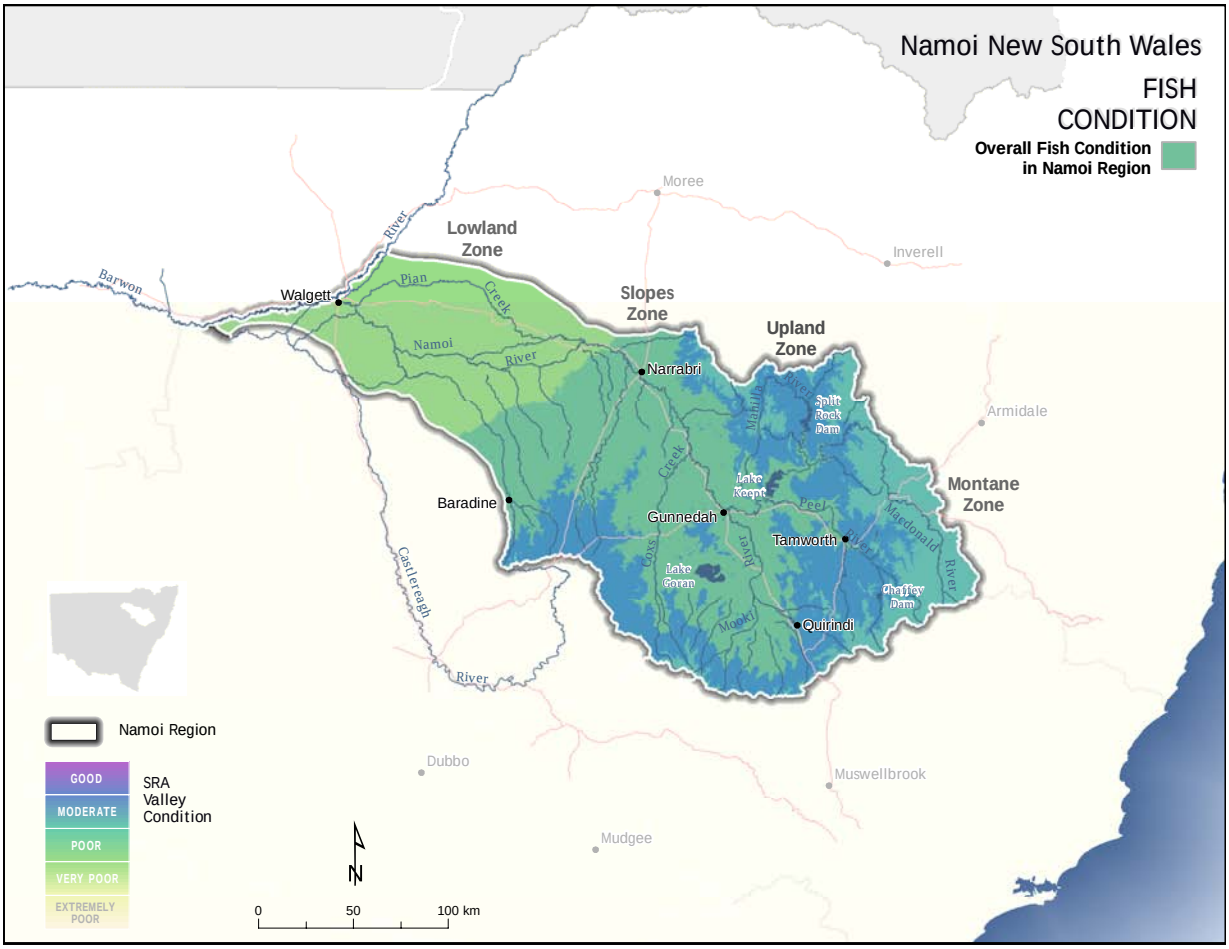


Figure 5 Fish condition across the Namoi region

Hydrology

Hydrologic condition (Figure 6) measures the ecologically significant aspects of the flow regime including volume, variability, extreme flow events and seasonality. Changes to flow regimes have significant potential to influence riverine ecosystems.

> 'The Namoi Valley was in good hydrological condition throughout (all zones: good condition), Hydrology Index scores (HI) at the 22 sites were 59–100, indicating good condition in all but one upland site. In general, the flow regime was near reference condition, but with changes in volume, seasonality and high flows in response to regulation (upstream) by storages and diversions (downstream)' (MDBC 2008).

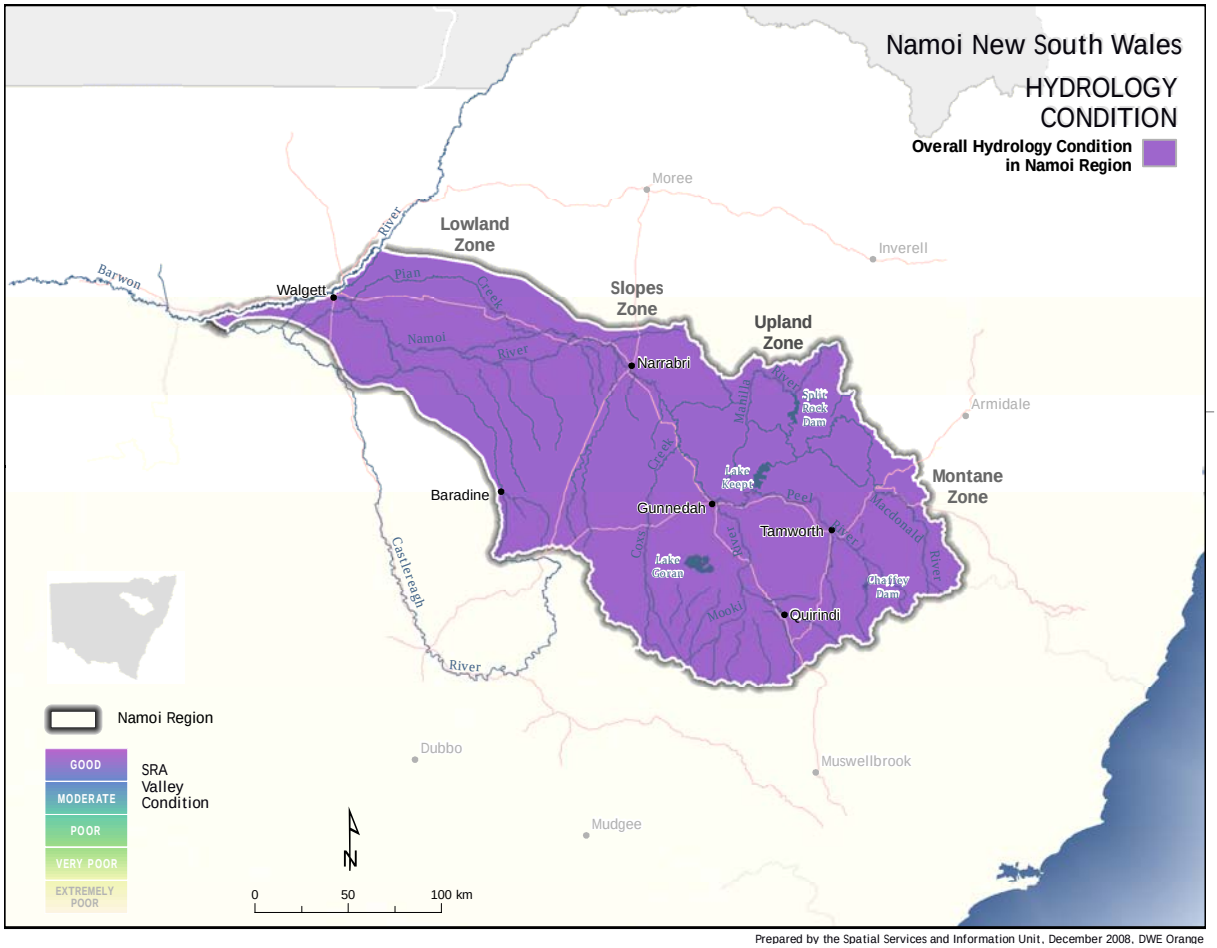


Figure 6 Hydrologic condition across the Namoi region

Hydrology condition

Data confidence	Commentary
Altitude zone condition – medium	Condition data derived from the Sustainable Rivers Audit (see www.mdbc.gov.au/SRA/river_health_check_-_sra_report_one).
Overall region condition – medium	Condition data derived from the Sustainable Rivers Audit (see www.mdbc.gov.au/SRA/river_health_check_-_sra_report_one).

Pressures

Introduction of pest species

Alien fish species

Alien fish apply pressure to native fish species, populations and communities as they compete for available resources (habitat and food). Some alien fish also prey on native fish.

Alien fish species assessment is derived using the nativeness indicator output from SRA models (see Davies et al 2008). Nativeness comprises three metrics:

- proportion of total biomass of native species
- proportion of individuals that are native
- proportion of species that are native.

Rankings range from 0 to 100; the lower the number, the greater the pressure from alien fish. The nativeness ranking is the average score of sites within each zone.

Valley name	Altitude zone	Nativeness ranking
Namoi	Lowlands	47
	Slopes	41
	Uplands	71
	Highlands	49

Water management

Alteration of natural temperature patterns

The temperature of water within aquatic environments, such as rivers, affects natural ecological processes. Water storages (dams) have the potential to release water that can be unseasonably cold during the warmer months. The change in water temperature in the river system downstream of a dam is referred to as cold water pollution (CWP) (Preece 2004). The table below shows storages that are likely to be associated with CWP, their priority and to what extent downstream effects (>5ºC peak depression) will be detected (where available) (Preece 2004). It should be noted that the known extent downstream is still uncertain and further monitoring will improve those temperature profiles.

Dam	Priority	Extent downstream	Impacted river
Keepit	High	300 km	Namoi

Keepit Dam on the Namoi River provides regulated flow for the irrigation of crops. Thermal stratification occurs during the warmer months and, while the storage is relatively shallow, cooling of the river occurs below the storage (Preece 2004). Keepit Dam is being upgraded to achieve a multitude of benefits that include improving its cold water mitigation protocols and fish passage.

The NSW Government is working with dam owners, community groups and environmental scientists to identify the areas most seriously affected, and to find methods to mitigate or prevent cold water pollution. NOW, in partnership with other key agencies, is implementing a strategy to control cold water pollution from dams identified for priority action in NSW.

Artificial barriers to fish passage

Many fish species migrate up and down rivers to breed or to find alternative habitat during extreme events such as drought. Construction of weirs, dams and road crossings can limit or prevent migration, resulting in loss or depletion of certain fish species upstream of such barriers.

In 2006, Industry & Investment NSW (I&I) undertook a detailed review of weir barriers to fish passage for each catchment management authority (CMA). Primary objectives included

identification of high priority barriers that have major impact on fish passage and aquatic habitat condition, priority ranking for remediation, and recommendations for appropriate remediation action. Below is a summary of the findings, which were updated by I&I in December 2008. It lists the priority ranking, and the increase in habitat area available to migratory fish, should the barrier be remediated.

Rank	Barrier name	Watercourse	Potential increase in habitat area (km)
1	Mollee Weir	Namoi River	220
2	Gunidgera Weir	Namoi River	50
3	Weeta Weir	Namoi River	70
4	Walgett Shire Council	Namoi River	70
5	Jewry Street Weir	Peel River	230
6	Calala Gauging Weir	Peel River	40

Barraba Weir on the Manilla River has been partially removed and is no longer considered a barrier.

Other pressures with the potential to impact on riverine ecosystem condition are listed below.

Agricultural and urban development

- Polluted runoff from agricultural, industrial and domestic sources
- Livestock grazing.

Loss of native vegetation

- Clearing of riparian vegetation
- Clearing of catchment vegetation
- De-snagging of instream channels
- Decline in natural replenishment of instream wood.

Introduction of pest species

- Aquatic and riparian weeds.

Water management

- Alteration of natural flow patterns.

Climate change

- Ability for biota to adjust to environmental changes
- Possible alterations to life cycle cues
- Unknown environmental tolerances of biota.

Management activity

State level

The State Plan natural resource management targets are being addressed through state, regional and local partnerships. The catchment action plans (CAPs) and the investment programs that support them are the key documents that coordinate and drive the effort to improve natural resources across NSW. The CAPs describe the whole-of-Government approach to address each of the state-wide targets at the regional level. The Namoi CAP can be found at www.namoi.cma.nsw.gov.au/52.html?5.

The riverine condition attributes have been grouped against management activities that are being applied to address associated pressures. Associating the management activities in this way identifies the actions being undertaken to address the specific pressures impacting on riverine condition.

At times, it is difficult to isolate the influence of individual and multiple pressures on some riverine condition attributes. Improvement of many condition attributes can also be derived from a single management activity. For example, riparian vegetation rehabilitation can influence the condition of water quality and the habitat for macroinvertebrates and fish. Managing altered river flow through water sharing plans (WSPs) can also improve water quality and then improve habitat for aquatic biota. Hence, the benefits from some of the listed management activities should not be considered in isolation. Where management activities clearly address a broad range of condition/pressure outcomes, these are listed against 'multiple condition/pressure actions'.

Hydrology

The riverine ecosystems target is being addressed at the state level largely through improved water sharing between users and the environment through WSPs and water purchase for the environment.

WSPs have been the key mechanisms in NSW for balancing competing interests in water management. The WSPs:

- share water between users, and between users and the environment
- increase allocations for the environment and other public purposes
- provide longer term, more secure, and tradeable property rights to facilitate investment and increase business returns from the water used.

WSPs have resulted in notable improvements in the management of NSW water resources by limiting use in the regulated rivers to 200 GL below the Murray–Darling Basin cap, and by providing flow patterns that are more like natural flow regimes. The recovery of additional environmental water through programs such as RiverBank and The Living Murray Initiative has also helped to sustain or improve NSW wetlands.

However, many riverine ecosystems are still under stress from altered flow regimes, and from land-use practices that adversely affect water quality and aquatic habitat. The key initiatives being undertaken to meet this challenge are:

- the completion of the remaining WSPs in the Murray–Darling Basin by 2011 and elsewhere before 2013

- progressing the recovery of water for the environment in the short term through RiverBank and The Living Murray, and in the longer term in cooperation with the Australian Government through the Water for the Future initiative
- adjusting future WSPs to account for climate change impacts and the Murray–Darling Basin Plan currently being prepared by the Murray–Darling Basin Authority.

Water quality

The following actions are being undertaken to address water quality issues:

- progress strategies to maintain valued ecological processes such as the Cold Water Pollution Mitigation Strategy, protecting riparian zones in urban areas and the NSW Wetlands Policy
- maintain water quality that is 'fit-for-purpose' through the NSW Diffuse Source Water Pollution Strategy, stormwater management and regulation of point source pollution
- effectively implement the monitoring, evaluation and reporting strategy
- provide a framework for councils to develop stormwater management objectives
- provide decision support tools and information to land managers
- develop regional water quality guidelines
- undertake ongoing water quality monitoring at strategic locations to assess the long-term trends and changes in condition.

Multiple condition/pressure actions

The Department of Planning (DOP) advocates that the planning system, in conjunction with relevant agencies and local government, has an important role in NRM and the protection of environmental values.

The planning process creates a strategic framework to identify, assess and prioritise land-uses and, to assist with strategic investment in the revitalisation/management of natural resource values. The framework and investment reflect two streams in the integration of natural resource management (NRM) and environmental protection – a 'strategic planning stream' and an 'investment stream'. These connections occur at a regional and local level and are important in the delivery of regional strategies (prepared by DOP) and local growth management strategies, local environmental plans (LEPs) and state of the environment reports (prepared by local councils).

The DOP state level measures that may enhance riverine condition include state environmental planning policies (SEPPs) (eg Rural Lands SEPP).

DOP also provides a regional context for planning through the development of regional growth strategies to guide sustainable growth and protect valuable natural and cultural assets. The development of regional strategies is undertaken with the involvement of the CMAs.

Regional level

At the regional level the Namoi CMA is undertaking the following activities in relation to the riverine ecosystems theme:

Multiple condition/pressure actions

- Riparian sites rehabilitated/riparian vegetation managed and enhanced/riparian zone managed for Best Management Practice (BMP) at locations throughout the catchment
- Aquatic habitat projects managed throughout the catchment

- Namoi Aquatic Habitat Initiative developed a collaborative project with I&I creating a demonstration reach between Boggabri to Narrabri
- Riverine Assessment Index Database developed, a collaborative project with the Cotton Cooperative Research Centre
- Riparian Condition Assessment developed a project benchmarking riparian vegetation for the catchment.

Water quality

- Namoi CMA water quality monitoring program 2008–2009
- Industry managed for improved discharge/efficiency.

A number of other groups are undertaking significant work in the region that is contributing to better outcomes for riverine ecosystems including:

Multiple condition/pressure actions

- Local government authorities' implementation of stormwater treatment works and protection of waterways through LEPs
- Integrated Monitoring of Environmental Flows Program
- NOW and NSW State Water's ongoing management of public water storages and flow releases to mitigate impacts on natural flow regimes and cold water pollution issues
- Liverpool Plains Land Management Committee riparian sites rehabilitated and vegetated/ vegetation managed for conservation/enhanced/managed under BMP.

Water quality

- NOW's Barwon Region Water Quality program.

Local level

DOP also provides for local planning measures and activities to address a number of pressures. These measures include:

- working with DECCW, NOW & I&I in developing standard NRM clauses for councils to incorporate into their new LEPs as part of the NSW Government's planning reform initiative
- preparing a practice note to provide guidance to councils on the environmental protection zones in the standard LEP instrument and how they should be applied in the preparation of LEPs. DOP is working on similar guidance for waterways and riparian corridors
- working with local councils as they develop their local strategic plans.

Further reading

ANZECC & ARMCANZ 2000, *Australian and New Zealand guidelines for fresh and marine water quality*. National Water Quality Management Strategy Paper No 4, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra, [www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality].

Davies PE, JH Harris, TJ Hillman & KF Walker 2008, *SRA Report 1: A Report on the Ecological Health of Rivers in the Murray–Darling Basin, 2004–2007*, prepared by the Independent Sustainable Rivers Audit Group for the Murray–Darling Basin Ministerial Council.

MDBC 2008, *Murray–Darling Basin Rivers: Ecosystem Health Check, 2004–2007*. A summary report based on the Independent Sustainable Rivers Audit Group's *SRA Report 1: A Report on the Ecological Health of Rivers in the Murray–Darling Basin, 2004–2007*, submitted to the Murray–Darling Basin Ministerial Council in May 2008.

Murray–Darling Basin Commission 2008, [www.mdbc.gov.au].

NOW in prep., 'Evaluation of water quality data and historical trends in New South Wales, Australia: Technical report for the Riverine Ecosystem Theme, as part of the New South Wales Monitoring, Evaluation and Reporting Strategy', NSW Office of Water, Sydney.

NSW Department of Primary Industries 2006, *Reducing the Impact of Weirs on Aquatic Habitat – New South Wales Detailed Weir Review. Lower Murray Darling CMA region,* Report to the New South Wales Environmental Trust, NSW Department of Primary Industries, Flemington, NSW.

NSW Office of Water, Triton Water Quality Database, Parramatta, Sydney, NSW.

Preece R 2004, *Cold water pollution below dams in New South Wales – A desktop assessment,* Water Management Division, Department of Infrastructure, Planning and Natural Resources, Sydney.

Published by: Department of Environment, Climate Change and Water NSW, 59–61 Goulburn Street. PO Box A290, Sydney South 1232.
Ph: (02) 9995 5000 (switchboard). Ph: 131 555 (environment information and publications requests).
Ph: 1300 361 967 (national parks, climate change and energy efficiency information and publications requests).
Fax: (02) 9995 5999. TTY: (02) 9211 4723.
Email: info@environment.nsw.gov.au Website: www.environment.nsw.gov.au
DECCW 2010/352 ISBN 978 1 74232 677 1 November 2010
Cover photo: DECCW – 'kingfisher'