

Levels of evidence for completing investigations and selecting measures

Guidance note

Issued 23 May 2011

1. Purpose of this guidance note

As part of implementing the first river basin management plans, we are undertaking investigations to:

- improve our certainty that an element is at less than good status,
- identify the reasons for any failures and
- identify feasible and proportionate measures (actions) to tackle those problems.

The Environment Agency is committed to completing the investigations included in the first river basin management plans by the end of 2012. This includes progressing the investigations which will improve our understanding of the problem (i.e. certainty that an element is failing and identifying reasons for failure) to the point where we can begin to identify and appraise actions.

Prior to the preparation of the second cycle of river basin management plans in 2015 (i.e. by end of 2014 / early 2015) these investigations must also have improved our certainty in the status of elements and any reasons for failure sufficiently to avoid, as far as possible, the need to justify alternative objectives on the basis of uncertainty¹.

Staff undertaking these investigations requested guidance to support their decisions on when an investigation is complete. It is not possible to give specific guidance on determining the end points of individual investigations, as this will depend upon local circumstances including the views of partners. However, this note sets out some general principles that can be used to help inform local judgements about the end points of investigations and the levels of evidence required to support actions. It also sets out some principles on integrated approaches (for example across surface water and groundwater) and the consideration of actions to address multiple pressures. These principles will be key to our approach to river basin and catchment management planning in future.

This note will also help explain the approach to our external partners and will help to indicate how they can contribute to and support this work.

¹ That is, justifying alternative objectives on the basis of 'Disproportionately expensive – significant risk of unfavourable costs and benefits' or 'Technically infeasible – cause of adverse impact unknown'.

As well as general principles for investigations and measures, this note sets out more specific guidance for specific types of pressures e.g. diffuse pollution.

Please note that this guidance note is being issued alongside updated guidance on investigative monitoring of eutrophication in rivers.

Additional guidance will be issued in future, as either updated versions of this guidance note or stand alone supporting guidance as set out in the box below:.

Next steps in developing guidance:

This initial guidance will be added to in further phases covering:

- further details on levels of evidence for investigations and measures related to groundwater (end May 2011)
- further details on levels of evidence for investigations into supporting conditions of morphology (end May 2011)
- the specific levels of certainty of failure required to drive different types of measures (end May 2011)
- the evidence needed to link biological failures to the pressure causing the failure (1st draft by June 2011)
- linking in Protected Area failures so we have one consistent and transparent planning process for measures (1st draft June 2011)

2. Investigations to confirm failure to achieve good status in surface waters

For surface waters in the first river basin management plans we expressed our certainty that an element (or water body) is at less than good status using the three categories of very certain, quite certain and uncertain. These definitions were based on statistical certainty from analysis of operational (i.e. routine) monitoring data (very certain $\geq 95\%$, quite certain $\geq 75\%$ $< 95\%$, uncertain $> 50\%$ $< 75\%$).

The level of certainty we need to have that an element really is at less than good status will be influenced by the actions required to resolve the failure.

For failures to achieve good status that require costly or targeted regulatory measures we will usually need to be very certain of the failure in order to justify the action. However for some low cost, voluntary type measures we will be able to take action where we are much less certain that the element is actually failing.

Classification and statistical certainty derived from operational monitoring may be unable, on their own, to provide the certainty needed to justify the actions that may be required, particularly if the failure is caused by pollution from diffuse or intermittent sources. In these cases additional evidence should be used to make a pragmatic, qualitative judgement of the certainty that there is a problem to solve, based on a weight of evidence approach (with the

classification data providing part of that weight of evidence²). This additional evidence could come from, for example, pollution incident or investigative monitoring data.

The specific levels of certainty required for different elements and reasons for failure will be set out in further phases of this guidance. These levels of certainty are being taken into account in designing and implementing the routine monitoring programme to make sure it delivers, wherever possible, the required level of certainty to support the necessary actions.

Operational monitoring is used to derive status classifications for WFD. This routine monitoring programme is determined nationally and is designed to detect changes in status over time, for example due to the effects of improvement actions.

Investigative monitoring is put in place locally by areas to provide additional information to improve confidence that there really is a problem to be solved or to determine the cause(s) of those problems. Data from investigative monitoring is not used for classification purposes.

*For example: ammonia in a water body is classified at moderate (uncertain) based on **operational monitoring** data. It is suspected that the ammonia comes from an intermittent point source but more certainty that there is an ammonia problem is required to justify possible actions. More operational monitoring is unlikely to provide more certainty about the ammonia status due to the suspected intermittent nature of the inputs. Instead **investigative monitoring** is undertaken by area staff, including the use of continuous monitors, which confirms that there are intermittent inputs of high levels of ammonia. This investigative monitoring increases the certainty that there is an ammonia problem to resolve, and so appropriate action can be considered, but it does not change the classification result. After action is taken to resolve the problem, appropriate operational monitoring will be reinstated to allow us to assess the effectiveness of the measures through the routine classification process.*

3. Investigations to determine cause of problem and identify actions in surface waters

Determining the cause of the problem involves identifying the reasons for failure and, if relevant, the source apportionment. We categorise reasons for failure as 'suspected', 'probable' or 'confirmed'³ to indicate our level of certainty in the identification of the reason.

² It is important to note that this weight of evidence approach to improve certainty that there is a problem to solve does not over-ride the classification result

³ See "Reasons for failure 2010 onwards – final guidance" for further explanation of certainty levels and the types of evidence considered relevant

The evidence required to justify some actions is specified by functional guidance and/or established processes e.g. water company improvement schemes under the Periodic Reviews.

In most cases however, **the decision on whether an investigation to identify the reason for failure is complete should be a pragmatic one based on the weight of evidence gathered** and whether this gives sufficient certainty to support the next step in the process, such as identifying and implementing actions.

Points to consider include:

- the weight of evidence required will depend partly on the actions that need to be justified (e.g. in general, low cost voluntary type measures will require a lower level of certainty in the identification of the reason for failure than expensive or targeted regulatory type measures);
- a weight of evidence about the cause of a problem can be developed by considering evidence across different elements in a number of water bodies in a catchment;
- the evidence needs to be relevant to the scale at which action will be taken (e.g. is site-specific action required or catchment-wide action);
- the weight of evidence needed to justify voluntary, partnership type action will depend on the certainty those taking the voluntary action require before putting the action in place. An investigation will only be complete when the interested parties agree they have enough information to justify a decision.

4. Justifying action in surface waters with a weight of evidence approach

Step 1 - Levels of evidence of problem

Judging whether sufficient weight of evidence has been gathered to demonstrate an environmental problem and therefore justify action will, in general, depend on the action required. This is represented schematically below.

The darker the shading then the greater the weight of evidence that exists for the failure to achieve good status and the cause of failure and the more costly and regulatory the actions that can be justified.

The specific contents of each box, in terms of the balance between the need for further investigations and the ability to take action, will depend upon the specific pressure and reason for failure. This will also determine how far investigations must progress before being considered complete e.g. the reason for failure needs to be 'confirmed' and we need to be 'very certain' the element is failing because we need to justify expensive or targeted regulatory action e.g. a Water Protection Zone or a sewage treatment works improvement scheme.

Reason for failure

Certainty in reason for failure ↑	Confirmed			
	Probable			
	Suspected			
	Unknown			
		Uncertain	Quite certain	Very certain
		Certainty there is a problem to solve (e.g. at less than good status) →		

This matrix has been completed for diffuse source pollution, point source pollution and abstraction and these are shown in Annex 1. The matrices summarise existing practice on levels of evidence to justify various actions already outlined in previous guidance. These should be used to guide judgements on when an investigation is complete and sufficient evidence is in place to justify the required action.

It is important at this stage to note a couple of key principles:

- there should be no delay in implementing **some** actions whilst more evidence is gathered to justify further possible actions e.g. 'broad scale' actions justified by being 'quite certain' there is a problem and having a 'suspected' reason for failure should be implemented even whilst work may be continuing to improve the certainty in the reason for failure to 'probable' in order to support more targeted action.
- if there is reasonable confidence that the actions justified by a particular level of evidence (e.g. voluntary or non-regulatory actions) will be sufficient to address the problem and achieve the objective then those actions should be implemented and there is no need to continue to gather more evidence to support further action (such as targeted regulation) at this stage.

Step 2 - levels of evidence for measures

When appraising possible measures (actions) to address a problem, it may be necessary to gather evidence on technical feasibility, cost effectiveness and costs and benefits. Whether any evidence is required and what this evidence might be will depend upon the action being appraised.

It is important to look at the range of environmental problems that may be occurring within a water body (e.g. across pressures, sectors) and adjacent water bodies to see if environmental problems can be tackled with the same measure, or packages of measures. Relatively simple single pressure issues may be resolved with straight forward appraisal of measures, whereas more complex issues may require cross-pressure or sector ways of dealing with the problem (refer to Figure 1).

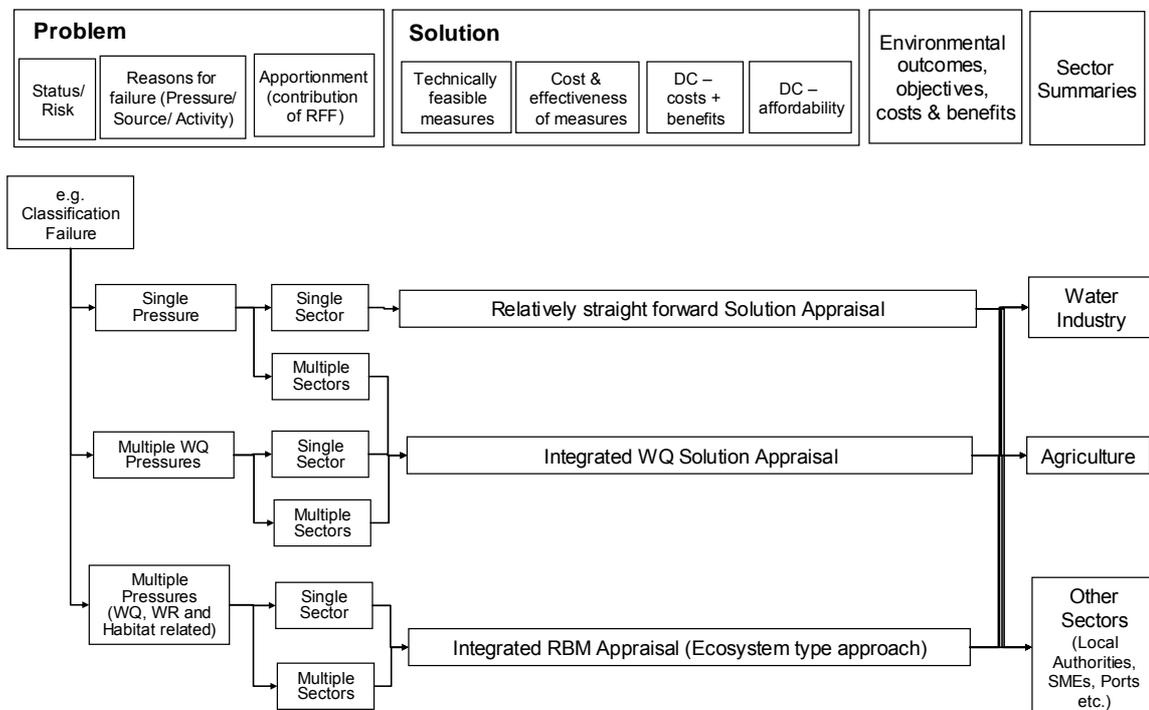
Some general guidance on the types of evidence required and sources of evidence for different types of actions to tackle diffuse pollution is presented in Annex 2.

5. Catchment planning and integrated approaches

A catchment scale, integrated approach to actions appraisal is required to:

- identify the most appropriate and cost-effective packages of actions to address failures caused by multiple pressures / multiple sectors (see Figure 1)
- integrate actions to address both surface water and groundwater problems for good ecological status/potential and protected area objectives together
- support partners in identifying appropriate actions that they can implement and/or support
- consider ecosystem services benefits of proposed actions (e.g. reducing flood risk alongside diffuse pollution control)

Figure 1. River Basin Management Planning



6. Additional guidance available

“100210 Investigations briefing note v2” (see O: /RBD Information / Investigations Baseline)

“Reasons for failure briefing note v1 22.04.10” (see O: /RBD Information / Investigations Baseline)

“Reasons for failure 2010 onwards – final guidance”

100202_Advice Note on eutrophication monitoring, Water Quality, February 2010

100914_P advice note, Water Quality, September 2010

Guidance on investigative monitoring of eutrophication in rivers, Water Quality, May 2011.

Contact for queries

If you have any questions about this guidance, please contact Mark Scott, E&B Senior Advisor (river basin management planning).

Annex 1

The matrices in this annex summarise existing practice on levels of evidence to justify various actions. These should be used to guide judgements on when an investigation is complete and sufficient evidence is in place to justify the required action.

A1.1 Diffuse source pollution

Reason for Failure	Confirmed	<p>Investigate: Investigate failure until 'quite certain'</p> <p>Action: Targeted nationally funded advice / incentive</p>	<p>Investigate: Investigate failure until 'very certain' if hard regulation or less stringent objectives are likely to be needed</p> <p>Action: Targeted local partnerships, targeted nationally funded advice / incentive and targeted enhanced regulation inc. use of Anti-pollution Works Notices</p>	<p>Action: Implement regulatory measures (e.g. enhanced enforcement campaign inc. use of Anti-pollution Works Notices) and WPZ for WFD and PA objectives OR consider Less Stringent Objective</p>
	Probable	<p>Investigate: Investigate failure until 'quite certain'</p> <p>Action: Targeted local partnerships</p>	<p>Investigate: Investigate cause until 'confirmed' if you suspect 'no regrets' measures may prove insufficient</p> <p>Action: Targeted local partnerships and/or targeted nationally funded advice / incentive</p>	<p>Investigate: investigate to 'confirm' cause if hard regulation or less stringent objectives are likely to be needed</p> <p>Action: Targeted local partnerships, targeted nationally funded advice / incentive and targeted enhanced regulation inc. use of Anti-pollution Works Notices</p>
	Suspected	<p>Investigate: Investigate failure until at least 'quite certain' AND investigate cause until at least 'probable'</p> <p>Action: General advice & basic requirements and possibly targeted local partnerships</p>	<p>Investigate: Investigate cause until 'probable'</p> <p>Action: General advice & basic requirements and possibly targeted local partnerships</p>	<p>Investigate: Investigate cause until 'probable'</p> <p>Action: Targeted local partnerships</p>
	Unknown	<p>Investigate: Investigate failure until at least 'quite certain' AND investigate cause until at least 'probable'</p>	<p>Investigate: Investigate cause until at least 'probable'</p>	<p>Investigate: Investigate cause until at least 'probable'</p>
		Uncertain	Quite Certain	Very Certain
Certainty there is a problem to solve				

A1.2 Point source pollution

Reason for Failure	Confirmed	<p>Investigate: to increase confidence that compliance is at risk with current discharge performance.</p> <p>Action: Address any permit non-compliance that could be contributing to status failure.</p>	<p>Investigate: to get to very confident of failure if know further action will be needed.</p> <p>Action: Address any permit non-compliance that could be contributing to status failure.</p> <p>If permit limits can be calculated to be insufficient to meet the environmental standards (now or with planned increase in point source load) take action to implement revised limits OR consider Less Stringent Objective. This may also be evidenced by deteriorating status.</p>	<p>Action: Implement consent improvements through appropriate mechanism (e.g. PR14, EPR) OR consider Less Stringent Objective.</p>
	Probable	<p>Investigate: to confirm link to point source discharges and to increase confidence that compliance is at risk with current discharge performance.</p> <p>Action: Address any permit non-compliance that could be contributing to status failure.</p>	<p>Investigate: to confirm link to point source discharges and confidence that compliance is at risk with current discharge performance.</p> <p>Action: Address any permit non-compliance that could be contributing to status failure.</p>	<p>Investigate: to confirm link to point source discharges.</p> <p>Action: Address any permit non-compliance that could be contributing to status failure.</p>
	Suspected	<p>Investigate: to confirm link to point source discharges and to increase confidence that compliance is at risk with current discharge performance.</p> <p>Action: Address any illegal discharges or pollution incidents.</p>	<p>Investigate: to confirm link to point source discharges and confidence that compliance is at risk with current discharge performance.</p> <p>Action: Address any illegal discharges or pollution incidents.</p>	<p>Investigate: to confirm link to point source discharges .</p> <p>Action: Address any illegal discharges or pollution incidents.</p>
	Unknown	<p>Investigate: to confirm status impacts and cause.</p>	<p>Investigate: to identify cause. If point sources are implicated investigate to increase confidence that compliance is at risk with current discharge performance, and to confirm the cause.</p>	<p>Investigate: to identify cause.</p>
		Uncertain	Quite Certain⁴	Very Certain⁵
Certainty there is a problem to solve				

Notes for point source pollution matrix

Improving certainty there is a problem to solve

- Pool data over a longer period of recent quality to increase our confidence in whether a site is really failing or not (to do this check that quality is relatively stable)
- Look back over past data to see how quality is changing, is there evidence that it is getting worse? (and therefore increasing risk of more significant non-compliance that

⁴ e.g. Quite Certain for a single element fail

⁵ e.g. Very Certain for a single element fail; Uncertain / Quite Certain for a nutrient classification fail with supporting biological impact evidence; Quite certain classification for storm overflow impact with robust evidence of other impacts

needs to be addressed), or maybe tending to get better (and therefore if the decline continues there may be no need for further interventions)?

- For nutrient fails the key is weight of evidence from sensitive biological measures of eutrophication impact, not the degree of confidence in the phosphate failure (separate guidance on assessing eutrophication impacts is being issued alongside this guidance).
- Improvement actions at point sources are expensive and these costs need to be justified by being very certain that there are current impacts or very certain future impacts if improvements are not implemented (e.g. because it can be demonstrated that current consent limits are insufficient to confidently meet new WFD standards whether or not this is currently detected from routine monitoring, including because planned increasing point source load will cause failure of the WFD standards).
- The very certain could be at key sites in the downstream catchment which necessitates consideration of pollution reduction at a number of upstream sources.
- For intermittent storm overflows you might be able to increase confidence of impacts by looking for other impact evidence which can be proven to result from a cause and effect link to the pollution sources.
 - For the impacts of intermittent point sources it may not be possible to achieve very certain failure from routine compliance with water quality standards. This is because our typical monthly routine chemistry monitoring is not likely to detect infrequent intermittent sewage discharges, or at least it wouldn't unless the storm discharges were discharging quite frequently (...and that is not expected to be the case given the opportunities for action to address unsatisfactory discharges in AMP rounds to date).
 - Impacts may be detected through a combination of invertebrate impact (deterioration of biological status class below intermittent discharges) and lower level failure of water quality standards (see Appendix A of PR09 planning document for advice on identifying unsatisfactory storm overflows). Impact evidence may also come from evidence of sewage fungus and other biological surveys beyond biological monitoring for status classification.
 - Remember the Bonferroni effect, which is that the more elements we measure the more likely we are (by chance) to detect one or more reported as failing. To apply weight of evidence from multiple failing elements there needs to be evidence of cause and effect between pollutant pressures and biological impacts.

Improving certainty about the cause of failure

- Improvement actions at point sources are expensive and these costs need to be justified by having confirmed evidence that failure is linked to pollutant pressure from point sources. This may be alone or in combination with other sources.
- This proven link can be shown by data or modelling of pollution sources putting compliance with water quality standards at risk.
- This proven link may be due to permit non-compliance, incidents, or permit limits which are insufficient to meet the environmental standards.
- The link could also be modelling demonstrating that proposed flow increases are putting failure of a water quality objective at risk.
- We may be able to demonstrate the importance of intermittent pollution by continuous monitoring campaigns. There may also be evidence that they are discharging more frequently than appropriate (e.g. pollution incidents, public complaints or operation in dry weather)
- Developing certainty that there is a problem to address and certainty about the sources causing the problem tends to be a parallel activity that builds together to give an overall level of confidence that action is required on a particular source.

This point source pollution example is presented in isolation to action on diffuse sources. In reality actions would not be considered in isolation and achievement of status improvements may depend or become possible through action on other sources in combination.

A1.2 Abstraction (note does not apply to flow regulation or reservoirs)

Reason for Failure	Confirmed	N/A for reason to be 'confirmed' there must be an identified problem, either an impact on biology or a high risk of deterioration	Action: Appraise remedial options including river restoration.	Action: Appraise remedial options including river restoration and changes to abstraction licences
	Probable	Investigate: Investigate problem until at least 'quite certain' AND investigate cause until 'confirmed'	Investigate: Investigate problem AND investigate cause until 'confirmed' Action: Implement lower cost actions	Investigate: Investigate cause until 'confirmed' Action: Implement lower cost actions
	Suspected	Investigate: Investigate problem until at least 'quite certain' AND investigate cause until at least 'probable'	Investigate: Investigate cause until at least 'probable'	Investigate: Investigate cause until at least 'probable' Action: Implement lower cost actions
	Unknown	Investigate: improve information on problem until at least 'quite certain' AND improve information on cause until at least 'suspected'	Investigate: improve information on cause until at least 'suspected'	Investigate: improve information on cause until at least 'suspected'
		Uncertain	Quite Certain	Very Certain
Certainty there is a problem to solve⁶				

Notes for abstraction matrix

Certainty there is a problem to solve: in the absence of evidence for biology element failure, certainty should reflect the severity of abstraction pressure (risk of deterioration)

⁶ For example, good ecology not supported or risk of deterioration

Annex 2. Evidence to support appraisal of measures

A2.1 Diffuse pollution

		EVIDENCE			
		Technically feasible	Cost effectiveness	Disproportionate cost - Balance of Cost:Benefit	Disproportionate cost - Fair sectoral distribution
MEASURES	WPZ	Local evidence (including other approaches are unlikely to be cost-effective and evidence that application of existing regulatory powers have had insufficient effect) set out in a site specific business cases			
	Targeted enhanced regulatory campaign (APWN)	Local evidence including case studies (e.g. Demo Test Catchments, Learning From Doing), RBMP Impact Assessments and Catchment Action Plans showing voluntary approaches alone are unlikely to be cost-effective			
	Targeted nationally funded advice/incentive	Some local evidence, collated Nationally e.g. as detailed in regulatory Impact Assessments and/or Ministerial decisions on particular initiatives (e.g. CSF and Periodic Price Review)			
	Targeted Local Partnership	Local evidence (e.g. Region or Catchment Action Plan) agreed between partners at local level			
	General advice and incentive	Nationally collated evidence e.g. as detailed in regulatory Impact Assessments and/or Ministerial decisions on particular initiatives			