Bellinger-Kalang Rivers Ecohealth Project

Assessment of River and Estuarine Condition

2011 Report Card

Technical Report for Report Card Preparation, Indicators and Calculation of Grades

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Background to Ecohealth

Rivers, estuaries and coastal lagoon systems are focal points for the cumulative impacts of changed catchment land-use, and increasing urbanisation and development in coastal zones. As a result, these ecosystems have become sensitive to nutrient enrichment and pollution, and degraded through habitat destruction and changes in biodiversity. The development of a standardised means of collecting, analysing and presenting riverine, coastal and estuarine assessments of ecological condition has been identified as a key need for coastal Catchment Management Authorities and Local Councils who are required to monitor natural resource condition, and water quality and quantity in these systems.

The Ecohealth Waterways Monitoring Program outlines a framework for the development of a catchment-based aquatic health monitoring program for rivers and estuaries in the Northern Rivers CMA with the aim of providing consistency in monitoring and reporting, and establish the partnerships required for local and regional dissemination of outcomes. This project brings together major stakeholders in the coastal management of Northern NSW; State agencies (NRCMA, OEH, DPI Fisheries), Local Council (Bellingen) and University Researchers (UNE) to develop, refine, report and promote a standardised estuarine health assessment tool for the Bellinger/Kalang system.

This document outlines the Ecohealth monitoring design, indicators and scorecard calculations for the Bellinger and Kalang (river and estuary) sites. Ecohealth looks at several key indicators of aquatic ecosystem health in our waterways, including water quality, river bank (riparian) vegetation, fish (distribution and population sizes), and waterbugs (macroinvertebrates).

Bellinger and Kalang Rivers Ecohealth Program Design

The design of the Ecohealth monitoring program is based on the NSW Monitoring, Evaluation, Reporting (MER) protocols for Rivers and Estuaries, and aligned with previous ecosystem health assessments undertaken within the local region, such as the Bellinger River Health Plan 2010.

The design process used literature review and stakeholder consultation to identify the spatial and temporal scale of the Ecohealth program in the Bellinger catchment, and document the specific research and management questions to be addressed by the program. The location and number of representative sampling reaches required to adequately address the questions will be system specific, but need to address the criteria below. These locations in conjunction with remotely sensed images were applied to the criteria below to refine the sample design and specific location of sites with project constraints (time, budget, personnel). Constraints on study design from available budgets limited the project to 22 sample locations and monthly sampling for water quality.

The location of the 10 freshwater monitoring sites (5 sites on each river) was based on selection criteria to:

- identify longitudinal change within the main stem of each river system,
- represent major tributaries of each river system or were identified by stakeholders as tributaries of interest for management;
- compare River Styles and elevations within and across catchments,
- locate ecological changes at the point of the tidal limit.

The location of the 12 estuarine monitoring sites (5 on the Bellinger River and 7 on the Kalang River) was based on selection criteria to:

- identify longitudinal change within the main stem of each river system,
- represent paired sites within salinity categories of; 0-15ppt, 15-30ppt and 30+ppt;
- compare River Styles and elevations within and across catchments,
- locate ecological changes at the point of the tidal limit.

Ecohealth Indicators

The indicators chosen focus on the condition of the system to best identify the stressors and pressures that cause change in ecological condition. The selection of indicators (and groupings of indicators) represents elements of the structure, function and composition of riverine and estuarine ecosystems.

Ecohealth Reporting and Calculations of Scores

The calculation of standardized scores for the Ecohealth program involves the use of 'trigger values' or thresholds were when exceeded an impact on the health of the system may occur. The thresholds used in the 2011 Bellinger-Kalang Report Card are listed below in the table of indicators.

Water quality variables were assigned a score based on how many times in a year the variable exceeded 0.5 or 1.5 times the trigger value. This was necessary as many of the trigger values have upper and lower limits. Scores were standardized to a maximum score of 1 (100%).

Macroinvertebrates required the development of a 'guideline value' to represent the best possible number of taxa, SIGNAL and EPT score, and a 'worst case scenario' score for these variables. Scores were calculated as 1-(actual value-guideline value/worst case scenario) Scores were standardized to a maximum score of 1 (100%).

Riparian scores in freshwater reaches comprised 24 environmental indicators, used to measure four sub-indices (Habitat, Vegetation, Bank condition and Disturbances) which, when combined, are used to calculate to an overall index of riparian condition. Scores were standardized to a maximum score of 1 (100%). Riparian scores for estuary reaches were derived from Telfer & Cohen 2010 and standardized to a maximum score of 1 (100%).

Fish scores were determined by an average of a Nativeness Index (proportion of native to introduced species), and expectedness index (predicted fish occurrence in undisturbed site versus what was caught). Scores were standardized to a maximum score of 1 (100%).

Variable	What is it?	Why do we measure it?	How was it measured?	Trigger values
pH	pH is a measure of the acidity of the water. The pH scale ranges from 1 (highly acidic to 14 (highly alkaline). A pH of 7 is neutral.	Changes in pH can indicate acid soils, and can impact aquatic animals such as fish.	A handheld Hydrolab Quanta multi-probe lowered into the water, and measurements taken every 1m depth. Units: pH	Freshwater: 6.5-8 Estuary: 7-8.5
Electrical Conductivity	EC is a measure of the ability of the water to conduct an electric charge, and is used as a measure of salinity.	High salinity can affect all plants and animals living in rivers and estuaries, and may indicate the presence of pollutants.	A handheld Hydrolab Quanta multi-probe lowered into the water, and measurements taken every 1m depth. Units: mS/cm	Freshwater: 0.125 – 2.2 mS/cm Estuary: n/a
Temperature	Ambient water temperature measured.	Water temperature is important to regulate the metabolism, mobility, and reproduction of all plants and animals in rivers and estuaries.	A handheld Hydrolab Quanta multi-probe lowered into the water, and measurements taken every 1m depth. Units: °C	Freshwater and Estuary: 15-35°C
Dissolved Oxygen	DO is a measure of the availability of oxygen to aquatic life.	The amount of oxygen in the water regulates the distribution, activity, movement, and behavior of all aquatic animals.	A handheld Hydrolab Quanta multi-probe lowered into the water, and measurements taken every 1m depth. Units: %	Freshwater and Estuary: 80-120%
Turbidity	Turbidity is the measure of light scattering by suspended particles in the water column, and provides an indication of light penetration depth.	Increases turbidity can lead to low light to prevent plant growth, smothering of habitats such as seagrass, irritation of fish gills, and transport of nutrients.	A handheld Hydrolab Quanta multi-probe lowered into the water, and measurements taken every 1m depth. Units: NTU	Freshwater: <50NTU Estuary: <10NTU
Nitrogen and Phosphorus	Nitrogen and Phosphorus are present in water in both dissolved (available to biota) or particulate (bound up in silt, organic matter and living plants and animals).	Nitrogen and Phosphorus are naturally occurring nutrients that originate from plant and animal matter. Excess nutrients from run-off can cause algal blooms.	Dissolved nutrients were collected from the surface water at each site, and filtered and stored/frozen in 125mL vials. Particulate samples were collected from the surface water at each site and remained unfiltered and stored/frozen in 125mL vials. Units: µg/L	TN - 500 µg/L, TP - 50 µg/L Dissolved N - 40 µg/L, Dissolved P - 20 µg/L TN - 300 µg/L, TP - 30 µg/L Dissolved N - 15 µg/L, Dissolved P - 5 µg/L
Chlorophyll a	Water column chlorophyll *a* is a measure of the biomass of algae/phytoplankton in the water.	Algae are largely influenced by temperature, light and nutrients, and provide a measure of the biological effect of these influences.	One liter water samples are collected on site, and filtered. Filter papers containing algal cells are analysed for chlorophyll concentration. Units: µg/L	Freshwater: <5 µg/L Estuary: <3.3 µg/L

Variable	What is it?	Why do we measure it?	How was it measured?	Trigger values
Macroinvertebrates	Aquatic macroinvertebrates are animals without backbones that live in freshwater and are large enough to see with the naked eye, such as worms, snails, beetles and shrimps.	Macroinvertebrates are one of the most commonly used biological indicators as they are widely distributed and easily samples. They are sensitive to pollution and changes in water quality and habitat, providing us with valuable information on the health of aquatic ecosystems.	Sweep net samples were taken from pool, riffle and edge habitats (where available) at all sites in Autumn and Spring. Water bugs are not assessed in Estuaries.	Regional trigger values were developed from literature and past studies for taxa richness (number of species), SIGNAL Score (pollution tolerance index), EPT taxa (number of mayflies, stoneflies and caddisflies.
Riparian Condition	Riparian vegetation are the plant communities along rivers and estuaries where the land and water meet, often referred to as streambank vegetation..	Healthy riparian (stream bank) and estuarine vegetation is important for maintaining good water quality and habitat for waterbugs and fish, as well as reducing erosion along streambanks. By monitoring vegetation communities for the spread of weeds and growth of native trees and the condition of streambanks for erosion over the long-term, we are gaining a better understanding of their condition and impact on water quality, macroinvertebrate and fish communities..	The Ecohealth program assessed riparian vegetation for Vegetation Condition(weeds, native, number of strata), Bank Condition (bank slope, undercutting, slumping), Habitat Condition (number of large and/or fallen trees, logs) and Disturbances (fencing, clearing, stock)	Regional trigger values were developed for each component of the Riparian Assessment from literature and a study in 2010.
Fish	Number of native and introduced fish .	Fish are an important component of the biodiversity of aquatic ecosystems, as fish communities reflect longterm changes in catchment land-use. Fish communities provide an integrated measure of river condition as they are highly mobile, long-lived and high in aquatic food webs.	Fish communities were measured at 18 sites in the Ballinger and Kalang Rivers by NSW DPI Fisheries using electro-fishing and trapping techniques.	Nativeness Index (proportion of native to introduced species), and expectedness index (predicted fish occurrence in undisturbed site versus what was caught).

Ecohealth Grading

The results of the sampling program were analysed to provide a description of the condition of water quality, waterbugs, fish and riparian areas, as well as the overall condition of each site, river and the entire catchment.

Condition scores were then calculated from whether, and how often the measured values exceeded environmental guidelines.

The condition scores were grouped in ranges and given a corresponding grade (see table). This scoring and grading system is based on the traditional format of a school report, with primary ratings ranging from a high of 'A', through intermediate ratings of 'B', 'C' and 'D', to the lowest possible score of an E. Secondary grades of + and – are included to provide greater resolution within a grade, and to better help show improvements over time.

Score	Grade	Condition
95/100	A	Excellent
85/100	B	Good
70/100	C	Fair
55/100	D	Poor
<45/100	E	Very Poor

The following table provides scores out of 1 and a corresponding grade from A to E for each site, as an average for freshwater and estuary reaches in each catchment, and overall scores for each catchment that combine scores from all sites..

	Water Quality		Riparian		Macroinvertebrates		Overall Site Score	Overall Site Grade
Site	**Avg Grade**	**Score**	**Avg Grade**	**Score**	**Avg Grade**	**Score**		
BR1	0.91	A-	0.75	B-	0.83	B	0.83	B
BR2	0.93	A-	0.74	C	0.82	B	0.83	B
RW1	0.92	A-	0.71	C	0.58	D	0.74	C+
BR3	0.92	A-	0.71	C	0.82	B	0.82	B+
NN1	0.96	A	0.68	C-	0.61	C-	0.75	C+
Freshwater Avg	**0.93**	**A-**	**0.72**	**C+**	**0.73**	**C+**	**0.79**	**B-**
BR4	0.81	B	0.65	C			0.73	C+
BR5	0.76	B-	0.65	C			0.70	C+
BR6	0.71	C	0.75	C+			0.73	C+
BR7	0.70	C	0.75	C+			0.73	C+
BR8	0.76	B-	0.75	C+			0.75	B-
Estuarine Avg	**0.75**	**B-**	**0.71**	**C+**			**0.73**	**C+**
KR1	0.90	A-	0.75	B-	0.70	C	0.78	B-
KR2	0.90	A-	0.6	D+	0.70	C+	0.73	C+
KR3	0.90	A-	0.4	E	0.70	C+	0.67	C
SC1	0.70	C+	0.42	E	0.38	E	0.50	D-
KR4	0.85	B+	0.48	D-	0.70	C+	0.67	C+
Freshwater Avg	**0.85**	**B+**	**0.53**	**D**	**0.63**	**C-**	**0.67**	**C+**
KR5	0.60	C-	0.73	C+			0.67	C
KR6	0.65	C-	0.84	B			0.74	C+
KR7	0.71	C+	0.72	C+			0.71	C+
KR8	0.70	C+	0.72	C+			0.71	C+
KR9	0.69	C	0.72	C+			0.70	C+
KR10	0.71	C+	0.72	C+			0.71	C+
KR11	0.80	B	0.72	C+			0.76	B
Estuarine Avg	**0.69**	**C**	**0.74**	**C+**			**0.72**	**C+**
Overall Freshwater - Bellinger and Kalang								
	0.89	B+	0.62	C-	0.68	C	0.73	C+
Overall Estuarine - Bellinger and Kalang								
	0.72	C+	0.73	C+			0.72	
Bellinger River	**0.84**	**B**	**0.71**	**C+**	**0.73**	**C+**	**0.76**	**B-**
Kalang River	**0.77**	**B-**	**0.64**	**C**	**0.63**	**C-**	**0.71**	**C+**