UK Technical Advisory Group on the Water Framework Directive

PROPOSALS FOR A GROUNDWATER CLASSIFICATION SYSTEM AND ITS APPLICATION IN REGULATION

Final Report

(SR1– 2007)

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Contents

INTRODUCTION

The United Kingdom's Technical Advisory Group on the Water Framework Directive (the UKTAG) is developing a classification system for the chemical and quantitative status of groundwater. Such a system is a requirement of the Directive.

The UKTAG is a working group drawn from the environment agencies, supported by comments and views from conservation agencies[1]. It provides technical advice to these agencies and to the UK's government administrations. The UKTAG also includes representatives from the Republic of Ireland.

Scope and purpose of this report

This is a technical report intended for those familiar with the issues of protecting groundwater. The report outlines the proposals of the UKTAG for a classification system. The report suggests how the system would help determine good status under the Directive. The report also looks at the implications for regulation. The report is supported by three papers that provide further technical detail on these subjects[2].

The report describes tests that aim to meet the requirements for classification set out in the Water Framework Directive and the Groundwater Daughter Directive. The purpose of this report is to seek views on how these requirements have been interpreted.

The UKTAG welcomes your comments via its website: www.wfduk.org/stakeholder_reviews.

The UKTAG will take account of your comments in a final report on these proposals. This is due later in 2007. It will be sent as advice to Defra, to the administrations of the devolved governments, and to the environment and conservation agencies.

The UKTAG proposes that the environment agencies use the system to decide the status of groundwater bodies. The environment agencies would report these results for consultation in late 2008 in the drafts of the River Basin Management Plans. The final results will be included in 2009 in the Directive's first cycle of Plans.

The approach to adopting the UKTAG's proposals might vary for each administration, depending on present and proposed legislation, and on policy in each country. This is a matter for Ministers to decide. It is subject to the normal policy-making considerations of the administrations and their agencies. Some of these agencies will be competent authorities under the Water Framework Directive.

[1] Countryside Council for Wales (CCW), Natural England (NE), Environment Agency (for England and Wales), Environment and Heritage Service (Northern Ireland) (EHS), Joint Nature Conservation Council (JNCC), Scottish Environment Protection Agency (SEPA), Scottish Natural Heritage (SNH), Republic of Ireland's Department of Environment and Local Government (DELG)

[2] UKTAG Papers 11b(i) – Groundwater Chemical Classification; 11b(ii) – Groundwater Quantitative Classification; and 11b(iii) - Application of groundwater standards to regulation.

This report is not a consultation on the requirements of the Groundwater Daughter Directive or its transposition into local legislation. In England there will be a separate consultation by government on the Groundwater Daughter Directive. This will start during the summer of 2007, with public consultation on options for transposition.

THE NEED FOR A GROUNDWATER CLASSIFICATION SYSTEM

The Water Framework Directive

The Directive came into force in 2000. It sets objectives for groundwater (Figure 1):

1. Status objectives: achieve good status and ensure no deterioration of status;
2. "prevent or limit" the input of pollutants; and,
3. take measures to reverse any significant and sustained upward trends in pollutant concentrations.

Two of these objectives (status and trends) are new – there has been no requirement to classify groundwater bodies into good or poor status or identify upward trends in pollutants before. Prevent or Limit is not new – a similar regime is already established by the existing Groundwater Directive[1].

The objectives are complementary. For example, status deals with large scale pressures on groundwater bodies, whereas the prevent or limit objective protects all groundwater from pollution and is assessed at a local scale.

This report deals mainly with the first of the objectives noted above - the blue boxes in Figure 1. This objective requires an assessment of the status of groundwater bodies. Each body must be assessed for chemical and quantitative status, and classified as good or poor.

The final section of this report examines the links between the first two objectives - the connection between classification and regulation[2]. This report does not look at the third objective - the reversal of trends.

Objectives for groundwater set by the Water Framework Directive rely in part on the protection of, or meeting the objectives for, surface waters that are fed by groundwater. The objectives for groundwater must similarly protect wetlands[3] that depend on groundwater. The objectives for such surface waters and wetlands must be known before the classification of groundwater can be complete in all respects.

Classification and defining good status

Good status for groundwater involves meeting a series of "conditions" defined in Annex V of the Water Framework Directive. Additional conditions for chemical status and assessment procedures are elaborated in the Groundwater Daughter Directive[4].

[1] Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances.
[2] For example: controlling the input of pollutants to groundwater via permits or notices.
[3] Generally called terrestrial ecosystems for the Water Framework Directive.
[4] Directive 2006/118/EC on the protection of groundwater against pollution and deterioration. OJ L372/19

The "parameters" to be used in classification are:

- groundwater level regime for quantitative status; and,
- conductivity and the concentrations of pollutants for chemical status.

In both cases, the "parameters" must be used to help decide the measures needed to protect the groundwater body. The measures must also protect, as noted already, any surface waters and wetlands[1] that depend on the groundwater body.

Member States have to use the "parameters", with the "conditions", to set up classification systems.

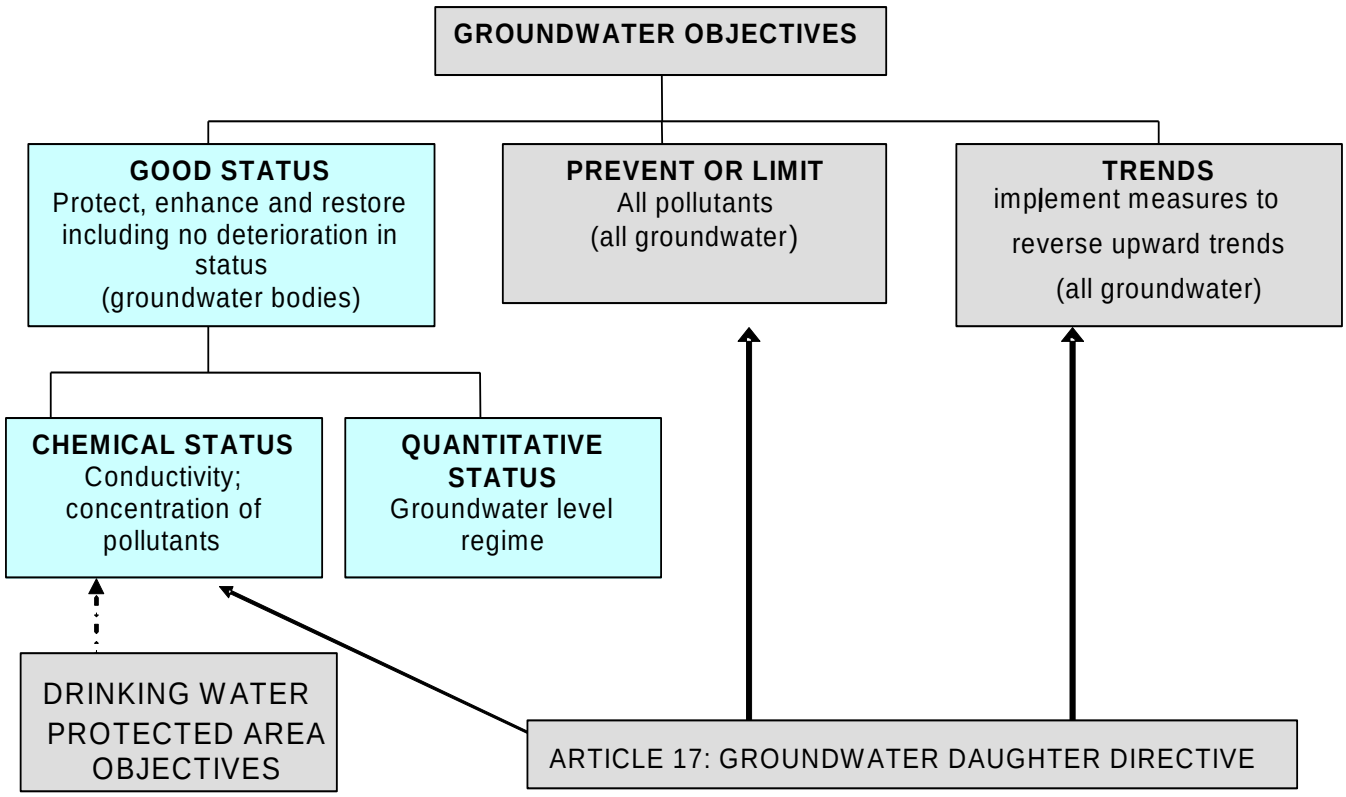


Figure 1: Groundwater objectives for the Water Framework Directive

[1] The "terrestrial ecosystems" of the Directive. Hence: groundwater dependant terrestrial ecosystems

The purpose of the classification system

To fulfill the requirements of the Water Framework Directive, the UKTAG proposes that its system applies to all groundwater bodies and that the environment agencies use it to derive the environmental standards[1] that will contribute to the determination of good status.

The UKTAG proposes that the environment agencies use these environmental standards as triggers for further investigation and that it is these investigations that decide whether the conditions for good status have been met (for chemical status this is a requirement of the Groundwater Daughter Directive). The environmental standards, and the action to achieve good status, will be published for consultation in 2008 in the draft River Basin Management Plans.

Existing standards for groundwater

Standards for groundwater are currently derived and used on an ad hoc basis to protect groundwater and to meet a range of legislative requirements. This process will not significantly change. The standards and conditions that are applied to environmental permits will now reflect all the objectives for the Water Framework Directive, including status. They are not necessarily the same as the standards set out in this report[2].

Comparisons with surface water

The requirements for classification set out in the Water Framework Directive and Groundwater Daughter Directive differ from those for the classification of surface water. For surface water, most of the standards define the boundaries of the classes and these classes reflect the ecology. Groundwater status does not directly reflect ecology but is required to take account of the needs of the particular rivers and wetlands[3] that depend on groundwater, the other uses of the groundwater body[4], as well as its general overall quality.

As a consequence, the classification of groundwater must reflect the unique features of each groundwater body and it is up to Member States to use their own systems, meeting the requirements of the Water Framework Directive and the Groundwater Daughter Directive. In doing this Member States will determine the environmental standards for each groundwater body.

For the chemical status of groundwater bodies, prescribed European standards and "threshold values" will be used as triggers for further investigation to determine whether

[1] For groundwater, the term “environmental standards” includes standards or conditions for water quantity, water quality standards, and the threshold values that will be discussed later in this report.
[2] Discussed at page 29 and in UKTAG Paper 11b(iii) – Application of groundwater standards to regulation.
[3] We use the term "receptors" for surface waters and wetlands that might be affected by groundwater.
[4] Such as for a water resource.

or not the conditions for good chemical status are met. The prescribed standards and threshold values do not by themselves define the actual boundary between good and poor status.

Future comparisons with other Member States

The other Member States are also developing classification systems for groundwater.

The UK and the Republic of Ireland have been working with other Member States on a project[1] funded by the European Union (EU) to develop a common method for deriving chemical threshold values for groundwater[2]. The outputs are being fed into the production of guidance as part of the EU's Common Implementation Strategy. This should help ensure a consistent approach.

River Basin Management Plans

Competent authorities are required to produce for public consultation by the end of 2008, drafts of the first River Basin Management Plans. For surface water, the plans will set out the objectives considered appropriate for each water body and, where the objective is less than good status by 2015, the reason for this. For groundwater, the plans will also give the environmental standards[3] for each water body.

To prepare these plans, the environment agencies will look at the existing condition of the water bodies and assess how far this falls short of the environmental standards, threshold values and other conditions associated with good status. The UK and the Republic of Ireland must do this for all water bodies identified as "at risk" of failing to meet good status[4].

In many cases the environment agencies will need to do more monitoring and assessment in order to complete this task. This monitoring will be targeted at the water bodies "at risk", and focus on the causes of these risks.

The UK and the Republic of Ireland will have to calculate by how much the pressures on each surface water body, and each groundwater body, would have to be reduced in order to achieve or maintain good status. It is an important aspect of the Water Framework Directive, that in making decisions on which measures are required, all the contributions to failure are investigated. This means looking at water quality, water quantity, and at the impact of man-made structures. It also involves assessing the contribution from groundwater to the failure of standards and conditions for surface waters.

[1] This is called BRIDGE (Background cRiteria for the IDentification of Groundwater thrEsholds).
[2] The EU has set up a formal process known as Intercalibration but only for surface waters. In Intercalibration, Member States work together to set criteria for targets for surface waters.
[3] Including the threshold values that have been set up for each groundwater body.
[4] Identified as "at risk" by the process of characterisation under Article 5 of the Water Framework Directive.

The competent authorities, in partnership with others, must appraise options to meet the objectives, and identify the most cost-effective combinations of measures.

Protecting the environment from deterioration

As well as achieving good status, there is the added objective to prevent deterioration of status[1]. For groundwater quality, the objectives that refer to status are complemented by the objective to "prevent or limit" the input of pollutants, and by the objective to reverse rising trends[3]. Full implementation of the "prevent or limit" objective will ensure there is no deterioration in status as a result of new contamination. This would also ensure, in due course, that upward trends are reversed[2].

The "prevent or limit" objective extends the regime of the existing Groundwater Directive[3]. The "prevent or limit" objective acts at a more local scale than the objectives expressed in terms of status. It aims to restrict local deterioration in chemical quality so that there is no harm to receptors[4], and no adverse effect on the use of the groundwater as a water resource.

Revising the classification system

The UKTAG believes its proposals are based on the best assessment possible, given current scientific understanding and the timetable of the Directive. The proposals have been developed by a group of groundwater experts from the UK and the Republic of Ireland in consultation with surface water colleagues and conservationists. The proposals have been subject to external peer review.

The UKTAG's final report on these issues will advise the UK administrations on the groundwater classification system that the environment agencies should use for the first River Basin Management Plans.

The system proposed by the UKTAG for the classification of the chemical status of groundwater bodies is prescribed in large part by the Groundwater Daughter Directive. The threshold values that result from implementing the system will be reviewed and consulted on every six years, as part of the cycles of River Basin Management Plans.

[1] Figure 1 and page 4
[2] Discussed in UKTAG Paper 11b(iii) – Application of groundwater standards to regulation
[3] Groundwater Directive (80/68/EEC) on the prevention of pollution of groundwater
[4] For example, all the surface waters and wetlands that might be affected by groundwater

OVERVIEW OF GROUNDWATER CLASSIFICATION

The process is carried out in the four stages described below and illustrated in Figure 2. Details are on the UKTAG website. The proposals in this report are for Stage 2 - the development of a method or system to use standards and thresholds that help determine whether the conditions for good groundwater status have been met.

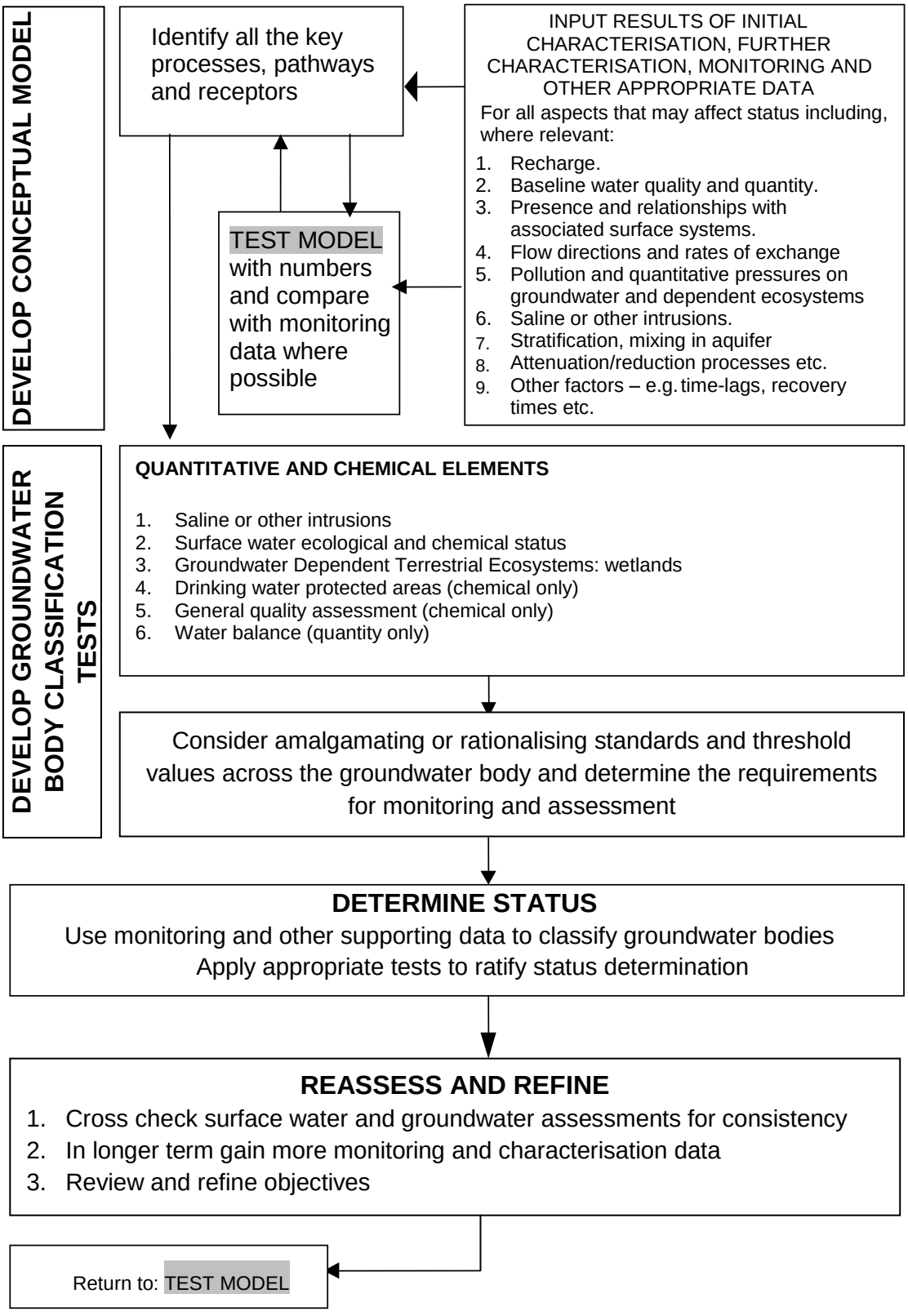
Stage 1: develop the conceptual model

The characteristics of a groundwater body make it difficult to determine how the system works, and how it interacts over time, for example, with rivers and wetlands:

- Groundwater is a widely distributed resource that is usually hidden from view and is difficult and relatively costly to investigate and monitor.
- The rate of groundwater flow is highly variable and normally slow compared with surface waters.
- Damaging activities that are taking place now may have no impact on the groundwater, or on the rivers and wetlands that depend on groundwater, for several months, years or even decades.
- The complex interactions of groundwater with geological media, surface water and ecosystems are difficult to discern.

For these reasons, the UKTAG proposes that conceptual modelling of the individual groundwater bodies be used by the environment agencies as a precursor to determining status. The conceptual model is a simplified representation of how the real groundwater body behaves. It is based on the analysis of field data. Any procedure that attempts to set standards or thresholds for the groundwater body as a whole, must take account of such a model.

Figure 2: The process of groundwater classification



Stage 2: develop the tests for a groundwater body

The proposed classification system is based on the "elements" defined in Annex V of the Water Framework Directive, and Annexes I – III of the Groundwater Daughter Directive. The elements are:

1. saline or other intrusions;
2. the objectives of the Water Framework Directive[1] for dependent surface waters including no deterioration in status;
3. damage to any wetlands that depend on the groundwater body;
4. Drinking Water Protected Areas;
5. a General Quality Assessment including the European standards for nitrate and pesticides in the Groundwater Daughter Directive. This affects the chemical status.
6. the water balance - the balance between abstractions and recharge (mainly replenishment by rainfall). This affects the quantitative status;

The six elements listed above have been developed into a series of tests.

Stage 3: determine status

This uses monitoring data to help classify and hence determine status. Ideally six years of data should be used. This links into the cycle of River Basin Plans.

For the first cycle, six years of monitoring data may not be available and the assessment will have to be carried out using what is available. If there are insufficient data to classify, the UKTAG proposes that the environment agencies report that the groundwater body is at good status, but with low confidence. This outcome should be used in setting priorities for further monitoring and investigation so that a better assessment can be made for the next River Basin Plan.

The assessment of status will be carried out over the next two years. The results will be published for consultation in 2008 as part of the draft River Basin Plan.

Stage 4: reassess and refine

This will be carried out as part of the six-year cycles of River Basin Plans.

Introduction to the tests for classification

[1] Article 4 of the Water Framework Directive

The tests assess whether a groundwater body meets all the criteria set out for good status. There are five chemical and four quantitative tests. Some are common to both the chemical and the quantitative classification. The tests are summarised in Table 1 and described later in this report. They are applied to the groundwater body as a whole.

Determining overall status for a groundwater body

The worst classification from the five chemical tests would be reported as the overall chemical status, and the worst classification from the four quantitative tests would be reported as the overall quantitative status. The confidence associated with the results for the worst case test would also be reported. This allows an estimate of the confidence that the assigned class is correct.

The results for chemical and quantitative status would then be combined to give an overall classification of good or poor (Figure 3). If either the chemical or the quantitative assessment is poor, then the overall class will be poor[1].

[1] This is the one-out all-out system required by the Water Framework Directive.

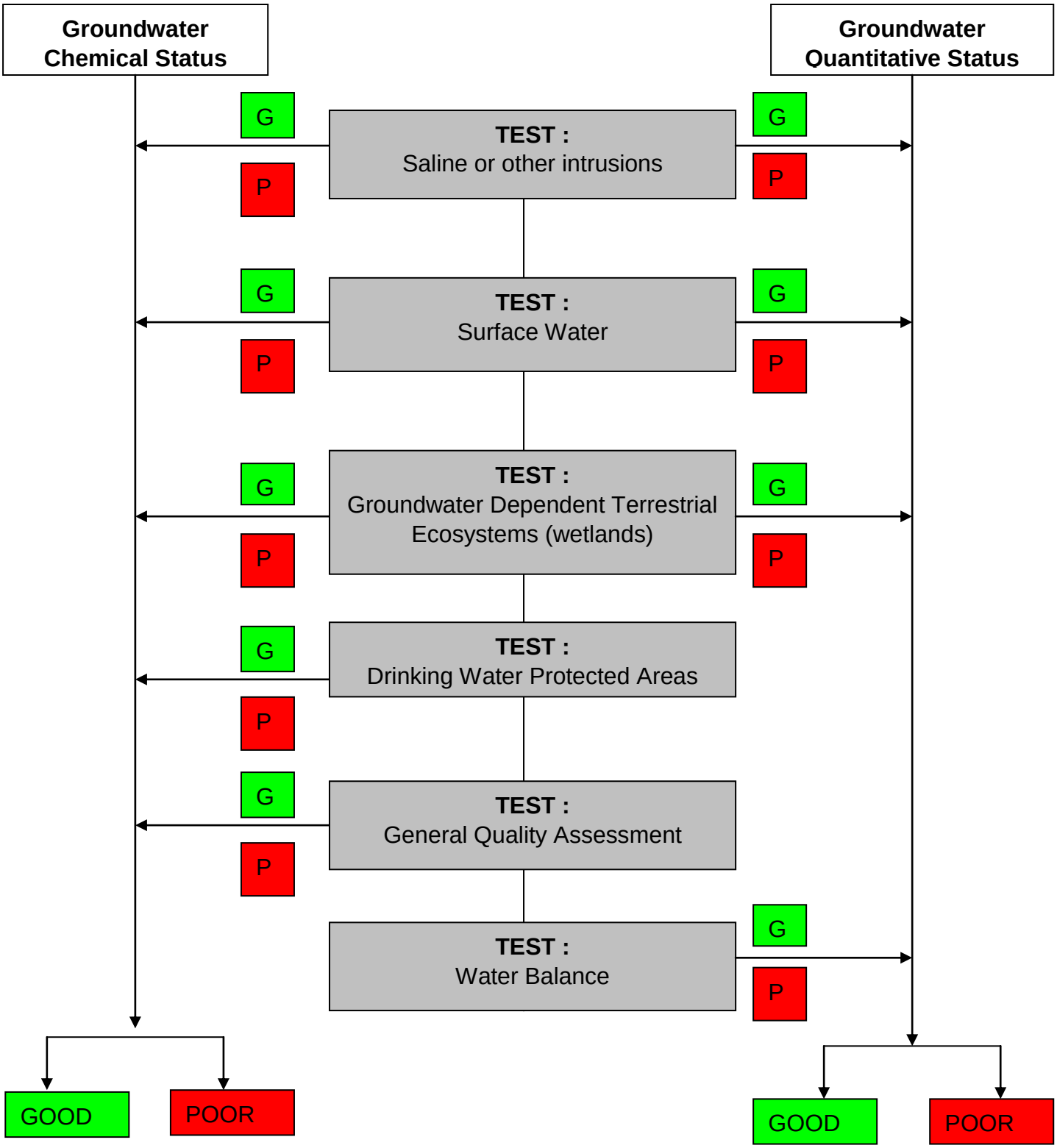
Table 1: Classification elements	
Classification Element[1]	Test
Common to both quantitative and chemical	
No saline or other intrusion Alterations to flow direction resulting from level changes may occur temporarily, or continuously in spatially limited areas, but such reversals do not cause salt water or other intrusion, and do not indicate a sustained and clearly identified anthropogenically induced trend in flow direction likely to result in such intrusions[2] Changes in conductivity are not indicative of saline or other intrusion into the groundwater body[3]	*Entry into the groundwater body of either:* saline water of higher conductivity or salinity from connate or sea water; or water of different chemical composition from other groundwater bodies or surface waters and which is liable to cause pollution.
Surface water No "failure to achieve the environmental objectives specified[4] for associated surface waters" nor "any significant diminution in the status of such waters"	No significant diminution of surface water chemistry and ecology
Groundwater Dependent Terrestrial Ecosystems (Wetlands) No significant damage to wetlands which depend directly on the groundwater body	No significant damage to these wetlands
Quantitative only	
Water Balance	The total abstraction is less than the recharge less the ecological needs of river bodies
Chemical only	
No deterioration in quality of waters for human consumption[5]	Meet the requirements for Drinking Water Protected Areas[6]
No significant impairment of human uses[7]	General Quality Assessment: the assessment of the quality of the groundwater body as a whole
No significant environmental risk from pollutants across a groundwater body[8]	

Note : The "parameters" to be used in classification are:

- groundwater level regime for quantitative status; and,
- conductivity and the concentrations of pollutants for chemical status.

[1] All impacts must arise from human activity
[2] Water Framework Directive: Annex V 2.1.2
[3] Water Framework Directive: Annex V 2.3.2
[4] Under Article 4 of the Water Framework Directive
[5] Groundwater Daughter Directive: Article 4.2 b (iii)) and paragraph 4, Annex III
[6] Under Article 7(3) of the Water Framework Directive
[7] Groundwater Daughter Directive Article: 4.2 b (iv)
[8] Groundwater Daughter Directive Article 4.2 b (i) and paragraph 3, Annex III

Figure 3: Summary of the tests used in classification



The results of each test are combined on a "one out all out" basis for overall classification of POOR or GOOD STATUS for both quantity and chemical. The worst result of these is then reported for the groundwater body overall.

GROUNDWATER CLASSIFICATION – KEY PRINCIPLES

(1) The procedure for classification is set in legislation

The principles are set in the legislation for the Water Framework Directive and Groundwater Daughter Directive.

(2) The scale of application

Status is determined for, and describes the condition of, whole groundwater bodies. Groundwater bodies are normally large (tens to hundreds of square kilometres) and are usually associated with several surface water bodies.

(3) Classification and characterisation

The process follows logically from the risk assessments and the characterisations carried out for the Water Framework Directive. As a result of these, groundwater bodies are grouped as "at risk" or "not at risk" of failing good status.

Groundwater bodies that are "not at risk" are automatically classed as good status. As required by the legislation, the tests described in this report, and which determine status, are carried out only on groundwater bodies that are "at risk".

In accordance with good practice for risk assessment and as an aid to the rapid assessment of the potential for not meeting good chemical status, "screening values" are proposed in this report. These will be used to improve the risk assessment[1]. If a screening value is exceeded this indicates that there is an impact from human activity that needs to be assessed as part of classification.

(4) The different types of standards

Groundwater quality standards are a combination of standards set by the European Union and "threshold values". As noted above, the threshold values are the standards established by Member States[1]. They can be national standards or set for a particular groundwater body. European Standards have been set only for nitrate and pesticides.

If all the European Standards and all the threshold values are met the groundwater body is at good chemical status. The failure of any European Standard or the failure of any threshold value triggers further investigation to determine whether the conditions for good status have been met. In this sense, the European Standards and the threshold values do not by themselves represent the boundary between good and poor status. This is a key difference to most of the surface water standards.

[1] As described in UKTAG Paper 11b(i) - Groundwater Chemical Classification

No standards have been set for the quantitative aspects of groundwater status. The approach is to determine, based on weight of evidence, whether the abstractions cause measurable and unacceptable impacts either on the groundwater body, or on associated surface water bodies.

(5) Investigative approach

The variety of classification elements, the volume and precision of monitoring data, and the uncertainties in our understanding of groundwater flow and quality, contribute to uncertainty in the classification process. Whilst the Water Framework Directive emphasises the use of monitoring data during classification, the Groundwater Daughter Directive allows other data to be taken into account in chemical classification, if any of the threshold values or European Standards are exceeded.

A weight of evidence approach, with monitoring data complemented by conceptual understanding and data on risk assessment, is essential to ensure the reliable classification of groundwater bodies and subsequent proper targeting of measures in River Basin Planning.

(6) Multiple receptors and multiple standards

The definitions of good chemical and quantitative status, and the standards and threshold values that determine status, depend on the condition of, for example, all the wetlands and rivers that rely on groundwater. Each of these may have different sensitivities to water level and/or pollutants. As a result it is possible that different environmental standards may apply within a single groundwater body.

(7) Monitoring and classification

The classification depends on good data from monitoring. To provide these, long-term programmes must be established. Good monitoring requires:

- The location of the sites should be based on a conceptual understanding of the groundwater system, taking into account the way water moves underground and to rivers, and the objectives for the groundwater body.
- The selection of the parameters should be based on the existing or potential pressures, the need to understand the natural (or baseline) characteristics, and the need to collect other information for classification.
- The level or frequency of monitoring should be sufficient to take account of both short and long-term variations, be good enough to assess trends, and allow the estimation of the necessary summary statistics[1].

[1] To provide unbiased estimates; to be able to assess the statistical errors in the estimates of summary statistics; to assess trends and summary statistics with the required levels of statistical confidence

(8) Classification standards and regulatory standards

The standards and conditions that are applied to environmental permits will reflect not only the requirements for chemical status but also the other groundwater objectives of the Water Framework Directive, including the requirements discussed above and later to "prevent or limit" the input of pollutants (page 30). This means that the particular standards and conditions used for permits to control the input of pollutants to groundwater are not the standards and threshold values described in this paper and used for classification of water bodies as a whole.

PROPOSALS FOR CHEMICAL STATUS

As previously mentioned, the proposed classification scheme for quality is divided into five tests, using the criteria set out in the Water Framework Directive and its Groundwater Daughter Directive. Technical details are provided in a further UKTAG paper [1].

The proposals of the UKTAG, documented in the following pages, are set out as follows:

- A summary of the features of each test including:
  - why it is needed[2];
  - the key concept behind the test;
  - what the test involves - and the conditions for meeting good status;
  - the proposed criteria for classification (the screening values, threshold values and quality standards);
  - where the test should be applied - at what points in the groundwater body;
  - how the test should be done;
  - the chemical parameters included.

[1] UKTAG Paper 11b(i) - Groundwater Chemical Classification
[2] In all cases this is because it is set in the legislation for the Water Framework Directive and the Groundwater Daughter Directive

Chemical Test 1: saline or other intrusions

Why undertake this test? - the element is set in the legislation

Good status occurs when "changes in conductivity are not indicative of saline or other intrusion into the groundwater body"[1]. We need to identify entry into the groundwater body of either:
(a) saline, connate or sea water of substantially higher conductivity or salinity than the background groundwater;
(b) water of substantially different chemical composition from other groundwater bodies or surface waters and which is liable to cause pollution.

Key concept:

Status, and the presence of an intrusion of poor quality water, is determined through an assessment of trends in conductivity or other indicator substances. The test is designed to detect the presence of an intrusion that is induced by the pumping of groundwater.

What is the test?

The conditions for good chemical status are not met when a threshold value is exceeded and there is either: a significant and sustained rising trend in one or more key parameters at relevant monitoring points; or an existing significant impact on a point of abstraction as a consequence of intrusion.

Trigger for the test: elevated chloride or conductivity, or pressure from abstraction
Screening value: for natural substances, the upper limit of the range of natural background for each monitoring site
Threshold value: the same as the screening value but used in combination with the assessment of trend

Where is the test conducted?

At monitoring points identified as representative of potential intrusion.

How would we do the test?

- Is the mean of the last 6 years greater than the natural background and is there evidence of pressure (from the quantitative assessment)?
- Is there a trend, or is there an existing significant impact on a point of abstraction?

If the answer is "yes" to both questions, the groundwater body is poor status.

Which chemical parameters?

The test should be done for all relevant chemical parameters where characterisation has identified that the groundwater body is "at risk" of not meeting good status for saline or other intrusions. As a minimum, conductivity should be assessed. For groundwater bodies "at risk" from intrusions other than saline, additional parameters can be selected.

Chemical Test 2: surface water

[1] Water Framework Directive: Annex V 2.3.2

Why undertake this test? - the element is set in the legislation

Good status: "the chemical composition of the groundwater body is such that the concentration of pollutants are not such as would result in failure to achieve the environmental objectives specified under Article 4 for associated surface waters nor any significant diminution of the surface water ecological or chemical quality of such bodies"[1]. We need to identify the impacts on surface water caused by groundwater quality.

Key concept:

Status is determined by combining the results of the surface water classification and an assessment of the chemical inputs from groundwater bodies into surface water bodies[2]. There is a need to assess whether this contribution, or any consequent impact on surface water ecology, is sufficient to threaten the objectives of the Water Framework Directive.

What is the test? Good chemical status is not achieved when an associated surface water body does not meet its objectives, threshold values are exceeded and groundwater contributes at least 50% of the relevant surface water standard.

Trigger for the test: the surface water is less than good status
Screening value: the Environmental Quality Standard (EQS) for the surface water body (with a check against the natural background concentrations)
Threshold value: the surface water EQS adjusted for the effects of dilution and, where appropriate, for attenuation within the groundwater environment.

Where is the test conducted?

Depending on the type of pollution, monitoring data are aggregated across a groundwater body (or bodies) or assessed at individual points (identified as representative of potential pressures).

How would we do the test?

Compare the mean of last 6yrs monitoring data with the TV. Is the TV exceeded? If "yes" and the cause is human activity, calculate the chemical loading to the surface water. Does the contribution from groundwater exceed 50 per cent of the surface water standard? If so, the groundwater body is poor status

Which chemical parameters?

These depend on the characterisation of risks and the assessments of the status of the surface waters. Where a surface water body fails its objectives (good status or good ecological potential), the assessment should be carried out for the pollutants responsible for the failure.

[1] Water Framework Directive: Annex V; 2.3.2
[2] rivers, standing waters, estuaries etc

Chemical Test 3: Groundwater dependent terrestrial ecosystems (wetlands)

Why undertake this test? - the element is set in the legislation

Good status occurs if: “the chemical composition of the groundwater body is such that the concentration of pollutants are not such as would result in any significant damage to terrestrial ecosystems which depend directly on the groundwater body”[1]. We need to identify impacts on these wetlands caused by groundwater quality.

Key concept:

Status is determined through a combination of the assessment of the condition of wetlands and an assessment of the chemical inputs from groundwater bodies into wetlands. Is the contribution from groundwater quality to the wetland sufficient to cause significant damage?

What is the test?

Conditions for good chemical status are not met when a dependent wetland is (or is at risk of being) significantly damaged, threshold values are exceeded and groundwater contributes a significant proportion of the inputs. The test of significance will be determined on a case by case basis, taking into account the functioning of the wetland using the surface water significance test (Test 2 above) as a guiding principle.

Trigger for the test: a damaged wetland or wetland at risk of being damaged

Where is the test conducted?

Monitoring data are assessed for points in the groundwater body identified as representative of potential pressures on wetlands from pollution.

How would we do the test?

Identify damaged wetlands and ascertain whether the supporting chemical conditions in the wetland are being met. If "no", check if threshold values are exceeded at the relevant monitoring points in the groundwater body as a result of human influences, and if the contribution from groundwater is significant compared with other chemical pressures? If the answer is "yes" to both these points, then the groundwater body has poor status.

Which chemical parameters?

These depend on the results of characterisation of risk and the assessment of the condition of each dependent wetland. The assessment should be carried out for the pollutants responsible for the damage (or risk of damage) to the wetland.

[1] Water Framework Directive: Annex V 2.3.2

Chemical Test 4: Drinking Water Protected Areas

Why undertake this test? - the element is set in the legislation

Good status: we interpret this as a requirement (as a minimum) to prevent deterioration in groundwater quality and so avoid the need for new or additional treatment of abstractions for drinking water[1]. We need to identify trends that might lead to additional treatment.

Key concept:

Good chemical status is met when, at the point of abstraction for water intended for human consumption, there is no deterioration in groundwater quality due to human influences that could lead to an increase in water treatment. This test assesses trends in quality from the current baseline and the relationship of this baseline to standards for drinking water.

What is the test?

Conditions for good chemical status are not met when there is a significant and sustained rising trend in a key parameter at the point of abstraction and the threshold value is exceeded.

Trigger for test: the threshold value is exceeded
Screening value: an appropriate percentage of the Drinking Water Standard, or some other requirement of the Drinking Water Directive[2].
Threshold value: the screening value, but used in combination with the assessment of trend.

Where is the test conducted?

At the point of abstraction of "water intended for human consumption" as defined in the Drinking Water Directive. Abstractions that come within the scope of the Drinking Water Directive must be considered but not all abstractions need to be assessed. Representative sites are selected on the basis of the conceptual model of the groundwater body, the assessment of pressures and impacts, and knowledge of the pattern of abstraction.

How would we do the test?

- Is mean of last 6 years greater than the threshold value and is this due to human influences?
- Is there an upward trend in pollutant concentrations due to human influences?

If the answer is "yes" in both cases, the groundwater body is poor status.

Which chemical parameters?

All parameters within the scope of the Drinking Water Directive are assessed, including chemical, microbiological and radiological. For some there may be no formal standard. To meet the requirement of the Drinking Water Directive to take account of "any other requirements to ensure that drinking water is free from contamination that could constitute a danger to human health" responsible bodies may have defined a value that represents no risk to human health. In this context both the Drinking Water Standard and these "other requirements" are used.

[1] Groundwater Daughter Directive: Article 4 2 (c) (iii) and paragraph 4, Annex III: "for bodies of groundwater identified in accordance with Article 7(1) of Directive 2000/60/EC, the requirements of Article 7(3) of that directive are being met…"
[2] As described in Annex II of UKTAG paper 11b(i) - Groundwater Chemical Classification

Chemical Test 5: General Quality Assessment

Why undertake this test? - the element is set in the legislation

Good status: "…the concentrations of pollutants exceeding the groundwater quality standards or threshold values are not considered to present a significant environmental risk, taking into account, where appropriate, the extent of the body of groundwater which is affected;" and "the ability …to support human uses has not been significantly impaired ..."[1]. This is an assessment of the groundwater body as a whole. We need to identify large-scale quality problems that may impede, now or in the future, the legitimate use of the groundwater.

Key concept:

Status is determined through an assessment of the areal extent of a groundwater body exceeding an EU Standard or a threshold value. Is pollution of sufficient extent to compromise either the prescribed standards or human uses of the body as a whole? The test is not intended to assess local pollution.

What is the test?

Good chemical status is not met when a threshold value or EU Standard is exceeded at monitoring points, and a representative aggregation of the data at the groundwater body scale indicates a significant environmental risk or a significant impairment of human uses.

Trigger for the test: concentrations of pollutants, or the data from the characterisation of risk, exceed background levels.
Screening value: nitrate 37.5 mg/l; pesticides 0.075 ug/l (individual) and 0.375 ug/l (total); natural substances – the upper limit of the range of natural background; synthetic substances – the limit of detection.
Standards and Threshold values: the appropriate percentage of[2]:
(a) the nitrate standard: 50 mg/l – from Annex I of the Groundwater Daughter Directive
(b) the pesticide standard: 0.1ug/l (individual) and 0.5 ug/l (total) – also from Annex 1
(c) any relevant use based standard for synthetic substances (becomes a threshold value);
(d) for natural substances – upper limit of the range in natural background, or a relevant use based standard, whichever is the most stringent (becomes a threshold value).

Where is the test conducted?

At individual monitoring points using the mean of the last six years of data. The test is carried out only where there is sufficient monitoring across the groundwater body (or group of bodies) to assess the potential for a widespread impact.

How would we do the test?

The data from sites representative of the groundwater body or group of groundwater bodies are aggregated and compared with standards or thresholds.

Which parameters? Only pollutants for which an EU standard is set (nitrates or pesticides), or for which the risk characterisation process has indicated a risk of significant impairment of human uses.

[1] Groundwater Daughter Directive: Article 4 2 (c) (i) and (iv)
[2] Using the procedure in Annex II of UKTAG paper 11b(i) - Groundwater Chemical Classification

PROPOSALS FOR QUANTITATIVE STATUS

As previously mentioned, the proposed classification scheme for groundwater quantity is divided into four tests. Technical details can be found in a further UKTAG Paper[1].

The proposals, documented in the following pages, are set out as follows:

- A summary of the key features of each test including:
  - why it is needed[2];
  - the key concept behind the test;
  - what it involves - and the conditions for meeting good status;
  - the proposed classification criteria (screening values, threshold values and quality standards;
  - where the test should be applied - at what points in the groundwater body;
  - how the test should be done;
  - which parameters are to be tested.

Quantity Test 1: saline or other intrusions

This is the same as the chemical classification test described on page 19.

[1] UKTAG Paper 11b(ii) - Groundwater Quantitative Classification
[2] In all cases this is because it is set in the legislation for the Water Framework Directive.

Quantity Test 2: surface water

Why undertake this test? - the element is set in the legislation

Good status: "the level of groundwater is not subject to anthropogenic alterations such as would result in failure to achieve the environmental objectives specified under Article 4 for associated surface waters or any significant diminution in the status of such water"[1].

Key concept:

Status is determined through a combination of the results of the surface water classification based on river flows, and an assessment of the scale of the impact that groundwater abstractions have on river flows. The test determines whether the impacts of groundwater abstractions on river flows, or any consequent impact on surface water ecology, are sufficient to threaten the objectives of the Water Framework Directive.

What is the test?

Conditions for good groundwater quantitative status are not met when an associated surface water body does not meet its objectives because of groundwater abstraction impacts on river flows, and at least 50 per cent of the allowable abstraction[2] can be attributed to groundwater.

Trigger for the test: river flows are below the recommended limits.

Where is the test conducted?

A representative point is chosen for a surface water body, downstream of the relevant abstractions from surface water and groundwater.

How would we do the Test?

We would determine the effect on river flows of existing abstractions and discharges. Is the allowable abstraction exceeded? If "yes", we calculate the contribution of groundwater abstractions as a percentage of the allowable abstraction. Does the contribution exceed 50 per cent of the allowable abstraction? If "yes", then the groundwater body has poor status. Otherwise the groundwater body is good status for this test.

[1] Water Framework Directive: Annex V: 2.1.2

[2] Allowable abstraction rates from rivers (based upon flow standards) are proposed in the UKTAG's first report on environmental standards

Quantity Test 3: Groundwater dependent terrestrial ecosystems (wetlands)

Why undertake this test? - the element is set in the legislation

Good status: "The level of groundwater is not subject to anthropogenic alterations such as would result in any significant damage to terrestrial ecosystems which depend directly on the groundwater body"[1]. We need to identify impacts on wetlands caused by altered groundwater levels or flows.

Key concept:

Status is determined through a combination of the assessment of the condition of wetlands and an assessment of the effects on wetlands of changes in levels within groundwater bodies. The test estimates whether the changes in the water levels or flows within the wetland are sufficient to cause significant damage.

What is the test? -

Conditions for good quantitative status are not met when a dependent wetland is significantly damaged, **and** the pressures in the groundwater body give rise to significant proportion of the changes in water levels or flows. The test of significance would be determined on a case by case basis, taking into account the functioning of the wetland and using principles that are similar to those for the surface water test (Quantity Test 2, above).

Trigger for test: a damaged wetland or wetland at risk of being damaged.

Where is the test conducted?

Monitoring data are assessed at points within the wetland that are representative of potential pressures.

How would we do the test?

Identify the damaged wetlands. Are the supporting conditions for level and flow in the wetland being met? If the answer is "no", is the departure from the required environmental conditions at relevant monitoring points in the wetland caused by anthropogenic influences in the associated groundwater body? And is the contribution from groundwater significant compared with other quantitative pressures? If the answer is "yes" to both of these points, the groundwater body is poor status. Otherwise the body is good status for this test.

[1] Water Framework Directive: Annex V: 2.1.2

Quantity Test 4: water balance

Why undertake this test? - the element is set in the legislation

Good status: “The level of groundwater in the groundwater body is such that the available groundwater resource is not exceeded by the long term annual average rate of abstraction"[1].

"available groundwater resource" means the long term annual average rate of overall recharge of the body of groundwater less the long-term annual rate of flow required to achieve the ecological quality objectives for associated surface water specified under Article 4, to avoid any significant diminution in the ecological status of such waters and to avoid any significant damage to associated terrestrial ecosystems[2].

Key concept:

Status is determined by an assessment of the available groundwater resource within a groundwater body. The test asks whether abstractions exceed the available resource, having determined the quantity of water needed to meet the flows required to support the ecology of rivers.

What is the test?

Conditions for good quantitative status are not met when the total of the long term annual average abstraction exceeds the available resource.

Where is the test conducted?

The test is carried out across a whole groundwater body. It considers all the surface water bodies that cross it.

How would we do the Test?

(1) Estimate the long term annual average recharge;
(2) Calculate the long term annual average abstraction;
(3) Estimate the contribution from groundwater, as an annual average, needed to support river ecosystems across the groundwater body
(4) The available resource is calculated by subtracting the result of step (3) from that in step (1).

If total abstractions (step 2) exceed the available resource (step 4) then the groundwater body is poor status. Otherwise it is at good status for this test.

[1] Water Framework Directive: Annex V: 2.1.2
[2] Water Framework Directive: Article 2 Definitions 27

THE IMPLICATIONS

This is the first time a groundwater classification has been developed for the UK and the Republic of Ireland. As such the UKTAG cannot point to differences in the numbers of waters in good classes as a result of its proposals. In addition the results of classification will not be known until the system has been used to:

(1) determine the particular threshold values for the individual groundwater bodies;

(2) assess the overall status of each groundwater body.

The environment agencies will report results for consultation in late 2008 as part of the draft River Basin Management Plans. They will be incorporated into the final Plans for the first cycle in late 2009.

In the meantime, Table 2 gives the findings from the Water Framework Directive's exercise of characterisation. This shows the current understanding of the risks of not meeting good status by 2015.

Table 2: Characterisation of groundwater for the UK and the Republic of Ireland

	Number of water bodies		Per cent of water bodies	Area (square kilometres)	Per cent of area
Scotland (2007)	Total	343	-	78,390	-
	At risk	196	57.1	26,159	33.4
England (2004)	Total	310	-	108,252	-
	At risk	259	83.5	84,419	78.0
Wales (2004)	Total	46	-	22,458	-
	At risk	17	37.0	5,456	24.3
Northern Ireland (2004)	Total	67	-	13,587	-
	At risk	15	22.4	6,009	44.3
Republic of Ireland (2004)	Total	757	-	68,900	-
	At risk	459	60.6	18,400	26.7

CLASSIFICATION AND REGULATION

In order to meet the status objectives for groundwater bodies, a combination of measures will be included in the River Basin Management Plans. These Plans must also include measures to meet the other objectives for groundwater, particularly that to "prevent or limit" the inputs of pollutants. Achieving this latter objective will contribute to meeting objectives framed in terms of status. It will be done mainly by using the regulatory mechanisms currently available to the environment agencies.

The environment agencies anticipate no fundamental changes to existing regulatory regimes as a consequence of the classification of groundwater for the Water Framework Directive. The relationship between the standards and thresholds used for classification and those used in regulation is summarised below.[1]

Regulation of abstractions

As discussed above, for the quantitative status for groundwater bodies, competent authorities will use regulatory controls when managing water resources to ensure that:

- the long term annual average abstraction does not exceed the long term annual average recharge less an allowance for the flow required for the ecology of rivers;
- enough water remains in the groundwater body to ensure that the ecology of dependant wetlands[2] is not damaged; and
- no saltwater or other intrusions are induced as a result of abstraction.

Regulation of the input of pollutants

To affect a receptor[3] a pollutant must move through the groundwater. This movement varies with the physical and chemical characteristics of the geological strata. The pollutant may be subject to dilution and attenuation[4] along its way from an input to a receptor.

For this reason some inputs of pollutants may have little or no impact on the receptors noted in the definition of good chemical status of groundwater. But these inputs may still cause local pollution.

Under the Water Framework Directive and the Groundwater Daughter Directive it is possible to have local pollution in a groundwater body of good chemical status.

[1] More detail can be found in UKTAG Paper 11b(iii)– Application of groundwater standards to regulation.
[2] Referred to by the Directive as Groundwater Dependant Terrestrial Ecosystems
[3] For example, the surface waters and wetlands that might be affected by groundwater
[4] Such as chemical decay

However, the more widespread the pollution, the more likely the groundwater body will be poor status.

Compared with the requirements for good status, the "prevent or limit" objective provides protection to all groundwater, to a wider range of receptors, and at a more local scale. "Prevent or limit" measures are the first line of defence in preventing pollution. In contrast, the assessment of status will provide a six yearly review of the general condition of a groundwater body.

The requirements to "prevent or limit" complement those for status. Notwithstanding the time needed to enable the historical legacy of releases to degrade or disperse, if all the "prevent or limit" requirements were met everywhere within a groundwater body, it would be at good chemical status.

All discharges, disposals or other activities that release listed[1] substances to groundwater are subject to controls under the existing Groundwater Directive[2]. The requirements are implemented through a range of regulatory regimes. Subject to enabling legislation, the environment agencies will apply the wider requirements of "prevent or limit" to the regulatory regimes within their control[3].

These wider requirements apply to inputs of pollutants outside the reach of current regimes. For example, many sources of diffuse pollution are not subject to controls via permits or notices. A range of regulatory and non-regulatory measures may be necessary. In some cases other regulatory bodies or third parties may operate these.

Regulatory regimes that control inputs of pollutants to groundwater should in future reflect all the groundwater objectives in the Water Framework Directive (See Figure 1 - status, trends, protected areas and prevent or limit). The threshold values and standards that contribute to the assessment of status may differ from the controls that are applied to inputs of pollutants at a local scale.[4]

[1] Substances listed for the Groundwater Directive (80/68/EEC)
[2] Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances.
[3] This includes the regimes for Pollution Prevention and Control, landfill, discharges to ground, and contaminated land
[4] More detail can be found in UKTAG Paper 11b(iii) – Application of groundwater standards to regulation.

REFERENCES

[1] Groundwater Chemical Classification for the purposes of the Water Framework Directive and the Groundwater Daughter Directive. Final draft. April 2007

[2] Groundwater Quantitative Classification for the purposes of the Water Framework Directive. Final Draft. April 2007

[3] Application of Groundwater Standards to Regulation. Final Draft. April 2007.

The above can be accessed from:
http://www.wfduk.org/stakeholder_reviews/stakeholder_review_1-2007/sr1-2007-gwreports/