NSW GOVERNMENT

State of the catchments 2010

Riverine ecosystems

Southern Rivers region

State Plan target

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

Background

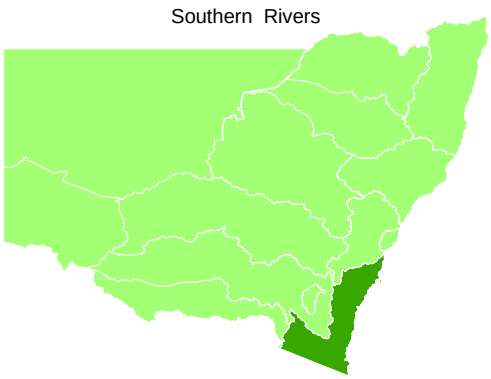
The Southern Rivers region covers more than 30,000 km^2, is bounded by Stanwell Park in the Illawarra to the north and includes all coastal catchments south to the Victorian border. The region has nine catchment areas including the Shoalhaven, Illawarra–Hacking, Clyde, Deua, Tuross, Bega and Towamba coastal catchments, and extends westwards to include the Snowy and Genoa catchments (Figure 1). This diverse region has many river systems that include the Minnamura, Kangaroo, Shoalhaven, Clyde, Deua, Tuross, Brogo, Moruya, Bega, Bemboka and Towamba rivers, all of which flow east to the coast; and the Genoa and Snowy rivers that originate in New South Wales and flow into lower catchments in Victoria.

The largest catchment in the Southern Rivers region is the Shoalhaven, covering 7300 km^2. The Shoalhaven River rises in the highlands of the Southern Tablelands at an altitude of 864 m above sea level and is 327 km in length. The Mongarlowe River is a major tributary of the Shoalhaven River and flows from the steep mountains of the Budawang Range, joining the main trunk of the Shoalhaven River near Braidwood. The southern section of the Shoalhaven River flows northwards before it merges with the southern flowing Kangaroo River and then flows east. The Kangaroo River and some of its tributaries fall rapidly downstream through gorge country onto alluvial plains near Nowra. Downstream of the gorge country near the confluence of the Kangaroo River with the Shoalhaven River, the river enters Tallowa Dam, which supplies water to Sydney and the Shoalhaven region.

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



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 is described for macroinvertebrates, fish and hydrology by using a five point scale, a similar ranking process to the scale used in the Sustainable Rivers Audit (SRA) (Davies et al 2008). Trend information is provided for the water quality indicators: electrical conductivity, turbidity and temperature.

For the aquatic biota and hydrology indicators, different colour schemes are presented on the maps. A number of different methods were applied in the coastal regions, based either on a coastal adaptation of the SRA approach to condition assessment, or an interim approach where data or model availability did not allow an SRA style approach. Outcomes were not available for some areas. In all coastal regions, altitude zones could not be applied to macroinvertebrate modelling, unlike in the inland regions (ie SRA approach). For hydrologic condition mapping, where models were available, techniques based on the SRA approach were applied and the colour scheme on the map is similar to that used for inland regions (ie solid shading); for non-modelled catchments, hatching is used to indicate that a different method based on potential extraction pressures has been applied. The overall condition ratings have been applied based on whole-of-catchment, combinations of catchment management authority (CMA) areas, or major sub-region boundaries as applicable.

Condition

Water quality

Condition was determined for the following indicators of water quality in the Southern Rivers 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 2005–2008. For turbidity in coastal rivers, the lower limit of the guideline was adopted (ie 2 and 6 nephelometric turbidity units (NTU) for upland and lowland rivers respectively). The guidelines for total phosphorus were <0.02 mg/L for upland rivers and <0.05 mg/L for lowland rivers. The classification of sites as belonging to upland or lowland rivers was based on altitude as recommended by the ANZECC guidelines (upland >150 m and lowland <150 m above sea level).

The map (Figure 1) shows the percentage of water quality samples at each site that exceeded the 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 2) were determined for the following indicators of water quality in the Southern Rivers 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.

Records generally range from 1968 to 2006 for EC; from 1970 to 2006 for temperature; and from 1976 to 2006 for turbidity.

The NSW discrete water quality data archive (ie Triton database managed by the 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.

The percentage of samples that exceeded total phosphorus guidelines was generally low to very low across the region, except at a few sites that had moderate levels of exceedance (Figure 1). The percentage of samples that exceeded turbidity guidelines ranged from low to moderate across the region.

Data confidence	Commentary
TP – medium	For TP, sites generally have 22 samples collected during the sample period. Confidence in the degree of representativeness of these data for the period of record is medium. Sampling intervals were consistently between one and two months.
Turbidity – medium	For turbidity, sites generally have 22 samples collected during the sample period. Confidence in the degree of representativeness of these data for the period of record is medium. Sampling intervals were consistently between one and two months.

Water quality trend

All sites across the region had stable trends for water temperature and EC (Figure 2). In contrast, all sites across the region had rising trends for turbidity. Caution should be applied to interpreting these results as generally the analysis only includes data up to 2006. Further monitoring is required to confirm current trends.

Data confidence	Commentary
EC – low	Missing hour-of-day affected both EC and temperature.
Temp – low	For EC, contradictory data created confusion; although several sites scored medium data confidence, the average was low.
Turbidity – medium	For temperature, data precision was an issue. Turbidity data suffered from gaps and sequences of low flow years.

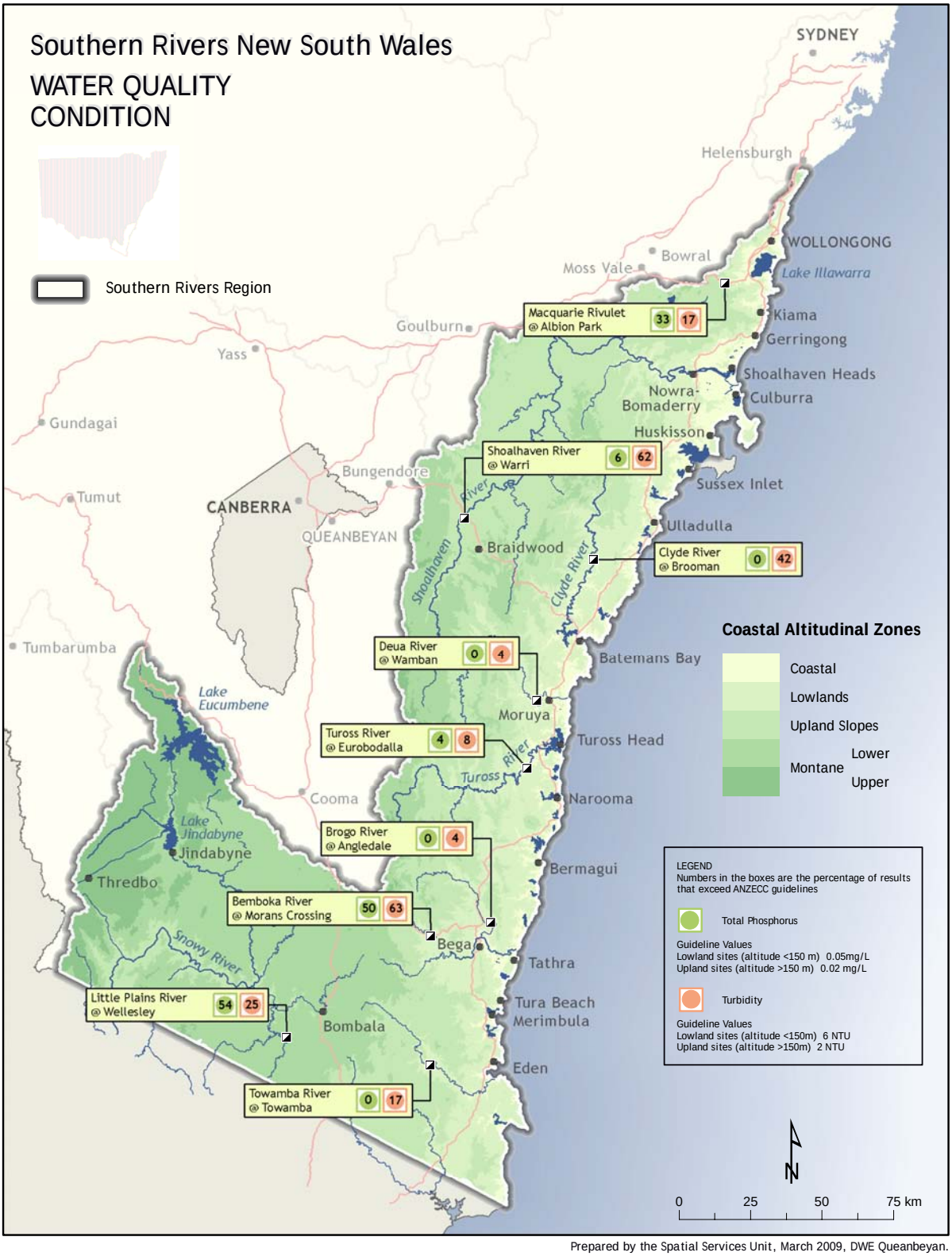
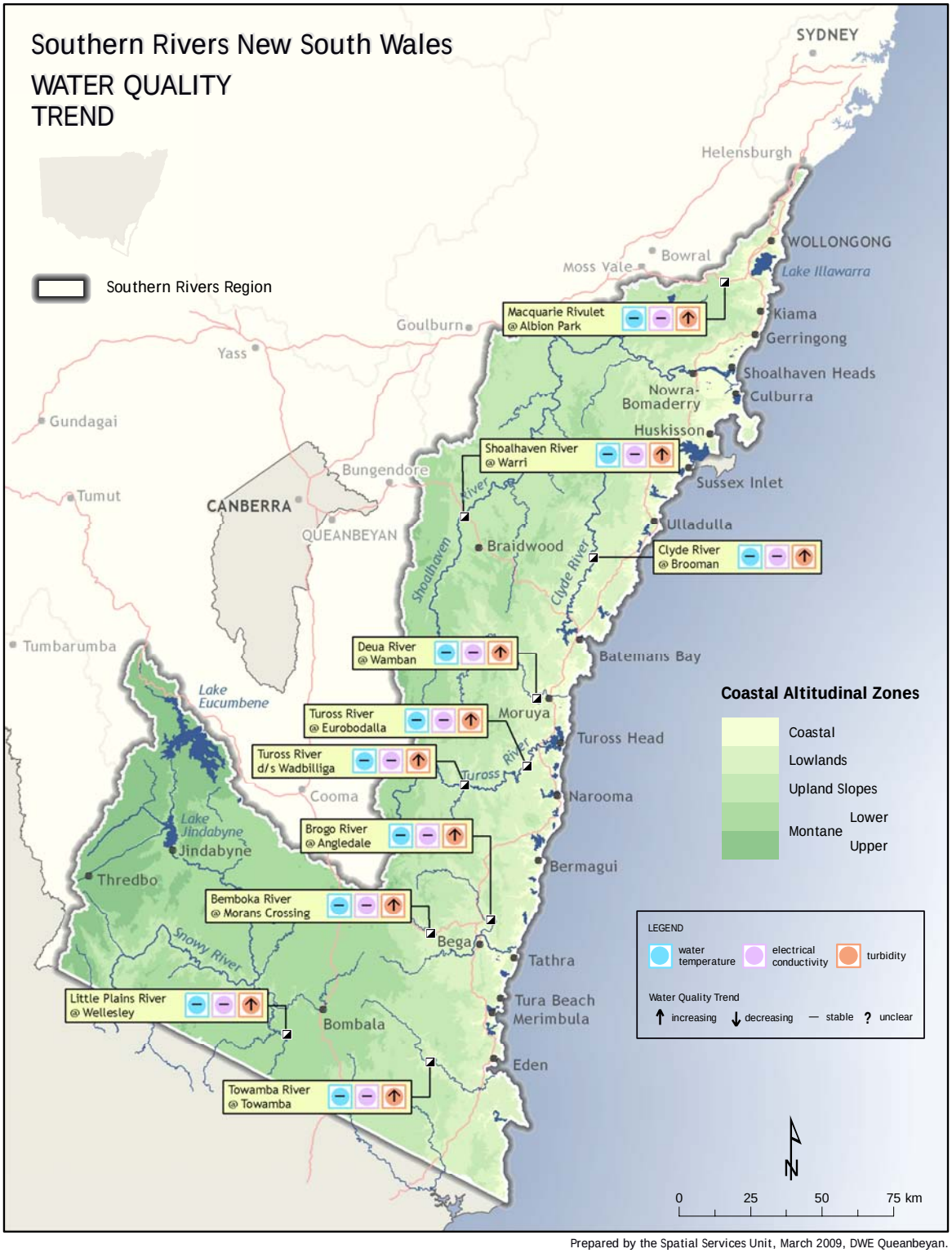


Figure 1 The Southern Rivers region and water quality condition across the region

Note: the values for **total phosphorus and turbidity represent the percentage of water quality samples** at each site that exceed the ANZECC guidelines**.**



Prepared by the Spatial Services Unit, March 2009, DWE Queanbeyan.

Figure 2 Water quality trend sites and outcomes within the Southern Rivers 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 condition of macroinvertebrate assemblages in the rivers of eastern NSW was modelled giving predictions of AUSRIVAS observed/expected (O/E) composition of macroinvertebrate fauna scores (see: ausrivas.canberra.edu.au/Bioassessment/Macroinvertebrates/Man/Sampling/NSW/NSW_Ausrivas_protocol_Version2_2004.pdf). The model incorporated major sub-regions in the Southern Rivers region (the Snowy Catchment in the Southern Rivers region and all remaining catchments in the same region). The AUSRIVAS O/E scores were scaled so the maximum possible value was 1, representing the condition when there was no observed disturbance. The scaling was achieved by subtracting the minimum possible value for that region (based on the maximum possible value of the disturbance index) from the prediction for each subcatchment and then dividing this by the full range of possible values. The scaled O/E scores were then mapped under five condition categories that represent different magnitudes of predicted loss of macroinvertebrate families compared with a relatively undisturbed reference condition (Figure 3).

1. **Very good:** loss of macroinvertebrate families was predicted to be less than five per cent and thus may be considered insignificant (O/E >0.95)
2. **Good:** loss of macroinvertebrate families was predicted to be less than 25 per cent (0.75<O/E<0.95)
3. **Moderate:** more than half of the macroinvertebrate families were predicted to be retained but over a quarter were lost (0.5<O/E<0.75)
4. **Poor:** most macroinvertebrate families were predicted to have been lost but over a quarter remain (O/E 0.25-0.5)
5. **Very poor:** three quarters or more of the macroinvertebrate families were predicted to have been lost.

The overall catchment condition score was calculated using the median of recent (2006–2008) AUSRIVAS O/E50 scores that were scaled using the formula ([O/E50 – minimum O/E50]/range of scores).

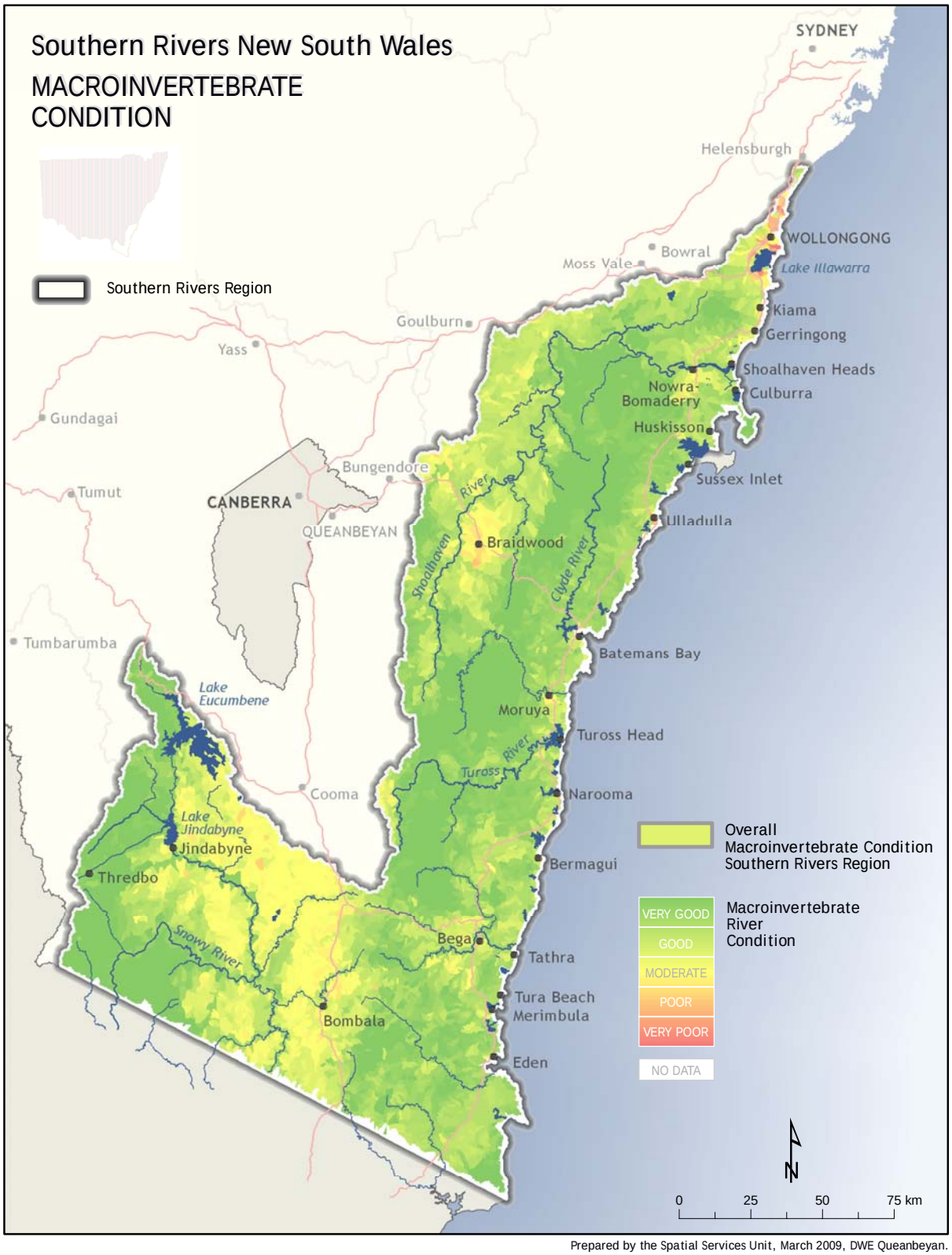
Further details on the scoring system for macroinvertebrates are listed in the technical report for riverine ecosystem condition (NOW in prep.).

Fish assemblages

The Fish Condition Index (Figure 4) integrates indicators of 'expectedness' (the actual presence of native species relative to the species expected under reference condition) and 'nativeness' (proportion of fish population that is native rather than alien). The Pre-European Reference Condition for Fish (PERCH) scores derived for the calculation of the expectedness indicator for coastal catchments are based on existing data and a literature review, but have not yet undergone expert panel evaluation.

The site selection, sampling and analytical procedure used in coastal catchments were largely as described in the SRA report (Davies et al 2008) for inland valleys. The few minor exceptions were the addition of a fifth catchment zone in coastal valleys, called the coastal plain, which extended from 3 m to 35 m above sea level, a minimum distance of 2.5 km between sampled sites, the inclusion of randomly selected sites that fell within impoundments, and the measurement and inspection of an additional 20 random individuals per species per operation after the SRA sub-sampling requirement had been met. Most importantly, sampling was not available for the minimum of seven sites per altitude zone, or a minimum of 18 sites per valley in coastal catchments, as required by the SRA method. However, the minimum site number requirements for coastal valleys have not yet been analysed and may differ from inland ones. Therefore, results from zones within valleys and valleys themselves should be interpreted with caution. However, at least seven sites were sampled per altitude zone per region so more confidence can be given to this data.

Data confidence	Commentary
Overall catchment score – low	Data was analysed for the period 2006 to 2008. Confidence in the single catchment rating is low due to the high variance of O/E50 scores from samples across the catchments.
Catchment model outcomes – medium	Assessments at many of the sites were based on AUSRIVAS O/E scores from a single sampling event that may be inadequate for representing the integrity of macroinvertebrate assemblages because of the large amount of uncertainty associated with each sample (Hose et al 2004, Gillies et al 2008). The five models developed for the coastal regions used all available macroinvertebrate assessments made between 1994 and 2008. Hence these maps represent the average condition of rivers since 1994. Disturbance indices used here (Stein et al 2002) were developed at a continental scale and do not incorporate some disturbances that are known to affect river biodiversity such as instream barriers and degradation of the riparian zone and instream environment. The hydrological component of the disturbance index was based on data that was too patchy to be incorporated into the models so the current models do not account for the ecological degradation caused by flow regulation. The significance of the correlations underlying the regression models and the results of validation tests performed for each model suggest that the maps produced are likely to represent broad-scale patterns in the integrity of macroinvertebrate assemblages in the rivers of the five coastal regions.



Prepared by the Spatial Services Unit, March 2009, DWE Queanbeyan.

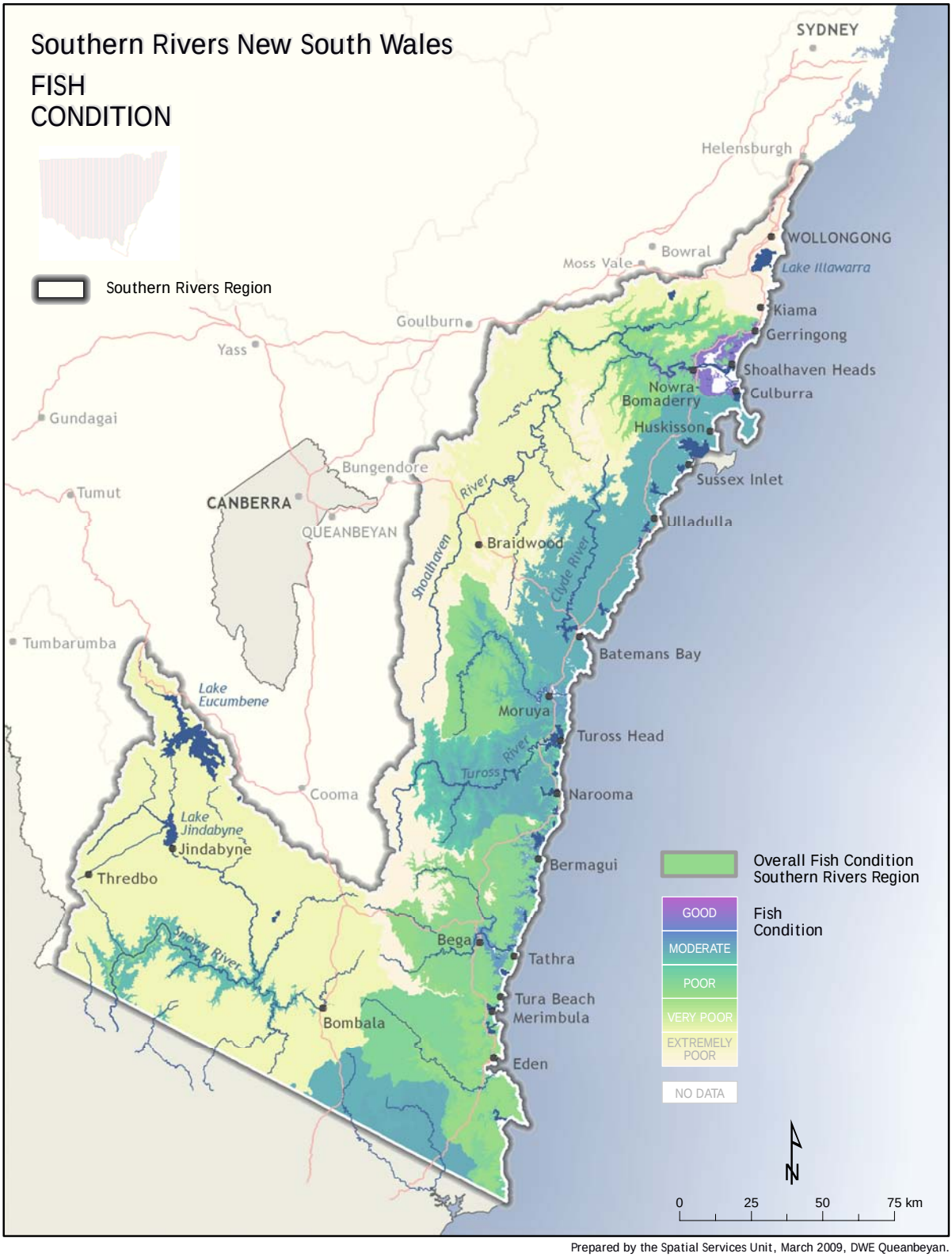
Figure 3 Macroinvertebrate condition across the Southern Rivers region

Fish condition

The overall fish condition was poor (Figure 4), with nativeness (the proportion of the fish assemblage that is native versus introduced fish) being moderate and expectedness (the proportion of species collected during sampling that were expected to have occurred in each basin zone before European colonisation) being very poor. Of the individual altitude zones, the coastal plain zone was in moderate condition, the lowlands and slopes zones were in poor condition, the uplands was in very poor condition and the highlands was in extremely poor condition. Nativeness was good in the coastal plain, lowland and slopes zones, moderate in the uplands and very poor in the highlands. Expectedness was poor in the coastal plain zone, very poor in the lowlands and slopes zones and extremely poor in the upland and highland zones.

Across basins, the Clyde and Genoa basins were in moderate condition, the Bega, Moruya, Towamba, Tuross and Wollongong Coast basins were in poor condition; and the Shoalhaven and Snowy basins were in very poor condition. Nativeness was good in most basins, except for the Shoalhaven, where it was moderate and the Snowy where it was very poor. Expectedness ranged from poor in the Clyde, Genoa and Tuross, to very poor in the Bega, Moruya, Snowy Towamba and Wollongong Coast to extremely poor in the Shoalhaven basin.

Data confidence	Commentary
Low to high	All data was collected within the three year period between 1 January 2006 and 31 December 2008. Data confidence varied from high in the coastal plain, lowlands and slopes zones - where there was limited spatial variability across sites within the zone - to medium in the uplands zone, where there was moderate inter-site variability within the zone, to low in the highlands zone, where there was substantial inter-site variability. Data confidence in the overall regional scale fish community rating was medium, given the moderate inter-site variability across sites throughout the region.



Prepared by the Spatial Services Unit, March 2009, DWE Queanbeyan.

Figure 4 Fish condition across the Southern Rivers region

Hydrology

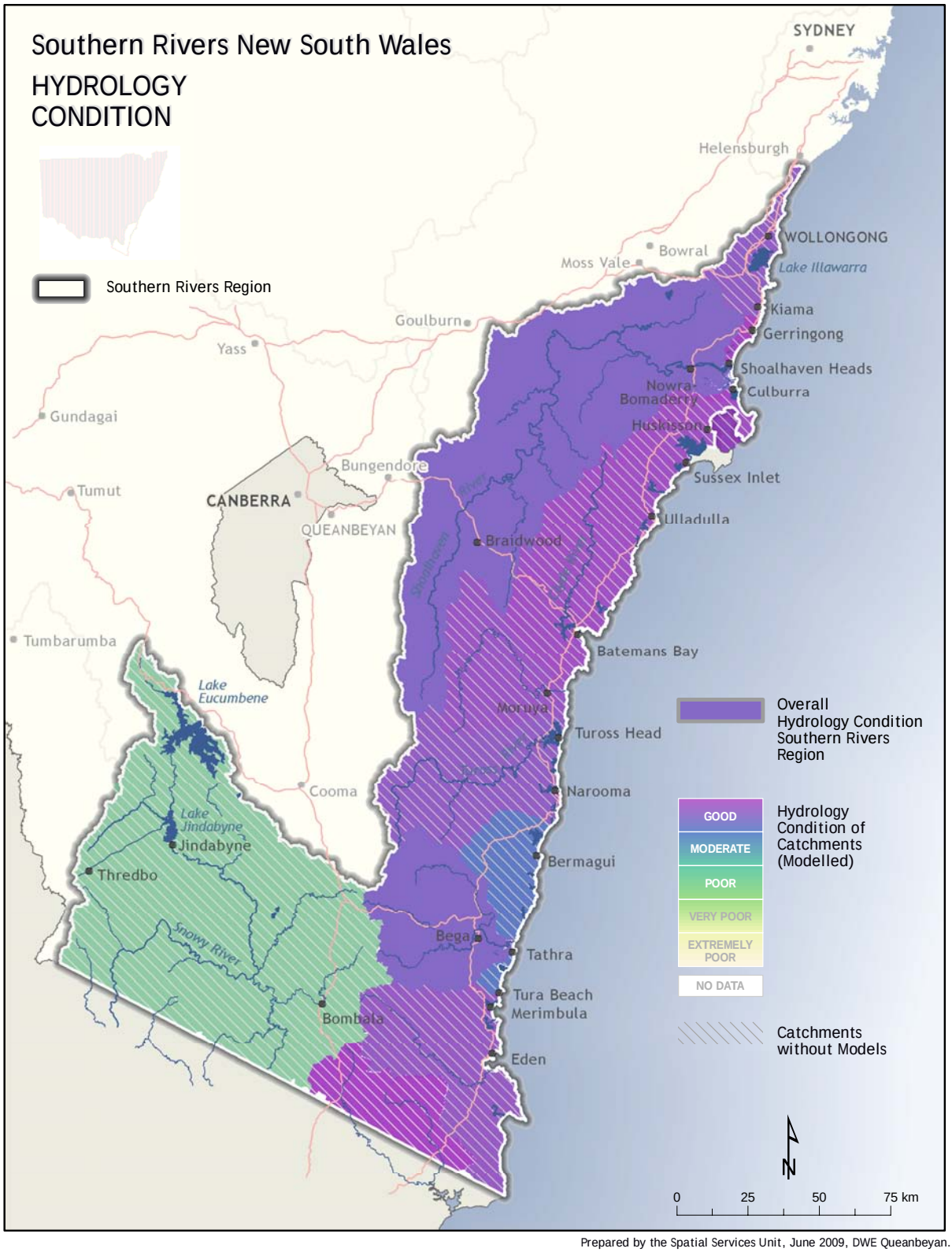
Hydrologic condition (Figure 5) in catchments with hydrology models (Bega River system) measures the ecologically significant aspects of the flow regime including volume, variability, extreme flow events and seasonality. Changes to flow regimes have significant potential to influence riverine ecosystems.

Hydrologic condition for the other coastal streams measures the degree to which annual flows in a dry year can be impacted on by extraction. Extraction is calculated by comparing annual water entitlement to annual flow in a low flow year (ie driest 10 per cent in years). In these streams, where instream impoundments are generally small, this indicator of hydrologic condition also reflects the extraction pressure on low flows. Increases in the frequency and duration of low flow periods have significant potential to influence riverine ecosystems.

The Bega River system, which has a hydrology model, is rated as having a good general hydrology condition in all altitude zones. The low and zero flow indicator (one of five indicators used in the general hydrology classification) showed the most impact on stream flow, with a few locations close to a moderate classification. The seasonality indicator (another of five indicators used in the general hydrology classification) showed the impacts of river regulation in the Brogo River with a couple of locations rated moderate. The general classification was also reflected in the river systems without hydrology models, with most of the area classified as good. The exception was the Snowy River where the hydropower scheme had a significant impact on the hydrology, attracting a poor overall hydrology condition classification.

Hydrology condition

Data confidence	Commentary
Modelled altitude zone condition – medium	Condition data derived from calibrated hydrologic models and indicators calculated by the same method as used in the Sustainable Rivers Audit.
Un-modelled catchment condition – low	Condition data for many of the smaller streams included estimates of annual flows for ungauged catchments.
Overall region condition – low	Overall condition is a combination of both modelled and un- modelled methods of assessing hydrologic condition hence includes estimates of annual flows for ungauged catchments.



Prepared by the Spatial Services Unit, June 2009, DWE Queanbeyan.

Figure 5 Hydrologic condition across the Southern Rivers region

Note: The Shoalhaven catchment is highlighted as 'no data'. This catchment may have modelling outcomes provided in 2009.

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
Wollongong Coast	Coastal Plain	77
	Lowlands	100
	Slopes/Uplands/Highlands	100
Shoalhaven	Coastal Plain	100
	Lowlands	100
	Slopes	100
	Uplands	44
	Highlands	17
Clyde	Coastal Plain	100
	Lowlands	100
	Slopes	100
	Uplands/Highlands	No data
Moruya	Coastal Plain	100
	Lowlands	100
	Slopes	100
	Uplands/Highlands	100

Tuross	Coastal Plain	98
	Lowlands	100
	Slopes	100
	Uplands	100
	Highlands	0
Bega	Coastal Plain	100
	Lowlands	100
	Slopes	100
	Uplands/Highlands	0
Towamba	Coastal Plain	100
	Lowlands	100
	Slopes	100
	Uplands/Highlands	No data
East Gippsland	Coastal Plain/Lowlands	100
	Slopes	No Data
	Uplands/Highlands	99
Snowy	Slopes	80
	Uplands	100
	Highlands	42

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
Fitzroy Falls	Medium	Not available	Yarrunga Creek
Tallowa	Medium	30 km	Shoalhaven
Eucumbene	Medium	Not available	Eucumbene
Jindabyne	Medium	Not available	Snowy
Cochrane	Medium	Not available	Georges Creek

Fitzroy Falls Dam has a limited potential to thermally stratify, due to a mean depth of 4.7 m, and therefore has a smaller CWP effect than other dams in this category (Preece 2004).

Tallowa Dam on the Shoalhaven River provides water for the Shoalhaven area and also to Sydney during droughts. The placement of Tallowa Dam within the catchment results in CWP being treated as a serious local issue, although the temperature downstream appears to be restored 30 km downstream (Preece 2004). Works have been undertaken to reduce CWP impacts.

Eucumbene and Jindabyne dams are located within the Snowy Mountains Scheme. Jindabyne Dam on the Snowy River has only small releases (Preece 2004), with a surface level outlet constructed in 2006, to minimise CWP. Eucumbene Dam on the Eucumbene River is the central storage for the Snowy Mountains Scheme, receiving the headwaters of five rivers; however, minimum releases results in insignificant CWP impact (Preece 2004).

At Jindabyne and Tallowa dams, works are being undertaken that are likely to significantly reduce CWP impacts.

Cochrane Dam has a short retention time due to hydropower operations and therefore has a smaller CWP effect than others in this category (Preece 2004).

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 in order to breed or 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 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	Mongarlowe Gauging Station	Mongarlowe River	4
2	Mullet Creek Weir	Mullet Creek	10
3a	Kangaroo River Gauging Station	Kangaroo River	40
3b	Delegate River Town Water Supply Weir	Delegate River	100
5a	Croobyar Weir No. 6	Croobyar Creek	8
5b	Braidwood Town Water Supply	Shoalhaven River	200

All weirs remain priority sites. Dalgety Weir has been removed from the list as it is a maintenance issue only.

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 Southern Rivers CAP can be found at: www.southern.cma.nsw.gov.au/news_publications-plans_strategies.php.

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 aim to make improvements in the management of NSW's water resources by providing flow patterns that are more beneficial for the river environment, particularly during low flow periods.

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 at the state level are:

- completing 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 Living Murray, and in the longer term in cooperation with the Australian Government through the Water for the Future initiative
- adjusting the 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:

- the Drinking Water Catchments Regional Environmental Plan No 1 (2006) aims to achieve water quality management goals while encouraging improved land-use practices for sustainable development, land managers and decision makers
- the Department of Planning is working with relevant government agencies and organisations to progress natural resource model clauses, including stormwater, for inclusion in the standard local environmental plan (LEP) instrument and to provide guidance on how local councils may incorporate these provisions into their new LEPs
- progressing strategies to maintain valued ecological processes such as the Cold Water Pollution Mitigation Strategy, protecting riparian zones in urban areas and implementing the NSW Wetlands Policy
- maintaining water quality that is 'fit-for-purpose' through the NSW Diffuse Source Water Pollution Strategy, managing stormwater and regulating point source pollution
- effectively implementing the monitoring, evaluation and reporting strategy
- providing a framework for councils to develop stormwater management objectives
- providing decision support tools and information to land managers
- developing regional water quality guidelines
- undertaking ongoing water quality monitoring at strategic locations to assess the long-term trends and changes in condition.

Fish

Instream habitat improvements are being achieved through the removal or modification of priority instream barriers to fish passage and installation of engineered log jams to create habitat heterogeneity.

Regional level

At the regional level, the Southern Rivers CMA is currently refining the priorities of rivers and water bodies in natural resource action plans for each of the six sub-regions of the Southern Rivers catchment.

Multiple condition/pressure actions

- Rehabilitation programs on the lower and upper Shoalhaven, Clyde, Tuross, Bega, Bombala and Snowy rivers are being implemented. Major creeks in the Illawarra region have also been targeted
- Rehabilitation programs are being implemented in several small priority coastal catchments, including along the Murrah, Wapengo and Towamba rivers to address priority degradation issues affecting these rivers and their estuaries.
- The Snowy River program has controlled willow along the 186 km length of the NSW section of the river; and 70 km of blackberries; and reintroduced 200,000 Australian bass.
- The riparian program across the Southern Rivers region has resulted in 112 km of stream bank being stabilised, 115 structures being built, 442 off-stream watering sites being installed and 141 stream bed stabilisation structures being built. The objective of these works was to reduce sedimentation, improve fish habitat and reduce nutrient input to the waterways.

- A riparian vegetation mapping project has been completed for the northern half of the Southern Rivers CMA region. This map shows which subcatchment areas are the most degraded and which have the most vegetation, to allow Southern Rivers CMA to prioritise where works need to occur.

Fish

- Southern Rivers CMA is contract managing the 'Bring Back the Fish' project. Through this project, high priority instream barriers in each coastal region will be targeted for modification to provide fish passage. Rehabilitation of key aquatic habitats will also be undertaken in each region.

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].

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