

Catchment management for the protection of water resources: The Ecosystem Health Report Card

A Rural Economy and Land Use Programme research project investigating the appropriate combination of regulation, advice, land use measures, incentives and voluntary action for a collaborative and adaptive approach to catchment management to protect rural land and water resources.



Policy and Practice Notes

The Rural Economy and Land Use Programme is a UK-wide research programme carrying out interdisciplinary research on the multiple challenges facing rural areas. It is funded by the Economic and Social Research Council, the Biotechnology and Biological Sciences Research Council and the Natural Environment Research Council, with additional funding from the Scottish Government and the Department for Environment, Food and Rural Affairs.

Diffuse water pollution originating from agriculture and other rural activities poses challenges for public policy and requires innovative management approaches. These range from best practices that improve income and the environment in farming and other sectors, to less intensive land use, and land use change. Implementation of the best ‘mix’ of measures for a given location requires the appropriate combination of regulation, advice, incentives and voluntary action, and can best be designed and delivered by an adaptive, collaborative approach to catchment management. To assist this approach, the project developed an Ecosystem Health Report Card in consultation with stakeholders in two case study catchments.

Can stakeholders contribute to catchment management?

In order to achieve this, it is essential to have high quality informational tools and decision-support systems that can communicate technical information to informed lay participants, and that can effectively integrate measured empirical data with location-specific detail that local people are able to provide.

Stakeholders can contribute to environmental policy development and implementation, and enhance the quality of professional enquiry through integration of independent scientific and local contextual knowledge.

What is an Ecosystem Health Report Card?

Engagement with stakeholders in the two case study catchments of the River Thurne in The Broads and River Tamar in south-west England revealed that communication of water quality monitoring data in a way that informs land users and other interest groups is essential to facilitate meaningful discussion of the causes of diffuse pollution and possible solutions. Stakeholders demonstrated a strong local demand for such information. The approach developed here originates in South East Queensland, Australia where an annual report card has been issued since 1999 on the ecosystem health of the region’s waterways (SEQ Healthy Waterways Partnership 2008). Validated by scientists, the Report Card provides a means for drawing together monitoring data and is distributed to the public, major stakeholders and politicians. It consists of a data table and a map-based graphic.

The Report Card can be used to:

- provide an easy to understand snapshot of the health of a catchment’s freshwater and estuarine/marine environments in relation to environmental targets and standards
- raise awareness of change in the condition of waterways over time
- build understanding of the effectiveness of improvements in land and water management
- focus management efforts and resource allocation to protect vulnerable areas and environmental values identified by the community
- demonstrate possible future scenarios

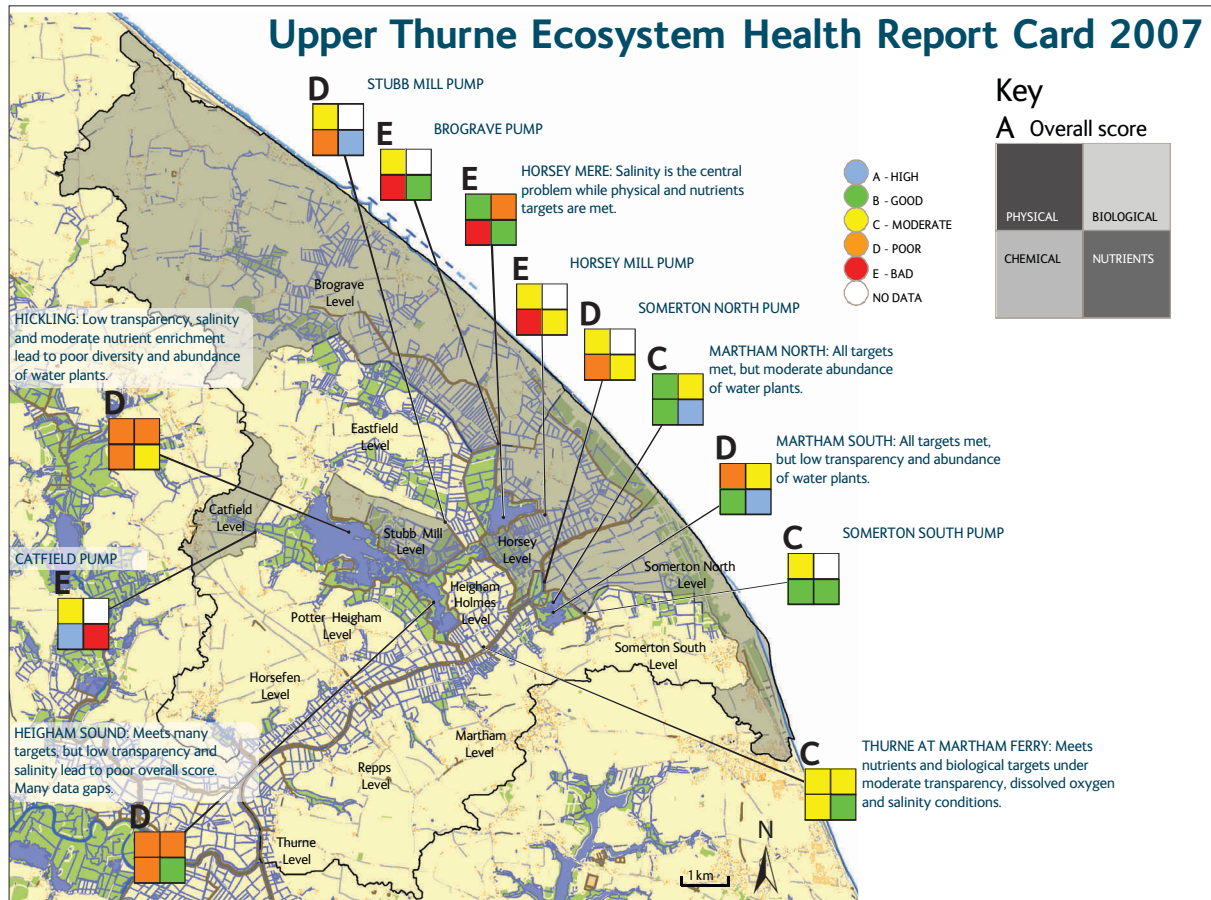
What makes for successful presentation of a Report Card?

In this project, discussion of the Report Card with stakeholders suggested the following requirements:

- selection of colours to best meet the needs of those who are partially colour blind or otherwise sight-impaired
- detailed design points, such as the use of squares to display information rather than circles which may be confused with the fractional representation of pie charts
- use of simple terminology, e.g. ‘water plants’ not ‘macrophytes’, ‘nutrient enrichment’ not ‘eutrophication’, ‘transparency’ not ‘turbidity’
- use of text annotations to explain local factors and key issues in more detail

Clear spatial demarcation of the catchment for each monitoring point is a feature of the Report Card. This helps to raise awareness of the contributing areas of pollution sources. People are interested to see what is happening “in their backyard”, but there are also legitimate concerns voiced by stakeholders over the specific causes of pollution requiring resolution through consultation.

Ecosystem Health Report Card for the River Thurne Catchment, Norfolk. Front page:



Back page:

Indicator	Parameter	Martham Ferry (River Thurne)	Martham Sth Broad	Martham Nth Broad	Somerton Nth Pump	Somerton Sth Pump	Heigham Sound	Hickling Broad	Catfield Pump	Stubb Mill Pump	Horsey Mere	Horsey Mill Pump	Brograve Pump
	Transparency	0.46	0.31	0.70			0.31	0.28					
	Temperature	1.81	1.59	1.74	1.74	1.91	1.76	1.80	2.25	1.92	1.85	1.68	1.96
	Suspended solids			1.07	1.04	1.04		0.97	1.06	1.06	1.03	1.04	1.03
	Dissolved oxygen (% sat.)	0.60	0.97	0.86	0.34	0.41	0.88	1.07	0.51	0.50	0.88	0.35	0.63
Physical	Dissolved oxygen (conc.)	0.46	0.99	0.86	0.51		1.19	1.15	0.59	0.44	1.27	0.52	0.63
	Acidity	1.38	1.50	1.41	1.19	1.31	1.47	1.43	1.33	1.29	1.27	1.26	1.22
	Alkalinity	1.34	1.28	1.38	1.48	1.41	1.31	1.00	1.22	1.43	1.40	1.38	1.47
	Electrical conductivity	0.45	0.76	0.96	0.29	0.95	0.29	0.18	1.30	0.33	-0.37	-0.08	-0.12
Chemical	Chloride	0.59	0.92	0.90	0.35	1.32		0.31	1.38	0.44	-0.15	0.03	-0.01
	Total phosphorus	0.94	1.13	1.11	0.88	1.00	0.94	0.86	0.90		0.98	0.62	0.98
	Filtered reactive phosphorus	1.05	1.05	1.05	1.04	1.04	1.05	1.05	1.03	1.04	1.05	1.02	1.04
Nutrients	Inorganic nitrogen	1.76	1.83	1.78	1.47	1.40		1.83	-0.12	1.67	1.39	1.51	1.19
	Chlorophyll	0.55	0.86	0.86			0.22	0.26			0.52		
	Diversity of water plants		0.84	0.89				0.19			0.33		
Biological	Abundance of water plants		0.46	0.51				0.05			0.20		

How is a Report Card produced?

The Report Card is based on the calculation of an ecosystem health 'score'. The score compares the measured value obtained for a water sample against both an agreed target (e.g. a water quality standard) and a worst case value (e.g. the boundary between 'poor' and 'bad' ecological status classes, or based on other scientific evidence). Parameter values can include physical, chemical, nutrient and biological information for a chosen sampling location that represents a water body in a catchment or sub-catchment. The calculations use the available monitoring data for a given reporting period with an individual parameter score calculated using the following equation:

$$\text{Score} = 1 - \frac{\text{Value} - \text{Target}}{\text{Worst case} - \text{Target}}$$

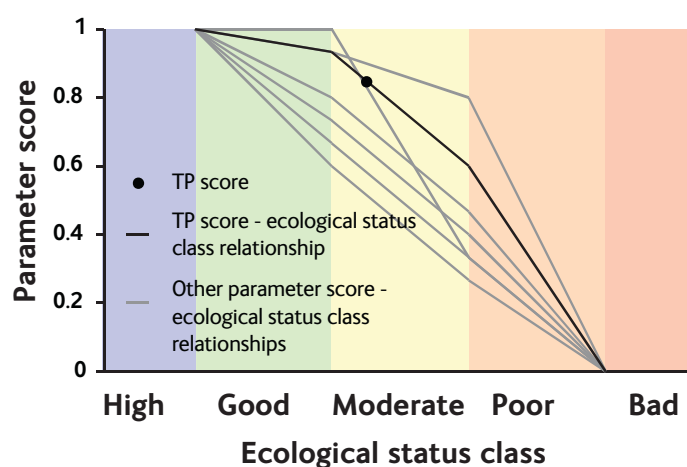
As an example, and using monthly values of total phosphorus (TP) concentration measured in 2007 in Hickling Broad in the Thurne catchment, the geometric mean obtained as the sample value is equal to 0.058 milligrammes per litre (mg/L) and is compared against a target or water quality standard concentration of 0.035 mg/L and a worst case concentration of 0.196 mg/L. Using this information, the computed score for this nutrient parameter is:

$$1 - \frac{[0.058 - 0.035]}{[0.196 - 0.035]} = 0.856$$

An "indicator score" for a monitoring site is taken as the worst among the reported parameters for each of the physical, chemical, nutrient and biological indicator classes. An "overall score" for the same site is then reported as the worst among the indicator scores. Comparison can be made between the calculated scores and given EU Water Framework Directive ecological classes as shown in the figure below, noting the different and generally non-linear mapping for different parameters. All this information can then be displayed in the Report Card graphically as a map and quantitatively in a table.

In deciding the final reported score, recognition is given to the EU Water Framework Directive "one out-all out" classification rule which has the advantage of providing a clear result and can be used to mobilise and spatially target limited resources, but should be supported by a breakdown of all the applied indicators to provide balance, report incremental improvements, and target specific mitigation measures.

Example translation of a given score into EU Water Framework Directive ecological status classes



It is important to note that the choice of targets, worst cases and averaging methods often requires a judgment based on limited monitoring data and current scientific understanding. For example, the UK Technical Advisory Group on the EU Water Framework Directive (UKTAG 2008a, b) has developed target values for some water quality parameters. For other parameters (suspended solids are a prominent example - UKTAG 2008b), the scientific knowledge is insufficient to set targets. The Report Card can incorporate changes in targets as new knowledge becomes available and so can demonstrate the resulting improvement or deterioration in the ecosystem health score. This helps to encourage transparency in reporting of water quality.

Further information

The research has been carried out at the University of East Anglia and SOAS, University of London.

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Useful resources:

SEQ Healthy Waterways Partnership (2008) Report Card 2008 for the waterways and catchments of South East Queensland.

<http://www.healthywaterways.org>

UKTAG (2008a) UK Environmental Standards and Conditions (Phase 1).

<http://www.wfduk.org>.

UKTAG (2008b) UK Environmental Standards and Conditions (Phase 2).

<http://www.wfduk.org>.

<http://www.relu.ac.uk/research/projects/Third%20Call/Smith.htm>

