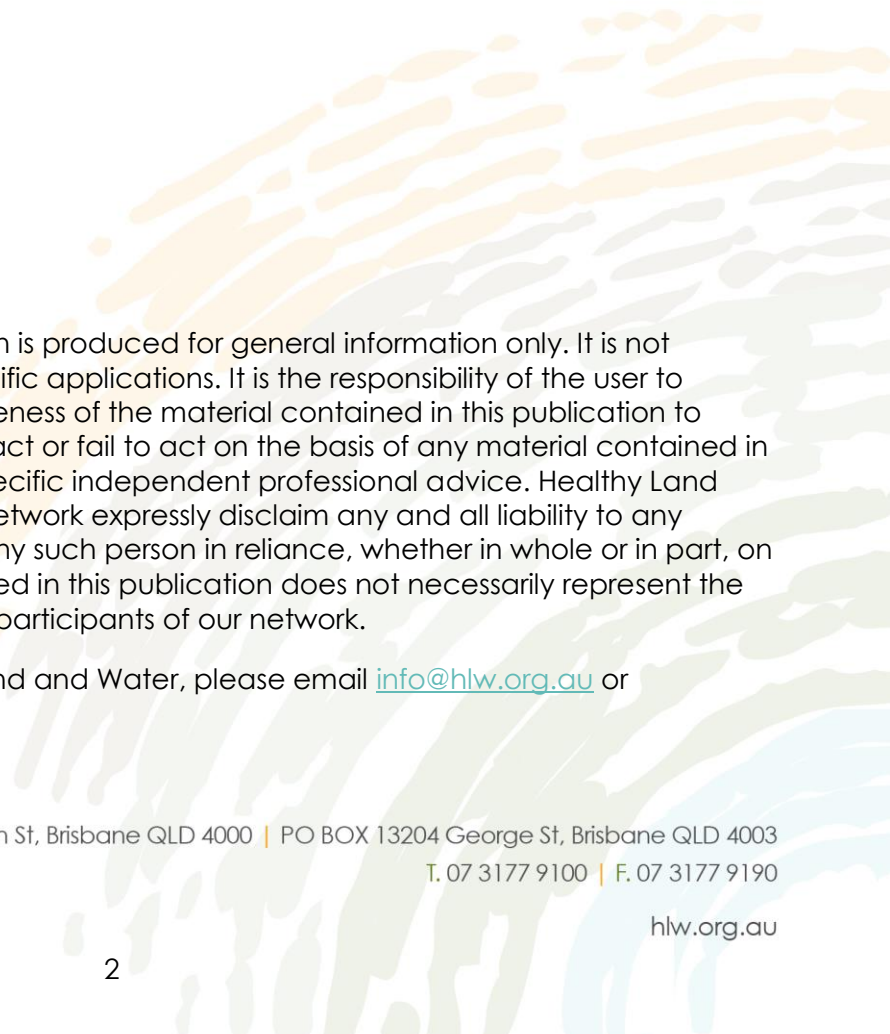




Report Card 2017

Methods Summary



The material contained in this publication is produced for general information only. It is not intended as professional advice on specific applications. It is the responsibility of the user to determine the suitability and appropriateness of the material contained in this publication to specific applications. No person should act or fail to act on the basis of any material contained in this publication without first obtaining specific independent professional advice. Healthy Land and Water and the participants of our network expressly disclaim any and all liability to any person in respect of anything done by any such person in reliance, whether in whole or in part, on this publication. The information contained in this publication does not necessarily represent the views of Healthy Land and Water or the participants of our network.

For further information about Healthy Land and Water, please email info@hlw.org.au or telephone (07) 3177 9100.

Level 19, 160 Ann St, Brisbane QLD 4000 | PO BOX 13204 George St, Brisbane QLD 4003
T. 07 3177 9100 | F. 07 3177 9190

hlw.org.au

Table Contents

Background.....	4
Summary	5
Environmental Condition Grade (A-F)	7
Calculating grades for catchments	8
Calculating grades for bay zones.....	16
Waterways Benefits Rating (1-5 stars)	20
Calculating Waterways Benefit Ratings for catchments	21
Actions	24
References	25

Background

For the past 15 years (commenced in 2000) the Ecosystem Health Monitoring Program (EHMP) has assessed the ecological condition of waterways in southeast Queensland (SEQ) and the results have been used annually to produce a Report Card. Since its inception, the EHMP has been recognised as a world-class environmental monitoring and reporting program.

In 2015, the monitoring program was revised to keep up with major advances in water quality automated monitoring and predictive modelling; and to create a program that reports not only environmental condition, but also the pressures affecting condition, the management responses to address those pressures and the social/economic benefits that the community receives from their catchments (Smith, 2014).

The monitoring program and report was designed to closely align with the aims and objectives that our members have for SEQ waterways in order for it to have maximum impact with a broad audience (e.g. government, community groups, industry and the general public). This ensures that the monitoring results that are published in the Report Card, and the management activities that are subsequently applied, are fully linked to the aspects of waterways that member's value and are committed to protecting or restoring.

The purpose of this document is to briefly describe how the report card grades are calculated (as of 2015) using a combination of 30 indicators of environmental condition and waterways benefits. It includes a brief description of each of the indicators used and the associated data sources.

More information can be found at hlw.org.au/reportcard and hlw.org.au/report-card/monitoring-program or contact info@hlw.org.au

Summary

Healthy Land and Water synthesises data annually from our monitoring program to produce the Report Card (Figure 1), which provides an easy to understand assessment of the health of our catchments and waterways, and highlights any issues that require intervention.

The Report Card is designed around three key elements:

1. **Environmental Condition Grade (A-F):** This grades 18 catchments and 5 regions of the bay, using 25 indicators that are combined into a single overarching index of environmental condition.
2. **Waterways Benefits Rating (1-5 stars):** This rates 18 catchments, using 6 indicators that are combined into a single overarching index of social and economic benefits that the wider community receive from with their waterways.
3. **Actions (recommendations):** This describes the barriers and drivers for individuals and groups helping to protect and improve waterways; also how and where management actions should be applied, and their impact on waterway health.

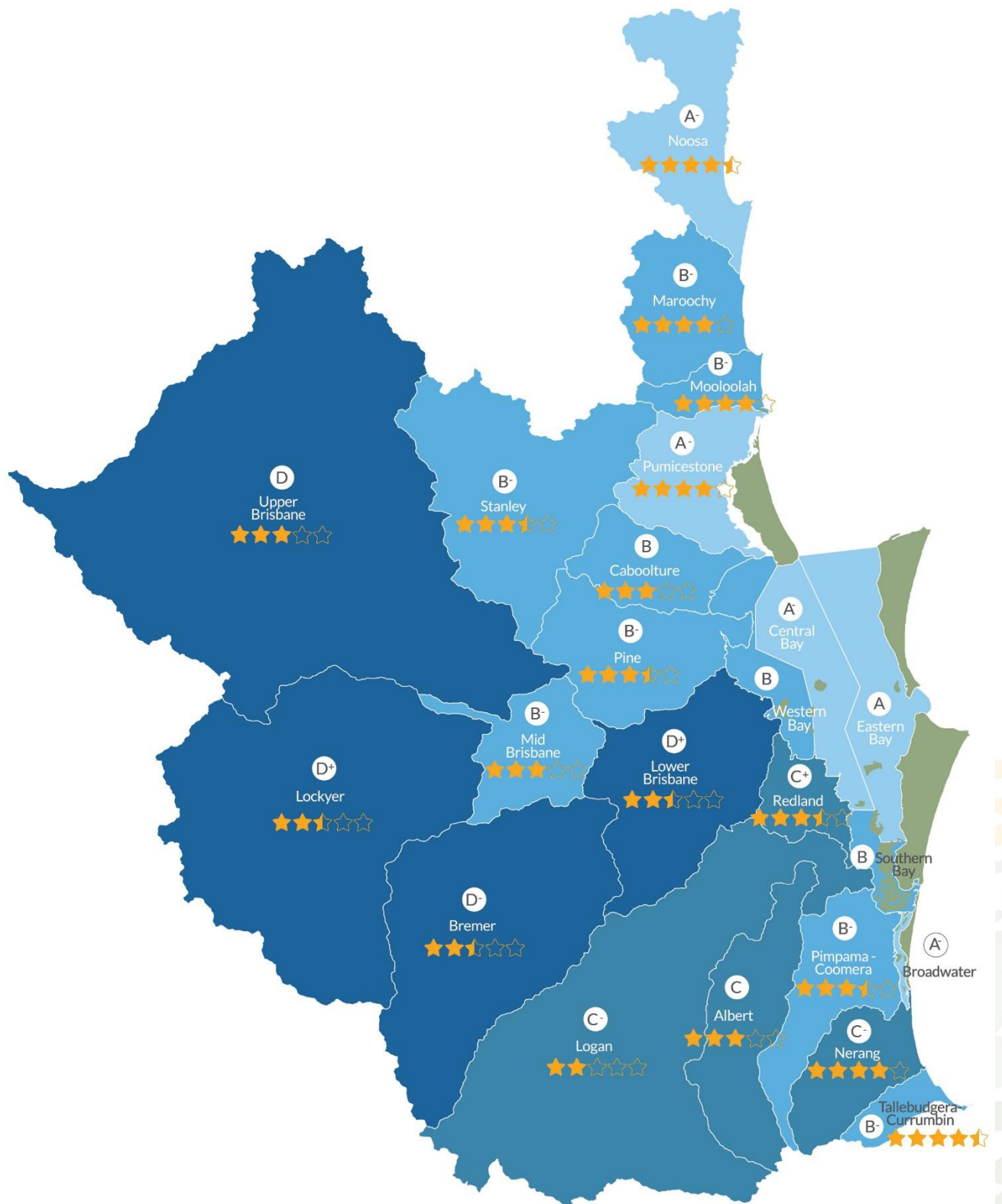


Figure 1 Report Card 2017

Level 19, 160 Ann St, Brisbane QLD 4000 | PO BOX 13204 George St, Brisbane QLD 4003
 T. 07 3177 9100 | F. 07 3177 9190

hlw.org.au

Environmental Condition Grade (A-F)

The Environmental Condition Grade is calculated from 25 indicators, assessing key freshwater and estuarine aspects of the waterways. Indicators are assessed against established guidelines and benchmarks, resulting in a single grade for each catchment or bay zone.

It assesses progress towards the five key objectives that our members have for SEQ waterways:

- restoring and maintaining key habitats (i.e. riparian vegetation) (NEW in 2015)
- reducing pollutant loads (sediment and nutrients) entering waterways (NEW in 2015)
- improving and maintaining water quality
- restoring and maintaining key ecosystem processes
- restoring and maintaining resilient and healthy aquatic communities (i.e. fish populations).

The Grades

(A) Excellent: Conditions meet all guidelines. All key processes are functional and critical habitats are in near pristine condition.

(B) Good: Conditions meet guidelines for most of the reporting area. Most key processes are slightly impacted and most critical habitats are intact.

(C) Fair: Conditions are close to meeting guidelines in most of the reporting area. Key processes are impacted but still functional and critical habitats are impacted.

(D) Poor: Conditions meet few of the guidelines in most of the reporting area. Many key processes are not functional and most critical habitats are impacted.

(F) Fail: Conditions do not meet the set guidelines. Most key processes are not functional and most critical habitats are severely impacted.

The reporting zones (see hlw.org.au/reportcard or Figure 1 for map)

Catchment grades are calculated for:

- Noosa
- Maroochy
- Mooloolah
- Pumicestone Passage
- Caboolture
- Pine Rivers
- Lower Brisbane
- Redlands
- Logan
- Albert
- Pimpama-Coomera
- Nerang Tallebudgera-Currumbin
- Stanley
- Upper Brisbane
- Mid Brisbane
- Lockyer
- Bremer

Bay zone grades are calculated for:

- Western Bay
- Eastern Bay
- Central Bay
- Southern Bay
- Broadwater

Calculating grades for catchments

The overall Environmental Condition Grade for each of the 18 reporting catchments is calculated using 22 indicators (Figure 2). For coastal catchments, the overall score is made up of: 20% indicators of freshwater communities & process, 20% indicators of estuarine water quality, 40% indicators of habitat, and 20% indicators of pollutant load. For the western catchments, the overall score is made up of: 40% indicators of freshwater communities & processes, 40% indicators of habitat, and 20% indicators of pollutant load. A score for each indicator is calculated using data from a combination of sources, including environmental modelling, monitoring and remote sensing. The following section describes the four components that make up the catchment grades, and how scores for underlying indicators are calculated:

1. FRESHWATER COMMUNITIES & PROCESSES (20%)
2. ESTUARINE WATER QUALITY (20%)
3. HABITAT (40%)
4. POLLUTANT LOAD (20%)

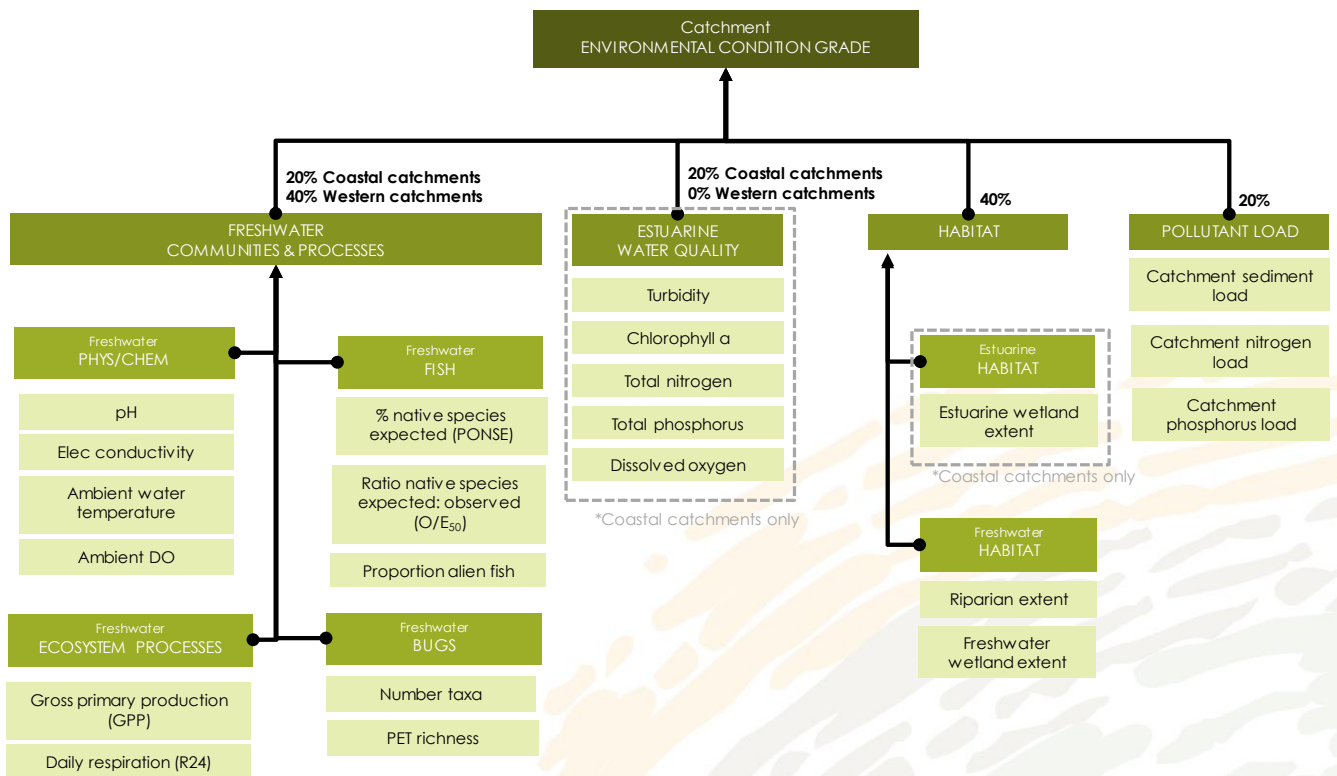


Figure 2 Diagram showing the 22 indicators (lightest green) that are combined into a single overarching environmental condition grade for the catchment reporting zones. Note that indicators for coastal catchments and western catchments are weighted differently.

Freshwater Communities & Processes (20%)

The condition of freshwater streams is reflected by the instream communities and ecosystem processes:

- Fish communities reflect a range of environmental disturbances and provide a measure of stream condition due to their mobility, long life and position near the top of the food chain;
- Aquatic bug communities (insects, crustaceans, snails, etc) are very sensitive to disturbance;
- Ecosystem process measures reflect the vigour or 'pulse' of a stream; and
- Physical and chemical conditions reflect stream water quality.

INDICES/INDICATORS

There are 11 indicators of Freshwater Communities & Processes, that wrap-up into 4 indices:

1. Fish

- i.** % native species expected (PONSE)
- ii.** Ratio native species expected:observed (O/E50)
- iii.** Proportion alien fish

2. Bugs

- iv.** Number of taxa
- v.** PET richness

3. Ecosystem processes

- vi.** Gross primary production (GPP)
- vii.** Daily respiration (R24)

4. Physical & chemical

- viii.** pH
- ix.** Electrical conductivity
- x.** Ambient water temperature
- xi.** Ambient dissolved oxygen

DATA COLLECTION & SCORING

A Stream Health Model is used to estimate the score for each index (i.e. fish, bugs, ecosystem processes, and physical & chemical) at 129 representative sites across South East Queensland (Figure 3). The model is validated with field data collected once per year at 75 freshwater sites through the ecosystem health monitoring program. The full 129 sites are sampled on a 3-year rotation (i.e. 48 sites are sampled every year, while 81 sites are sampled every 3 years on rotation). Scores are standardised to guideline values (Table 1).

Table 1 Freshwater indicator guideline values used to standardise scores.

Index	Indicator	Upland		Lowland or coastal		Tannin-stained		Operand	Unit	
		Guideline	WCS	Guideline	WCS	Guideline	WCS			
PhysChem										
	pH (min)	6.5	4.5	6.5	4.5	5	3	≥	[H ⁺]	
	pH (max)	8.5	10.5	8.5	10.5	8.5	10.5	≤	[H ⁺]	
	Conductivity	400	1041	400	1870	400	1870	≤	μS cm ⁻¹	
	Temp (max)	18	NA	22	NA	22	NA	≤	°C	
	Temp (range)	4	NA	4	NA	4	NA	≤	°C	
	DO (min)	30	NA	20	NA	20	NA	≥	% saturation	
	DO (range)	30	NA	50	NA	50	NA	≤	% saturation	
Ecosystem Processes										
	GPP	0.25	0.8	0.5	1.3	0.5	1.3	≤	g C m ⁻² day ⁻¹	
	R24	0.15	0.7	0.35	1.2	0.35	1.2	≤	g C m ⁻² day ⁻¹	
Fish										
	PONSE	100	0	100	0	100	0	≥	%	
	Ratio = O/E	1	0	1	0	1	0	≥	Ratio (number)	
	Prop. Alien Fish	0	100	0	100	0	100	=	%	
Bugs										
	Number Taxa	22	0	22	0	11	0	≥	Number	
	PET Richness	5	0	4	0	3	0	≥	Number	

Estuarine Water Quality (20%)

Water quality in estuaries refers to the physical and chemical properties of the water. Variation in water quality influences the types of organisms that will live and grow in an estuary.

INDICES/INDICATOR

There are five estuarine water quality indicators:

1. Turbidity
2. Chlorophyll a
3. Total nitrogen
4. Total phosphorus
5. Dissolved oxygen

INDICATOR DATA COLLECTION & SCORING

Estuarine and bay water quality models (using TUFLOW FV) are used to predict annual water quality medians throughout each of the estuarine and bay reporting zones. The models are validated using field data collected monthly at 182 sites (once per month for 8 months per year - February, March, May, August, September, October, November, December) through the Monitoring Program (Figure 4). Then the models predict water quality medians for each indicator which are used to calculate a standardised score. This is done by applying an area weighted 'distance from guideline' approach using the Queensland Water Quality Guidelines.

Table 2 Queensland Water Quality guideline and WCS (worst case scenario) for all water types in South-East Queensland for five parameters monitored in the program (turbidity (NTU), dissolved oxygen (%sat), total N (mg/L), total P (mg/L), chlorophyll a (ug/L)) (Water type maps and additional information can be found on the Queensland Government website (<https://www.ehp.qld.gov.au/water/policy/seq-moretonbay.html>))

WATER TYPE		Guideline	WCS (0.9)	Guideline	WCS (0.9)	Guideline	WCS (0.9)	Guideline	WCS (0.9)	Guideline	WCS (0.9)
		Turbidity		Diss Ox		Total N		Total P		Chl-a	
SEQ estuaries (exc. Noosa)	Enclosed coastal	6	13	90	82.1	0.2	0.5	0.02	0.1	2	5.4
	Mid estuary	8	82	85	57.8	0.3	1.3	0.025	0.5	4	12.1
	Upper estuary	25	89	80	54.1	0.45	1.5	0.03	0.5	8	18.3
Noosa River estuary	Enclosed coastal	4	5	90	90.9	0.24	0.29	0.015	0.018	1.8	2
	Mid estuary	8	24	85	87.5	0.38	0.51	0.016	0.02	2.5	2.9
	Upper estuary	22	56	85	84.4	0.75	0.77	0.02	0.025	5	5.3
SEQ bays	Pum Pass Outer	6	13	90	88	0.22	0.35	0.025	0.03	2.6	4.8
	Pum Pass Central	10	20	95	82	0.33	0.48	0.023	0.03	4	6
	Western Bays	6	16	95	92	0.2	0.32	0.03	0.08	1.6	6.5
	Central Bay	5	7	95	94	0.16	0.21	0.02	0.033	1	3
	Eastern Bay	1	5	95	95	0.16	0.18	0.016	0.02	1	2
	Southern Moreton Bay	7	25	95	90.9	0.2	0.32	0.024	0.055	2	5
	Broadwater	6	12	90	90	0.19	0.28	0.022	0.03	2.5	3.5



Figure 4 Estuarine water quality monitoring sites

T. 07 3177 9100 | F. 07 3177 9190

hlw.org.au

Habitat (40%)

Estuarine and freshwater wetlands, including riparian vegetation, provide a variety of critical functions and services including provision of habitat for aquatic organisms, stabilising the riverbank and sequestration of nutrients like carbon and nitrogen from the environment.

INDICES/INDICATORS

There are three habitat indicators:

1. Freshwater wetland extent (km²)
2. Estuarine wetland extent (km²)
3. Riparian extent (woody veg area (ha)/total stream riparian area (ha))

DATA COLLECTION & SCORING

Wetland extent is calculated every 4 years, with data derived from the Department of Environment and Heritage Wetland Info program (<https://wetlandinfo.ehp.qld.gov.au/wetlands/>).

The extent of riparian vegetation is calculated approximately every 3-4 years by the Department of Science, Information Technology and Innovation (DSITI), using Landsat satellite imagery.

Extent values are standardised to calculate a catchment score.

Pollutant Loads (20%)

Three major pollutants of concern in waterways are sediments, nitrogen and phosphorus.

Excess sediments in waterways reduces light penetration which restricts growth of aquatic plants, smothers benthic organisms and transports contaminants like nutrients and heavy metals.

Excess nutrients (nitrogen and phosphorus) in our waterways stimulates growth of macrophytes and algae (including cyanobacteria) to nuisance proportions, which displace endemic species, diminish light availability to benthic species, and cause excessive fluctuations in pH and dissolved oxygen which can stress and eliminate sensitive species.

INDICES/INDICATORS

There are three pollutant load indicators:

1. Sediment load (kg/year)
2. Nitrogen load (kg/year)
3. Phosphorus load (kg/year)

DATA COLLECTION & SCORING

The Source catchment model is run annually to estimate total annual sediment, nitrogen and phosphorus loads. The model simulates how catchment and climate variables such as rainfall, land use and vegetation, affect water runoff and subsequent pollutant loads (Figure 5).

The model estimates of total load are used to calculate a catchment score. The scores are standardised by scaling to the range of possible values across the region.

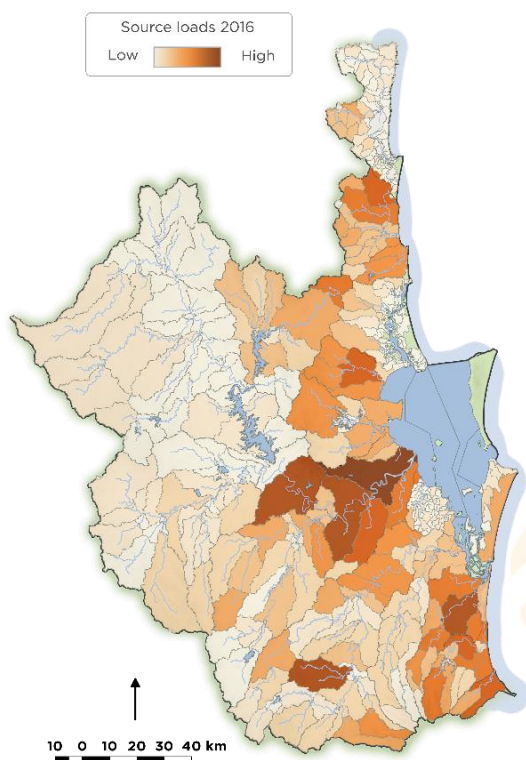


Figure 5 Example of pollutant loads modelled for Report Card 2016

Calculating grades for bay zones

The overall Environmental Condition Grade for each of the 5 bay reporting zones (Western Bay, Eastern Bay, Central Bay, Southern Bay, Broadwater) is calculated using 8 indicators (Figure 6). Water quality indicators make up 50% of the overall score, and habitat indicators make up the other 50% of the overall score. A score for each indicator is calculated using data from a combination of sources, including environmental modelling, monitoring and remote sensing. The following section describes the two components that make up the catchment grades, and how scores for the underlying indicators are calculated:

1. BAY WATER QUALITY (50%)
2. BAY HABITAT (50%)

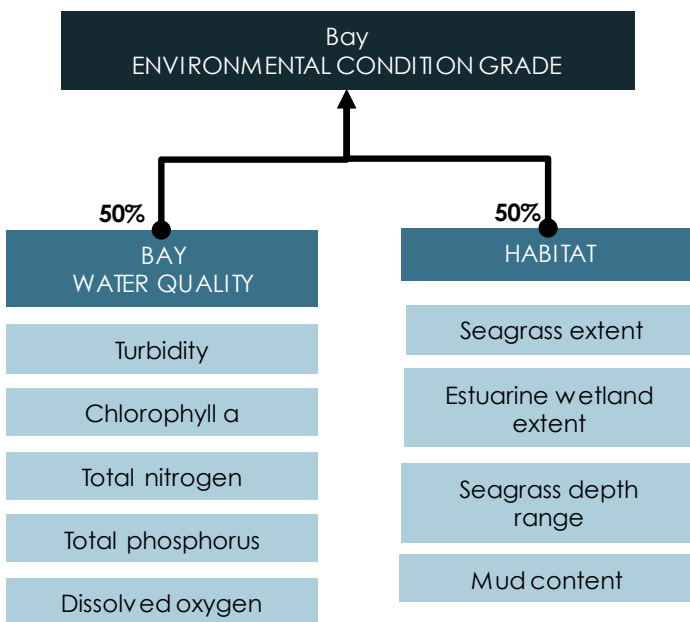


Figure 6 Diagram showing the 8 indicators (lightest blue) that are combined into single overarching environmental condition grade for each of the bay reporting zones.

Bay Water Quality (50%)

Water quality refers to the physical and chemical properties of the water. The variation and range of water quality influence the types of organisms that can live and grow in the waterbody.

INDICATORS

There are five bay water quality indicators:

1. Turbidity
2. Chlorophyll a
3. Total nitrogen
4. Total phosphorus
5. Dissolved oxygen

DATA COLLECTION & SCORING

Estuarine and bay water quality models (using TUFLOW FV) are used to predict annual water quality medians throughout each of the estuarine and bay reporting zones. The models are validated using field data collected monthly at 182 sites (once per month for 8 months per year - February, March, May, August, September, October, November, December) through the Monitoring Program (Figure 7). Then the model predicted water quality medians for each indicator are used to calculate a standardised score. This is done by applying an area weighted 'distance from guideline' approach using the Queensland Water Quality Guidelines (Table 2).

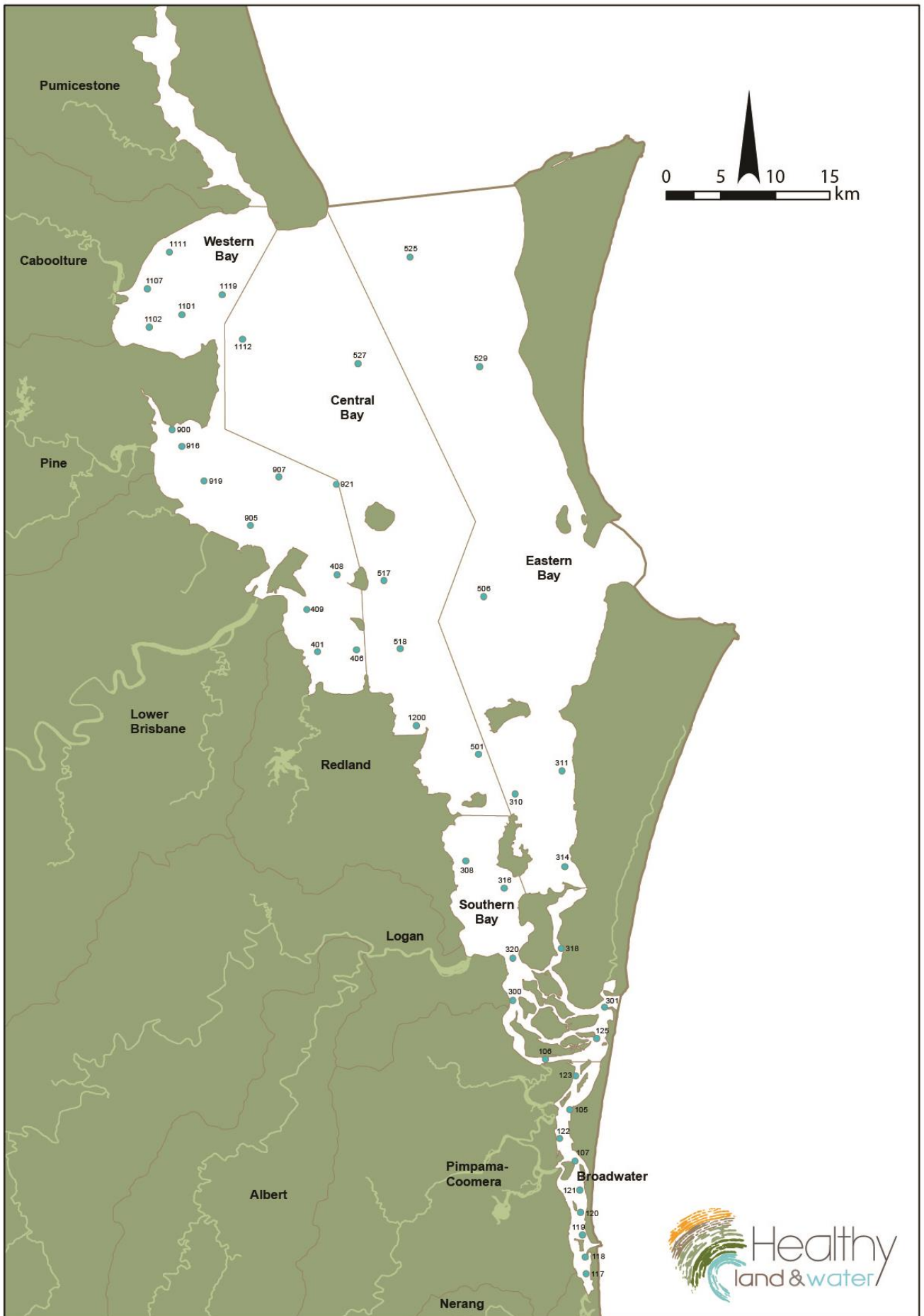


Figure 7 Bay water quality monitoring sites

Bay Habitat (50%)

Coastal wetlands, including seagrass meadows, provide a variety of critical functions and services including provision of habitat for aquatic organisms, stabilising the riverbank and sequestration of nutrients like carbon and nitrogen from the environment.

Mud content, reflects the level of pressure on bay habitats from catchment sediment loads. Similarly, seagrass depth range reflects the degree to which seagrass is under pressure from sediment loads and associated changes in water clarity.

INDICES

There are four indicators for Bay Habitat:

1. Wetland extent (km²)
2. Seagrass extent
3. Seagrass depth range
4. Mud content

DATA COLLECTION AND SCORING

Wetland extent is calculated every 4 years, with data derived from the Department of Environment and Heritage Wetland Info program (<https://wetlandinfo.ehp.qld.gov.au/wetlands/>). Wetland extent values are then standardised to calculate a final catchment score.

Seagrass extent is measured approximately every 3 years using a combination of field sampling and remote sensing. Field data is collected through the Healthy Land and Water monitoring program and by citizen science groups. Seagrass extent is expressed as the percentage of seagrass present compared to the 2004 map of seagrass extent in Moreton Bay.

Seagrass depth range is measured at 17 sites bi-annually the Healthy Land and Water monitoring program (see also hlw.org.au/report-card/monitoring-program). *Zostera muelleri* is used as the indicator species. The depth range and general profile of the seagrass bed is determined along a main transect recording the upper and lower distributional limits (Figure 8).

Mud content is measured approximately every 3 years by the University of Queensland and citizen science volunteers.

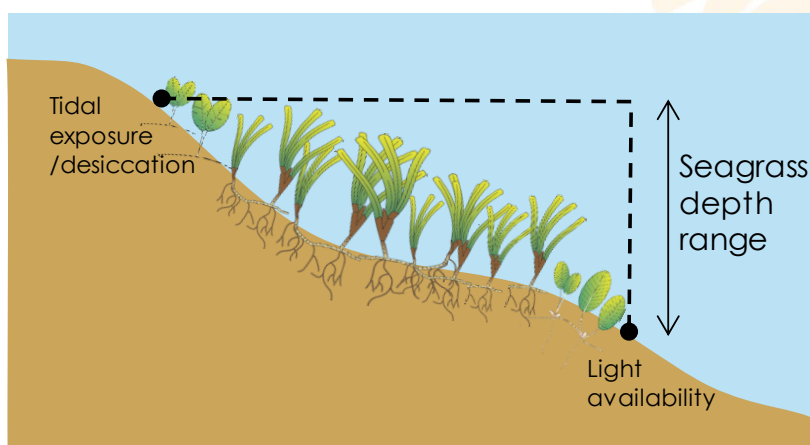


Figure 8 Schematic diagram illustrating how seagrass depth range is measured

Waterways Benefits Rating (1-5 stars)

Our waterways provide important benefits such as clean and safe drinking water, nursery habitats for recreational and commercial fishing, and a reliable water source for agricultural productivity. Recreation activities in and around waterways not only help to improve physical health and wellbeing, they also contribute approximately \$3.22 billion to the region's economy annually.

The Waterway Benefits Rating (introduced in 2015) help us to better understand how the social and economic benefits our waterways provide will be affected by changing environmental conditions.

The following components are measured:

- community satisfaction with local waterways,
- appropriate access to local waterways,
- personal benefits residents derive from using local waterways,
- community motivation to use and protect waterways,
- economic benefits generated through recreation, and
- contribution relevant catchments make to providing clean low-cost drinking water.

The 5-Star Rating

******* (5-stars) Maximum benefits:** Local community fully satisfied with local waterways, including their accessibility and usability. Maximum financial benefit from recreational use and low-cost drinking water.

****** (4-stars) Very high benefits:** Local community highly satisfied with local waterways, including their accessibility and usability. Very high financial benefit from recreational use and low-cost drinking water.

***** (3-stars) High benefits:** Local community generally satisfied with local waterways, including their accessibility and usability. High financial benefit from recreational use and low-cost drinking water.

**** (2-stars) Moderate benefits:** Moderate accessibility and usability of waterways limits community use and satisfaction. Moderate financial benefit due to moderate recreational use and higher cost drinking water

*** (1-star) Minimum benefits:** Minimal accessibility and usability of waterway result in little to no social or recreational benefits for the community. Minimum financial benefit due to low recreational use and highest cost drinking water.

The reporting zones (see hlw.org.au/reportcard or Figure 1 for map)

Waterway benefit ratings are calculated for the following catchments. There are no benefits ratings calculated for bay zones.

- Noosa
- Maroochy
- Mooloolah
- Pumicestone Passage
- Caboolture
- Pine Rivers
- Lower Brisbane
- Redlands
- Logan
- Albert
- Pimpama-Coomera
- Nerang
- Tallebudgera-Currumbin
- Stanley
- Upper Brisbane
- Mid Brisbane
- Lockyer
- Bremer

Calculating Waterways Benefit Ratings for catchments

The overall Waterway Benefits Rating for each of the 18 catchment reporting zones, is calculated by combining the score for five indicators (Figure 9). In drinking water catchments, social indicators make up 60% of the overall score, and economic indicators make up 40% of the score. In non-drinking water catchments, the social indicators make up 75% of the overall score, and economic indicators make up 25% of the overall score. The score for each indicator is calculated using data collected through a range of methods including community surveys and economic assessments. The following section describes the two components that make up the Waterways Benefits Rating, and how scores for underlying indicators are calculated.

1. SOCIAL (60%)
2. ECONOMIC (40%)

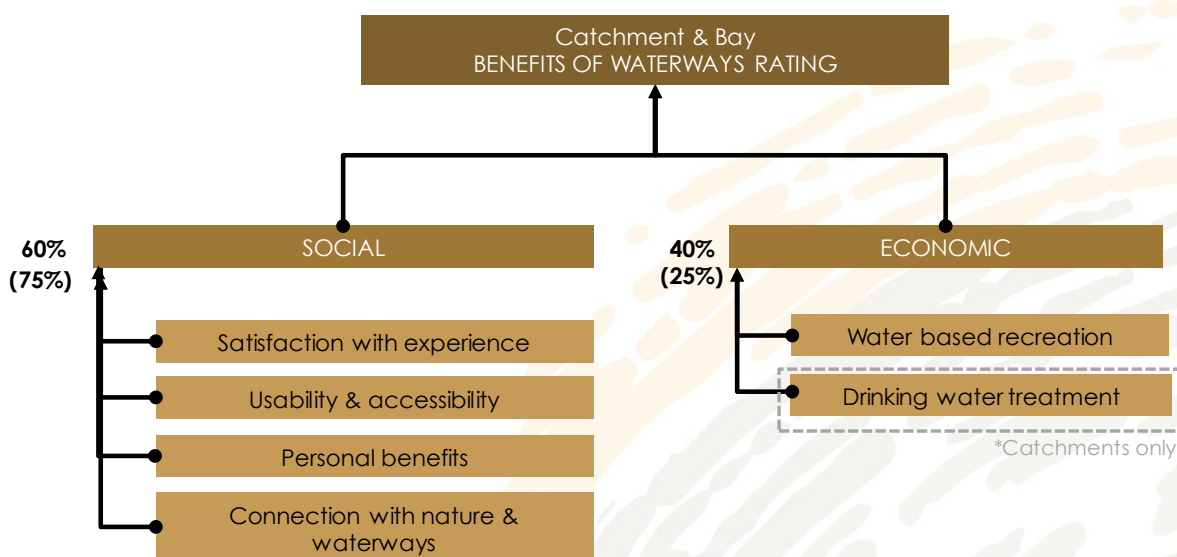


Figure 9 Diagram showing the 5 indicators (lightest brown) that are combined into a single overarching Waterways Benefit Rating for each of the catchment reporting zones.

Social (60%)

The level of social benefit a waterway provides the local community reflects two things:

- The community's willingness and ability of to continue using local waterways and experience the associated mental health, physical health and cultural benefits.
- The community's willingness and ability to support and participate in activities that improve the condition of local waterways

INDICES

The purpose of including the social indicators in the Report Card is to help encourage individuals, industry, communities of practice and governments to act in ways that improve or sustain the condition of catchments and the services they provide.

We measure four indicators of social benefit which have been included to help managers identify the elements of communities in each catchment that facilitate action (Figure 10).

These include:

1. Satisfaction with experience of local waterways
2. Usability and accessibility
3. Personal benefits
4. Connection with nature & waterways

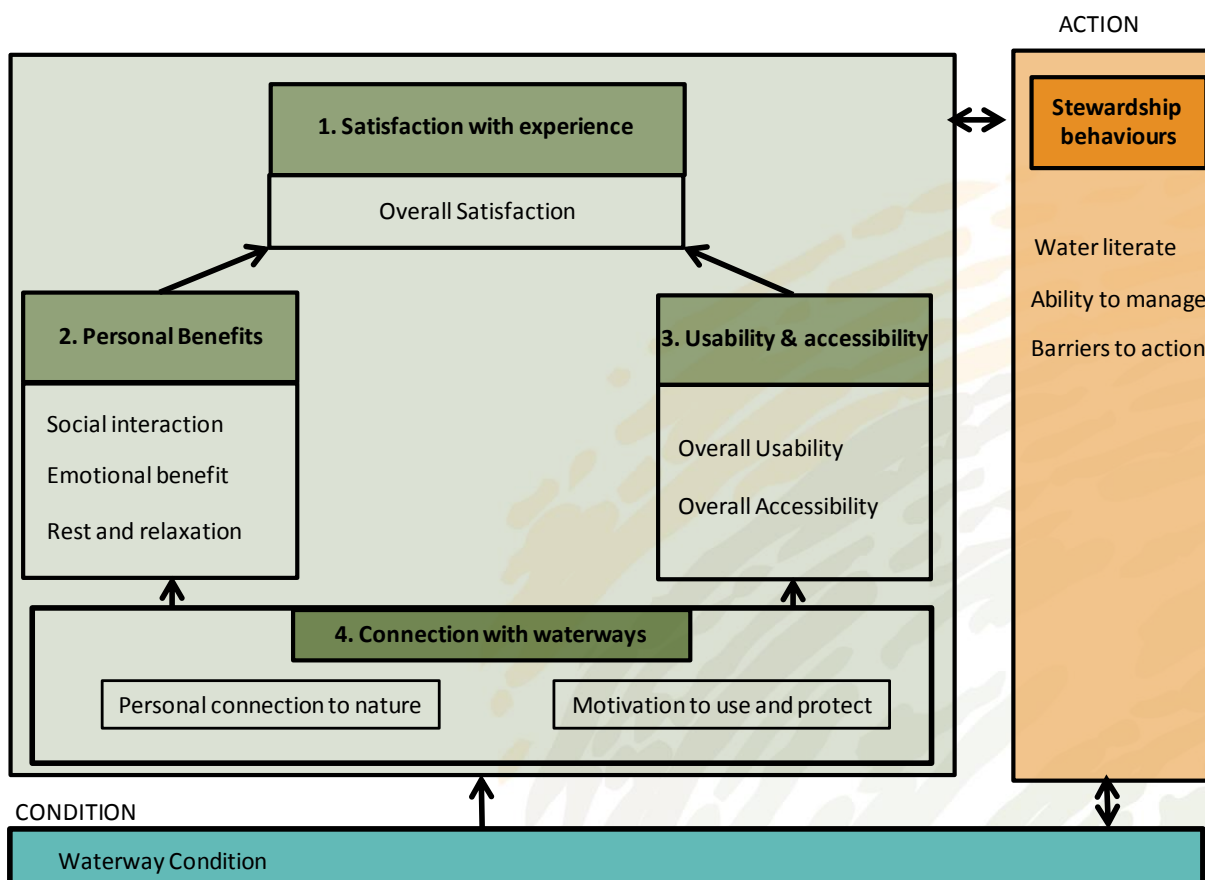


Figure 10 Framework for the four social benefits indices used in the report card.

DATA COLLECTION AND SCORING

A community survey of south-east Queensland residents is carried out annually. This provides a representative subsample of the population within each reporting zone. The survey is administered through a 20-minute online survey hosted by Queensland University of Technology. Survey respondents are recruited using panel data (more than 3000 people per year) and are adults (18+) living in South East Queensland.

Indicator scores are calculated as the percent (%) of survey respondents within a catchment who positively report satisfaction/usability/importance of local waterways.

Economic (40%)

Waterways have the capacity to provide significant economic benefits to the local community. For example, the frequency of visits and type of recreation carried out on and beside waterways has an economic value to the community.

In addition, the amount of sludge treated in the production of drinking reflects the quality of water entering a drinking water treatment plant and therefore the economic value of a drinking water catchment to the community.

Future report cards will include an index that reflects the value of waterways to agriculture.

INDICES

1. Drinking water value (N/A for non-drinking water catchments)
2. Water-based recreation value

DATA COLLECTION AND SCORING

Drinking water value is calculated annually using Seqwater sludge data based on kg/ML removed for each Water Treatment Plant (WTP).

The amount of water-based recreation carried out over the year is estimated using data from an annual community survey of South-East Queensland residents (described above). The \$ value is then calculated by multiplying the frequency of each recreational activity by an estimate of its value which has been derived from the literature.

Actions

Healthy Land and Water is working with the community, local and state governments, water utilities, SEQ Catchments and the Council of Mayors (SEQ) to prioritise action in each catchment.

We are developing regional decision support tools to assess the threats to environmental values within each catchment. Specifically, the environmental values/objectives are (as defined by our members):

- restore and maintain key habitats (i.e. riparian vegetation)
- reduce pollutant loads (sediment and nutrients) entering waterways
- improve and maintain water quality
- restore and maintain key ecosystem processes
- restore and maintain resilient and healthy aquatic communities (i.e. fish populations).

These tools help prioritise focus areas for action and support decision-makers in developing and implementing targeted, effective catchment management actions.

References

Smith, M. (2014) *The Healthy Waterways Report Card Program: Review and Redesign*, Healthy Waterways Ltd, Brisbane pp119



Level 19, 160 Ann St, Brisbane QLD 4000 | PO BOX 13204 George St, Brisbane QLD 4003
T. 07 3177 9100 | F. 07 3177 9190

hlw.org.au