Strength of Evidence Tables
Helping to Make Decisions on Causes of Poor Status

Headlines

Why this Might be Important for You

To increase the chances of success of improving the water quality in our river catchments, we need to implement measures that are based on robust evidence. Evidence for weighing up the causes that are central to (or responsible for) the problems in a water body comes in many shapes and forms. Examples include:

- Stakeholders' expert opinions and recollections;
- Conclusions in reports;
- Interpreted charts showing how things have changed over time or in space;
- Maps showing where suspected causes and problems coincide;
- Model predictions.

All such lines of evidence have real value, but how do we combine them to accomplish a balanced assessment?

This summary outlines an approach that has proved successful in helping stakeholders efficiently review and assess many disparate pieces of evidence. Although developed independently, the approach has links to "weight of evidence" approaches such as CADDIS used in the USA and Healthy Waterways in Australia.

Learning from our Mistakes

When we started, we provided stakeholders with lots of information and asked them to make their own decisions about the main causes of ecological failures.

Then we realised that overloading stakeholders with information with limited time hindered their ability to decide on the main causes of ecological failure and so the path to good measures was blocked.

After some iteration, we found we could use Evidence Tables like the one on the next page to summarise what each piece of evidence (report, chart, map etc.) tells us about each suspected cause of ecological failure in a water body. This approach brings together all types of information into a single assessment symbolised by a "+", "-" or "0": meaning evidence for, against or being inconclusive. Stakeholders were then asked to check our evaluation of the evidence with reference to their own knowledge and the supporting information supplied.

The examples below illustrate how different kinds of evidence were used in the Evidence Tables.

Evidence Examples for the Table

Evaluating South Culvert

The Water Framework Directive highlights poor water quality and invertebrates as the two main failures for Moston Brook, Manchester. Stakeholders had provided a list of nine suspected causes of these failures, one of which (sewage from storm overflows) is assessed for a culverted reach of the brook (South Culvert) using evidence (see the following three examples) in the Evidence Table on the next page.

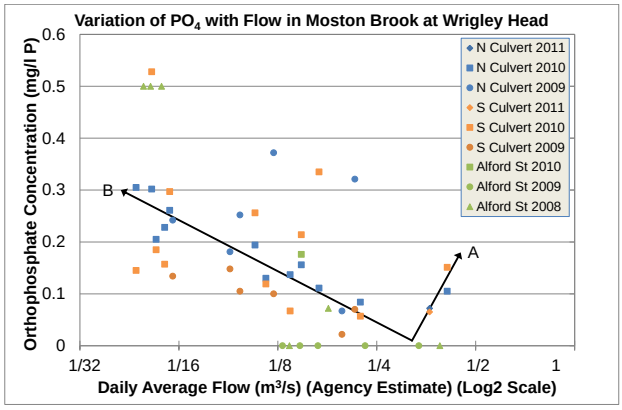
Example #1: A photograph

Environment Agency Photo Evidence of Sewage

Note: Sewage rags on culvert outlets are positive evidence of sewage discharge to the stream.

Example #2: Phosphates & Flow Chart

Graphed (Environment Agency) Data Evidence



Note: This plots sample concentration against flow at that time. A: deterioration with increased flows (suggests storm sewage); B: deterioration with reduced flows (strongly suggests plumbing mis-connections);

Example #3: 1990s Pollution Incidents

A table in a WS Atkins report (Ref 1) presents pollution incidents recorded by the Environment Agency in the 1990s. There were two incidents (1993 and 1995) in the vicinity of the two culverts, but it is not clear whether they were from the South Culvert.

Evaluating the Evidence

The Evidence Table below shows the evaluation of evidence for and against one of the suspected causes (sewage from storm overflows, column 1). The Table's columns describe the evidence we had gathered. The photographic evidence (Example #1) is described in blue text in column 2. This provides positive evidence that sewage discharges (from storm overflows and/or from sewage misconnections) are in fact a real cause so it scores a "+" in column 3.

The chart evidence (Example #2, line B) shows that most of the higher phosphate concentrations happen as flows reduce (red text in column 4), implying sewage from plumbing mis-connections rather than sewage storm discharges is the main problem. So, in terms of evidence for sewage from storm overflows as a cause it scores a "-" in column 5. There is, however, a hint of increased phosphate at high flows (line A on the chart in Example #2) suggesting some inputs of sewage from storm discharges (column 4 blue text and column 5 "+").

The evidence from Example #3 is described by the pink text in column 2 and because the evidence is inconclusive, it is given a score of "0".

Based on such Evidence Tables for each suspected cause, stakeholders were able to reach consensus on which were the main causes of problems from the nine suspected causes based on the existing evidence.

Find out More?

Ref 1: W S Atkins (2002) - Moston Brook Pollution Prevention Project, Desk Study, Final Report. Prepared for the Environment Agency, dated August 2002.

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Example Strength of Evidence Table

South Culvert – Evidence Relating to Sewage from Storm Overflows as a Cause

What does each piece of evidence tell us about each suspected cause of WFD failure in this sub-catchment? Scores: evidence supports [+], evidence opposes [-], evidence is uncertain [0], no evidence [NE], evidence not applicable [NA]								
WFD failures: ammonia (poor to bad), BOD (high to bad), phosphate (moderate)								
Suspected causes	**Line of evidence A** (variation across sub-catchments)		**Line of evidence B** (variation in time)		**Line of evidence C** (downstream changes)		**Line of evidence D** (source apportionment)	
	Results	Score	Results	Score	Results	Score	Results	Score
2) Sewage from Storm Overflows (i.e. Combined Sewer Overflows or Pumping Station Overflows, CSOs & PSOs)	1) Culvert from Highways Agency drawing (Fig 3.5) suggests original Bower Brook culvert heads NE-SW past XXX Pumping Station and then connects to South Culvert outfall. (Fig 3.5) 2) NIRS: Insignificant sewage incident (2011), Table 1.2. Could be blocked CSO but unlikely to be storm overflow. 3) 1990s incidents: Two sewage incidents (1993) & 1995) but not clear which culvert, Table 1.2 4) A lot of sewage rags visible on culvert grid. (photo on Fig 3.5) 5) Water Co modelling shows improvements needed at XXX CSO and Water Co will complete these by 2015.	+ 0 0 + +	1) PO4 concentrations generally increase with decreasing flow suggesting that continuous background source dominates (rather than storm discharges). (Fig 3.4) 2) PO4 concentrations at high flows (5%ile) are slightly higher than dilution of continuous inputs (see (1) above & Fig 3.4) and could imply additional source at high flows e.g. PSOs 3) NH4 v PO4 plot (Fig 1.7) shows higher NH4 which is more consistent with sewage source than landfill.	- + +	1) No sample data upstream of this culvert.	NE	1) SAGIS: CSOs major source of PO_4 across whole of Moston Brook (~60% compared to urban ~40%). No comparison within sub-catchments but XXX PSO marked on SAGIS map.	+

More suspected causes

What does each piece of evidence tell us about this suspected cause of WFD failure in this sub-catchment?
Scores: evidence supports [+], evidence opposes [-], evidence is uncertain [0], no evidence [NE], evidence not applicable [NA]

Evidence and Measures Projects

Evidence and Measures is a programme of work funded by Defra and the Environment Agency which has been working in a variety of catchments since 2008. It uses readily available evidence to help stakeholders identify locally-targeted measures aimed at delivering ecological improvements.