SEPA
Scottish Environment Protection Agency

Draft River Basin Management Plan for the Scotland River Basin District

Foreword

The Scotland river basin district has a reputation for having a high quality water environment. Our rivers, lochs, estuaries and seas are important and well-loved areas – interwoven into our way of life, supporting the best of our natural heritage and attracting tourists from all over the world. Our water environment is also very important for our economy and is integral to the success of many of our industries such as salmon farming, shellfish farming, tourism and distilleries.

We all depend on our water environment and have a responsibility for its care. In recognition of the high value of our waters, statutory agencies, private companies and non-governmental organisations have come together for the first time to produce a plan that looks at all aspects of water management in the Scotland river basin district.

The vision of the plan is to take care of and protect our valuable waters, enhance and add value to our water environment where it is needed most while ensuring we achieve sustainable economic development and protect the interests of those who depend on our water environment for their quality of life.

We will all need to work together to achieve these ambitious goals. Partnership projects between statutory organisations, non-governmental organisations, private companies and individual landowners will be particularly important for our success.

The plan describes the condition of our water environment covering groundwater, rivers, lochs, estuaries and coastal waters and sets out the actions needed to deliver environmental improvements up to 2027. It is a technical document which explains how we will work together to deliver our objectives. A series of area management plans provide regional information and describe local actions.

The plan has been produced for consultation and provides you with the opportunity to present your views and opinions on the proposed actions and environmental objectives set, and to contribute to the river basin planning process in Scotland.

Your consultation responses will support and inform the production of the final river basin management plan for the Scotland river basin district in 2009. The final plan will provide the framework within which we all work to manage, protect and improve our water environment and its natural heritage, supporting sustainable economic development and improving the quality of life for the people of Scotland.

Executive summary

River basin management planning represents a new era in the management of all aspects of Scotland's water environment. In recognition of the high value of our Scottish waters statutory agencies, private companies and non-governmental organisations have come together to produce the first draft river basin management plan for the Scotland river basin district. We are now putting this plan out for consultation. The feedback on the draft plan will help us produce the final plan by December 2009.

The aim of the plan is to:

- protect and improve the water environment in the Scotland river basin district;
- achieve sustainable economic development;
- protect the interests of those who depend upon our water environment for their quality of life.

The Scotland river basin district has fewer environmental problems than most others in the UK. The good quality of many of its waters supports tourism, some of the best salmon runs in the UK and a wide range of businesses that rely on quality water. Many of its waters are identified as protected areas because of their importance for nature conservation, economically important species of fish or shellfish, bathing or drinking water supply. It is therefore vital for us to protect our valuable water environment and, wherever possible, prevent our waters from deteriorating.

We have dramatically reduced water pollution over the past few decades resulting in major improvements in the quality of our waters. However, the Water Framework Directive requires us to consider impacts that go beyond pollution and also consider the impacts of water abstraction, impoundment, engineering activities and invasive non-native species.

New monitoring and classification systems have been put in place to help assess environmental impacts from the mountains to the sea. The initial results indicate that 60% of waters in the Scotland river basin district are classified as good status or better.

The key water management issues for those water bodies not achieving good status or better in the district are summarised in the box below.

Key water management issues for the Scotland river basin district

- Abstraction and flow regulation for electricity generation, drinking water supply and agricultural abstraction
- Diffuse pollution from rural and urban land
- Point source pollution from sewage, mining and quarrying and aquaculture
- Changes to the physical habitat (morphology) of a watercourse from engineering activities and agriculture
- Invasive non-native species

This draft plan sets realistic objectives for the next three river basin planning cycles to 2015, 2021 and 2027 recognising the need to balance the management of our water environment in the long term and the interests of those who depend on it.

A programme of measures (actions) to deliver these objectives has been drawn up through a network of national and area advisory groups made up of stakeholder organisations with an interest in the water environment. The programme includes existing regulatory, economic and voluntary measures as well as measures put in place for the river basin management plan. Examples include the Water Environment and Water Services (Controlled Activities) (Scotland) Regulations 2005 (CAR) and voluntary measures such as the removal of fish barriers.

The implementation of these planned actions will result in 67% of our water bodies achieving at least good status by 2015, giving an overall environmental improvement of 7% between 2007 and 2015.

However, even if we implement all the measures in this draft river basin management plan, there will still be pressures to be addressed including:

- nutrient enrichment of waters;
- changes in the physical habitat of our rivers;
- barriers to fish migration;
- invasive non-native species.

A set of additional measures and actions focusing on these remaining pressures is therefore being considered to deliver more effective and sustainable management of the water environment. These are set out in the Scottish Government's consultation on continued improvements.

Between now and the publication of the final river basin management plan for the Scotland river basin district, a number of steps will be taken including:

- refinement of classification assessments (ongoing);
- review and revision of objectives;
- identification of measures (ongoing);
- development of sector/implementation plans;
- consideration of all the responses to the consultations on this draft plan and supporting documents.

Once finalised, the river basin management plan will provide the Scotland river basin district with a comprehensive framework for co-ordinating and integrating the management of our inland, coastal and ground waters. This is the first time an integrated approach has been adopted in Scotland and partnership working will be essential for its successful delivery. So too will be the linking of river basin planning with other important planning processes. In addition all public bodies will have to have regard to the plan when carrying out duties that may affect the river basin district. This integrated approach will help ensure we achieve our objectives effectively and, as a result, deliver a wide range of benefits for the environment and people of Scotland.

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Maps

List of abbreviations

AAG	Area Advisory Group
AMP	Area Management Plan
AWB	artificial water body
CAR	Controlled Activities Regulations
GEP	good ecological potential
GIS	geographical information system
HMWB	heavily modified water body
LBAP	Local Biodiversity Action Plan
NAG	National Advisory Group
Q&S	Quality and Standards
RBD	River Basin District
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SPA	Special Protection Area
SRDP	Scotland Rural Development Programme
SSSI	Site of Special Scientific Interest
UKTAG	UK Technical Advisory Group
WFD	Water Framework Directive
WTW	water treatment works

Section 1 About this plan

1.1 Why do we need this plan?

The production of this draft river basin management plan (RBMP) for consultation is one of the requirements of the Water Framework Directive (WFD)[1] – legislation that will see similar plans being put in place across Europe. Publication of this draft plan represents an important step in the river basin planning process established under Water Environment and Water Services (Scotland) Act 2003 (WEWS) – the transposing legislation for the Scotland river basin district (RBD).

Once finalised after consultation, the plan will provide Scotland with a comprehensive framework for co-ordinating and integrating the management of our inland, coastal and ground waters. The WEWS Act[2] requires all public bodies to take account of the plan when undertaking functions that may have an effect on the river basin district. As part of the river basin planning process we will produce a river basin management plan for the district every six years.

The WEWS Act requires the RBMP for the Scotland river basin district to take an integrated approach to the protection, improvement and sustainable use of the water environment. It applies to groundwater and surface waters (rivers, lochs, estuaries and coastal waters out to three nautical miles) as well as wetlands directly associated with groundwater or surface waters.

Further information on the Water Framework Directive can be found on the European Union website,[3] information on the WEWS Act on the Scottish Government website[4] and more information on river basin planning on SEPA's website.[5]

1.2 What does this plan do?

This draft river basin management plan describes the condition of the rivers, lochs, estuaries, coasts and ground waters in the Scotland river basin district. Although Scotland's reputation for a high quality water environment is true for many of our rivers, lochs, estuaries, seas and groundwater resources, others are under pressure from human activity. This plan is about how we are planning to protect and improve Scotland's water environment over the next 18 years. The plan therefore sets out proposed environmental objectives for these waters and explains how we plan to achieve such objectives. A similar draft plan prepared with the Environment Agency is available for the Solway Tweed river basin district.

Key message

We need to manage the water environment in the long term, delivering realistic environmental improvements while supporting a wide range of uses. This draft plan sets out for consultation the proposed objectives for the next three river basin planning cycles to 2015, 2021 and 2027.

It is important our objectives strike a balance between the protection and improvement of the water environment and the interests of those who depend upon it for their livelihood or quality of life. The plan therefore focuses on:

- achieving improvements which offer the greatest benefits for the water environment and those who depend upon the water environment;
- supporting greater economic and recreational use of the water environment in a manner which avoids its condition deteriorating.

1.3 Who has been involved in developing this plan?

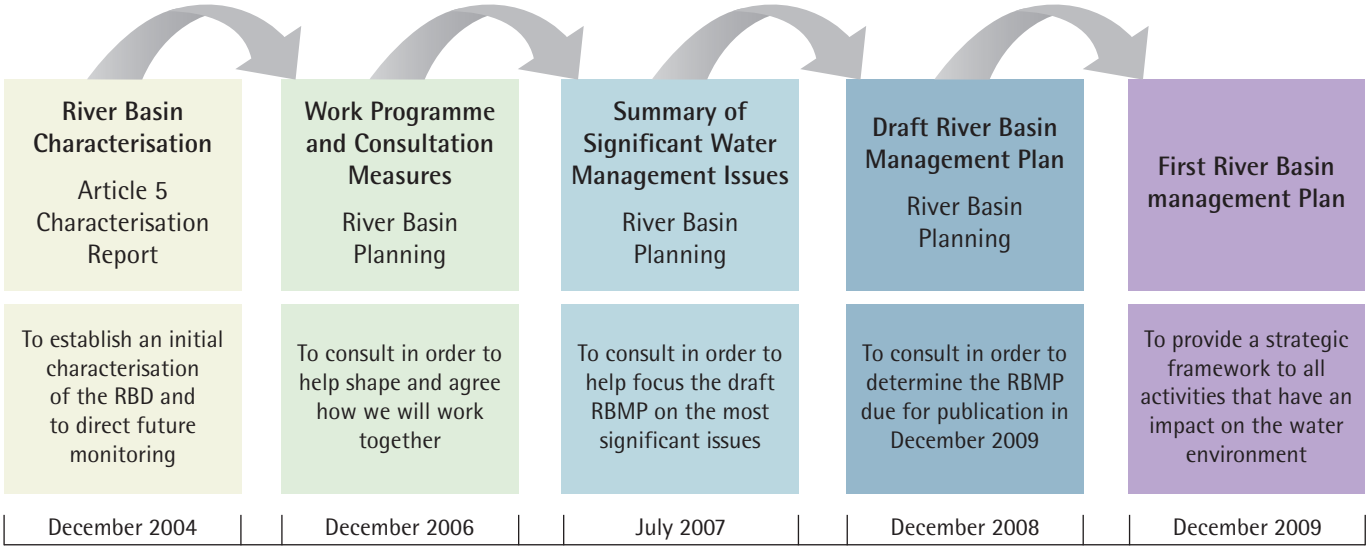
Although the production of the draft plan has been co-ordinated by SEPA,[6] it has involved a wide range of organisations with an interest in the water environment. SEPA's role in the development of the plan has been to provide information (particularly with regard to classification) and to co-ordinate information and input from others. In this document 'we' refers to all those involved in the production of this report, not SEPA. The term 'SEPA' is used explicitly to avoid confusion.

The organisations involved in the development of this report have been working together as members of the National Advisory Group and eight Area Advisory Groups.[7] Further information on the advisory groups can be found on SEPA's website.[8]

This draft river basin management plan builds on the information and consultation responses received from the documents prepared previously as part of the statutory river basin planning process (see Figure 1). In particular, the consultation responses from the Significant Water Management Issues report[9] have been reviewed and acted upon to inform the development of this plan.

[1]Directive 2000/60/EC
[2]Section 16
[3]http://ec.europa.eu/environment/water/water-framework/index_en.html
[4]www.scotland.gov.uk/Topics/Environment/Water/15561/2437
[5]www.sepa.org.uk/water/river_basin_planning.aspx
[6]Under the WEWS Act SEPA is responsible for the production of the draft river basin management plan.
[7]The WEWS Act refers to the area advisory groups as sub-basin advisory groups.
[8]www.sepa.org.uk/water/river_basin_planning.aspx
[9]www.sepa.org/water/water_publications/swmi.aspx

Figure 1: Reports produced during the river basin planning process



1.4 Who is this plan for?

This plan is aimed at those organisations and individuals involved with the management and use of land and water. It is intended to co-ordinate actions by responsible authorities, non-governmental organisations, industry, business and advisors to ensure their actions combine to produce the best possible water environment.

Information in the plan will assist in planning where development should be undertaken. It will help local initiatives aimed at improving natural heritage to identify where they should target their resources. The plan will also provide help in integrating objectives for the water environment across different planning processes (eg local authority development plans).

1.5 How should it be used?

The draft plan has three components (see Figure 2).

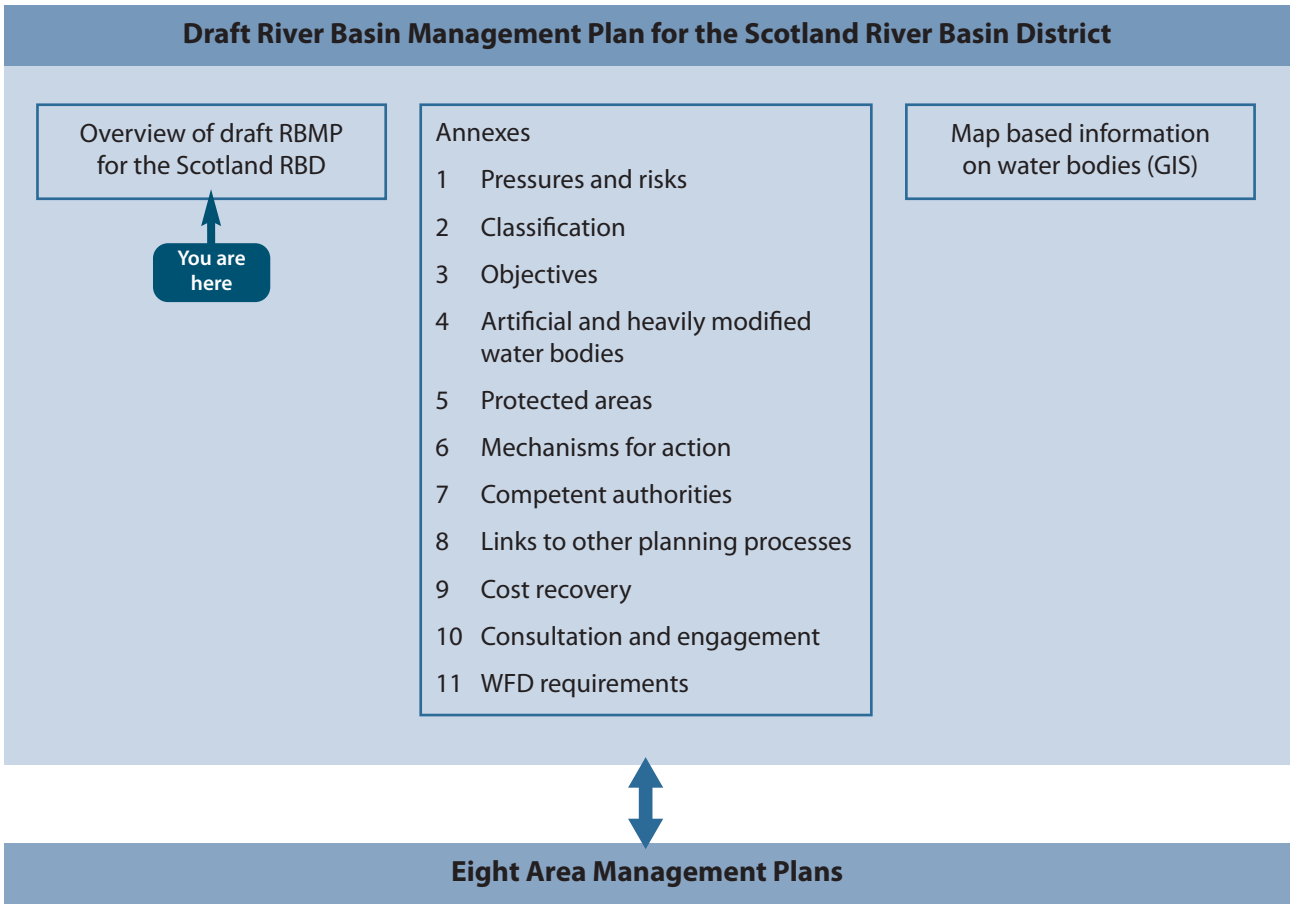
- This overview document explains how organisations involved in the management of the water environment will work together to deliver the plan.
- A series of annexes provides technical detail on each of the key aspects of the river basin planning process and forms the basis of the plan. These annexes are available from SEPA's website.[10]
- A web-based interactive map powered by a geographical information system (GIS) offers information on individual rivers, lochs, estuaries, coastal waters and groundwaters. The map, which can be found on the SEPA website (www.sepa.org.uk/water/river_basin_planning.aspx), provides details on the condition of each water body and the proposed objectives for that water body.

The draft plan is supplemented by eight area management plans[11] which provide regional information and describe local actions. The area management plans aim to provide local people with an understanding of the issues affecting the water environment and what actions can be taken to address them. These plans have been produced for the following Area Advisory Group areas within the Scotland river basin district:

- Argyll;
- Clyde;
- Forth;
- North East Scotland;
- North Highland;
- Orkney and Shetland;
- Tay;
- West Highland.

[10] www.sepa.org.uk/water/river_basin_planning.aspx
[11] Area management plans are defined as sub-basin plans under the WEWS Act.

Figure 2: Components of the draft river basin management plan for the Scotland river basin district



1.6 Assessing the impacts of this plan

This draft plan identifies those measures possible given the existing legislation and funding mechanisms available over the period to 2027. It also identifies where additional measures could help maintain the rate of progress in improving Scotland's water environment. Such additional measures may require changes to legislation, Government policy or funding, and are considered in the Scottish Government consultation on continued improvements. A link to the document can be found on the SEPA website.[12]

To support this consultation the Scottish Government has also prepared an impact assessment estimating the costs, benefits and implications of achieving the objectives outlined in the draft river basin management plan together with the additional measures being considered to maintain the trend of improvements. A link to the impact assessment can be found on the SEPA website.[12] The consultation closes on 22 March 2009.

In addition, all proposed public plans including the draft river basin management plan are subject to a strategic environmental assessment (SEA) which identifies and assesses their wider environmental impacts. SEPA has produced an SEA report for consultation which assesses the draft plan and the measures required to close the gap. A copy of the SEA report can be found on SEPA's website.[13] The consultation closes on 22 March 2009.

In addition, the Conservation (Natural Habitats, &c.) Regulations 1994 (which transpose the EC Habitats Directive into UK law) require an appropriate assessment of the implications of the plan for Natura 2000 sites. This is being undertaken by SEPA but will not be completed in time for the draft plan.

Scottish ministers are responsible for approving the draft plan and ensuring it reflects an appropriate and proportionate level of ambition for the protection and improvement of the Scottish water environment. Their decisions will also be informed by responses to the Scottish Government's consultation on continued improvements.

Based on the views gathered from the consultation on the draft river basin management plan and supporting documents, Scottish ministers will issue guidance to SEPA on how the rate of improvement can best be maintained and expressed in the final river basin management plan. The plan must be finalised by 22 December 2009. It will then be updated every six years.

[12] www.sepa.org.uk/water/river_basin_planning.aspx
[13] www.sepa.org.uk/water/river_basin_planning.aspx

Section 2 Public consultation – make your views heard

We want to hear what you think about the proposals set out in this draft river basin management plan for the Scotland river basin district. In particular, whether the proposed objectives strike the right balance and reflect your priorities for protecting and improving Scotland's rivers, lochs, estuaries, seas and groundwater. We also want to know what you think of the process used to develop the draft plan and the way in which information has been presented.

We welcome your responses on the consultation questions listed below – you will find more details on each of these throughout this consultation document. Where you can, please provide information to support the comments you make in your responses. Your responses will be taken into consideration when finalising the river basin management plan.

We will use this information to develop the final river basin management plan. This must be published on 22 December 2009.

Key message

We need views early! We will be looking at the consultation responses on the draft river basin management plan in two stages. The first will be those responses received by 22 March 2009. The second will be at the close of the consultation period on 22 June 2009.

The earlier we receive your comments the more time we will have to incorporate them. It would help us if you could respond by 22 March 2009, either in full or at least in the form of a summary setting out your principal comments and suggestions. This will help us develop the plan during the spring and summer next year. However comments received by 22 June 2009 will be fully taken into account.

Consultation questions

This consultation focuses on the actions proposed in the draft river basin management plan to address the pressures on the water environment in the Scotland river basin district. The consultation questions refer to information in this draft river basin management plan and the interactive GIS map.[14] Please provide any information you have to support your view.

Consultation question 1: Do you agree with our assessment of the ecological status/potential (condition) of individual water bodies in the Scotland river basin district?

Consultation question 2: This plan and Annex 3 sets out the objectives for the water environment for the next six years and beyond. To what extent do you agree with:

a. the level of improvements proposed by 2015?
b. the level of improvements proposed by 2027?

Consultation question 3: Are there water bodies where you think that the objective for the future should be different? If so, please provide details.

Consultation question 4: Have we identified the important existing measures that could be taken to address these pressures (Sections 7–11)? Please identify any important existing measures we have missed, including measures for individual water bodies (as detailed on the interactive GIS map).

Consultation question 5: Could you or your organisation, potentially working in partnership with others, help deliver existing measures or develop new measures?

Consultation question 6: We will need to work together to deliver the river basin management plan. Do you have suggestions on how we could work better together?

Consultation question 7: To be effective this plan has to influence other planning process. Have you suggestions on how to improve the way this plan links to other planning processes (Section 13)?

Please send your responses to this consultation by email to rbmp@sepa.org.uk though written responses can also be sent to:

Cath Preston
River Basin Planning Officer
SEPA
Erskine Court
Castle Business Park
Stirling FK9 4TR

[14] www.sepa.org.uk/water/river_basin_planning.aspx

Section 3 About the Scotland river basin district

The Scotland river basin district (see Maps 1a and 1b) covers around 113,920km² of land and water from Shetland in the north to Glasgow, Ayr and Edinburgh in the south and the Hebridean islands in the west. It contains extensive inland, coastal and ground waters. Around 4.8 million people live in the district, with most in the central belt between Glasgow and Edinburgh.

The rivers, lochs, estuaries,[15] coasts and groundwaters of the Scotland river basin district are an important natural heritage asset. They support a wide range of nationally and internationally important species such as salmon, otter and freshwater pearl mussel. Within the district these waters support 104 Special Protection Areas and 131 Special Areas of Conservation designated under the EC Habitats Directive for their international conservation importance for species and habitats. These areas include a variety of water-dependent habitats including intertidal mudflats, wetlands and standing waters.

Our waters are important not only for wildlife but also for recreation and for the economy. Many of our freshwaters support areas designated for their economically important fish species and for drinking water supply, while our coasts support bathing waters and areas designated for their economically important species of shellfish. The good quality of many of our waters supports tourism, some of the best salmon runs in the UK and businesses that rely on water quality such as aquaculture, salmon farming, bottled water and whisky production.

The water environment of the Scotland river basin district is subject to less pressure than many other regions of the UK. However there are issues that need to be addressed to ensure the protection and improvement of our waters. The most significant environmental problems for the district are concentrated around the larger population centres such as Glasgow and Edinburgh, but also in the productive agricultural areas along the east coast. The pressures on the water environment are described in detail in the Significant Water Management Issues report.[16] Further information regarding the management of these pressures is provided in Sections 6–11.

3.1 The economic value of our water environment

The economic importance of water use in the Scotland river basin district was described in the economic characterisation report published in 2005.[17] Several important documents have been published since then which provide strategic frameworks, goals and targets to help secure economic prosperity in Scotland. These documents include:

- UK Shared Framework for Sustainable Development;[18]
- Scotland's Sustainable Development Strategy;[19]
- Government Economic Strategy;[20]
- draft National Planning Framework 2 for Scotland.[21]

All recognise the importance of ensuring that the Scottish economy grows within environmental limits.

Several of the sectors considered to be of strategic importance in Scotland have close links with the water environment. These include:

- renewable energy generation (particularly through hydropower generation);
- food and drink (including fish processing and whisky production);
- tourism.

Other industries with links to the water environment include the water industry, agriculture, aquaculture, some types of manufacturing, navigation and transport. Two key sectors in particular – agriculture and the water industry – will need to take action in response to this river basin management plan.

In the ten-year period prior to the publication of the economic characterisation report, the Scottish economy grew by 26%; there has been 2.6% growth since 2005. Strategic targets for the economy include raising the rate of growth of Scotland's gross domestic product (GDP) to the UK level by 2011 and matching the GDP growth rate of the small independent EU countries by 2017. The relative contributions made by different sectors of the economy in 2004 are shown in Figure 3.

[15]In general this document refers to 'estuaries' rather than 'transitional waters' as used in the Water Framework Directive. Transitional waters are defined in the Directive as "bodies of surface water in the vicinity of river mouths which are partly saline in character but are substantially influenced by freshwater flows".
[16]www.sepa.org/water/water_publications/swmi.aspx
[17]www.sepa.org.uk/water/characterisation_reports.aspx
[18]One Future – Different Paths. The UK's shared framework for sustainable development, Defra, 2005.
[19]Choosing Our Future: Scotland's Sustainable Development Strategy, Scottish Executive, 2005.
[20]The Government Economic Strategy, Scottish Government, November 2007.
[21]The National Planning Framework for Scotland 2 (discussion draft), Scottish Government, January, 2008

Figure 3: Scottish gross domestic product share, 2004

Source: Scottish Executive, 2004

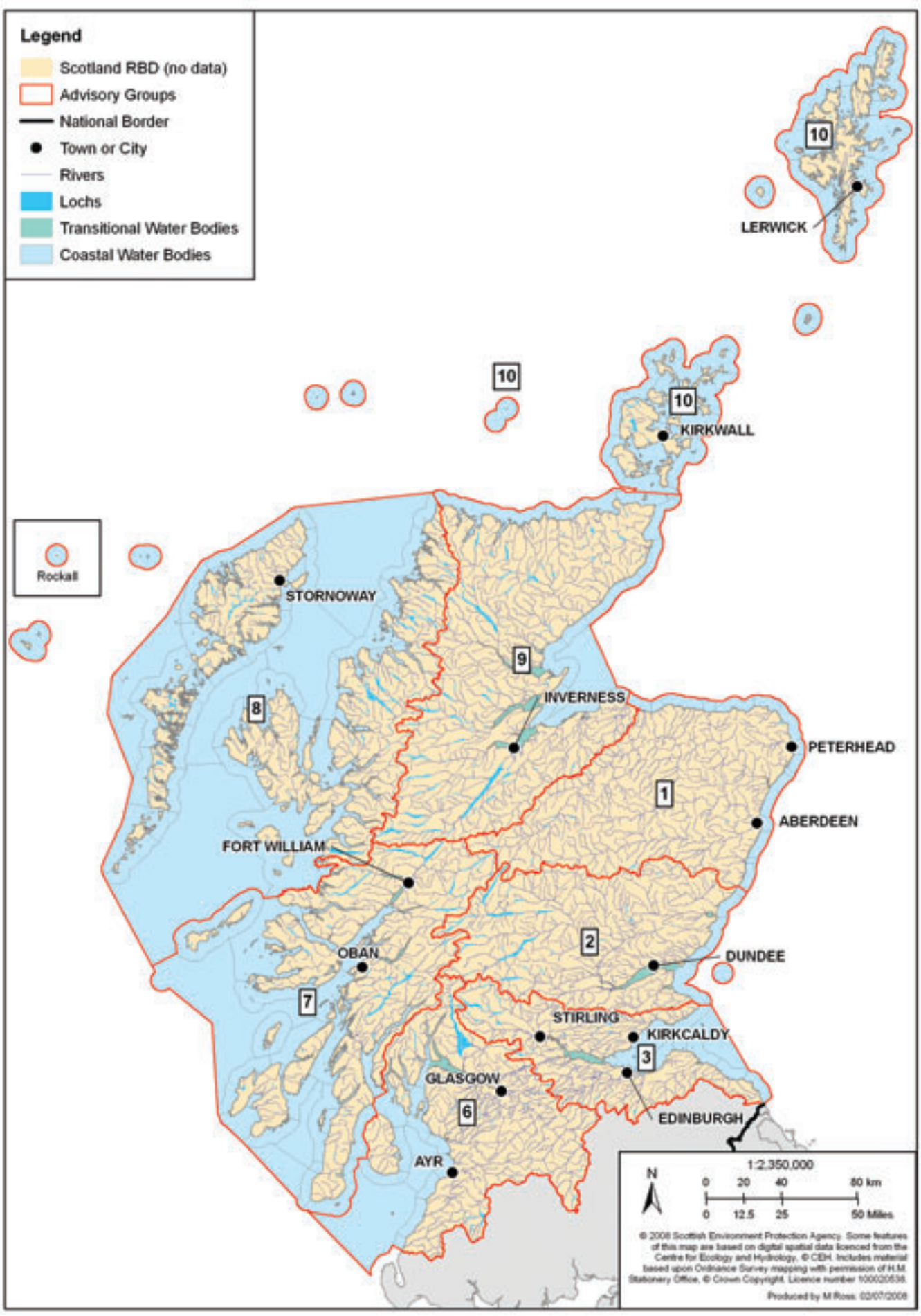
The data shown in Table 1 highlights the differences between the data used in the characterisation report (1995–2005) and the following financial year (2005–2006). Since 1995 the agriculture, forestry, wood and wood production, chemical, spirits and construction sectors have all increased their contributions to the economy. Of the strategic sectors with links to the water environment, the contributions from the electricity, gas and water supply sectors in particular have risen. In contrast contributions from the food and drink, the textiles, leather and footwear and the pulp, paper and printing industrial sectors have fallen.

Table 1: Economic contributions from the main water-using sectors for the period 1995–2005 and the financial year 2005–2006

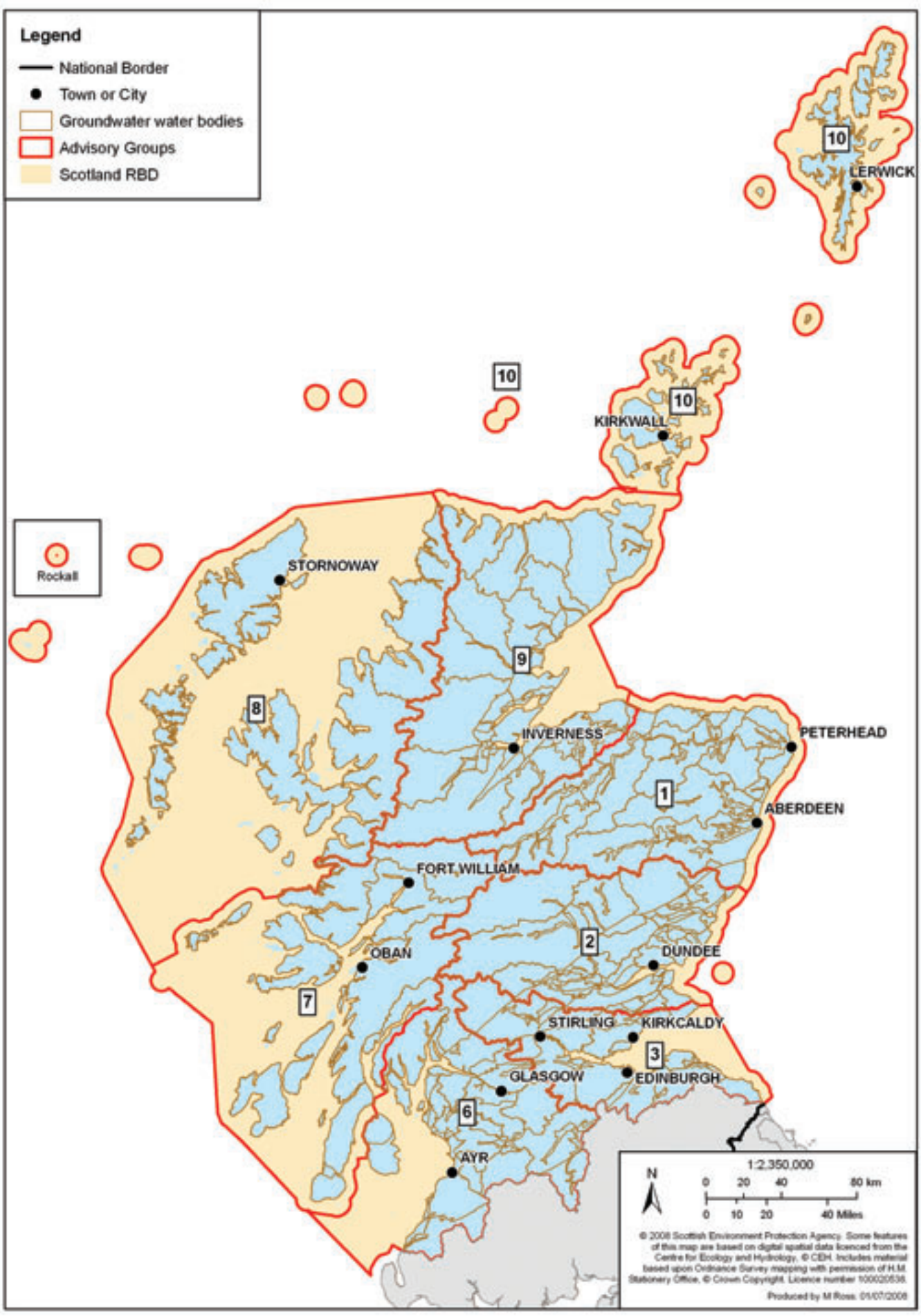
Sector	Growth (%)	
	1995–2005*	2005–2006
Agriculture and forestry	11.2	-2.1
Fishing	-3.0	-4.4
Mining	-17.6	-9.3
Food and drink	-6.4	1.1
Spirits	7.3	4.7
Textiles, leather, footwear, etc	-55.4	-8.5
Wood and wood production	8.9	8.1
Pulp, paper and printing	-19.7	-11.2
Chemicals and man-made fibres	50	1
Electricity, gas and water supply	7.6	3.4
Construction	35.2	6.4

*Economic statistics, Scottish Government website (2008)

Map 1a: Surface water bodies in the Scotland river basin district



Map 1b: Groundwater bodies in the Scotland river basin district



Section 4 Assessing the state of our water environment

Previously SEPA's classification system and water quality reports concentrated on the effects of discharges and the diffuse inputs of potential pollutants. Over the last few decades, significant improvements have been made to improve the quality of our water where it has been affected by pollution. Indeed the recent *Scotland's Water Environment Review 2000–2006*[22] highlights that water quality in 37% of our rivers, 20% of our estuaries and 45% of coasts improved between 2000 and 2006. Improvements have been achieved through considerable planning, major investments in sewage treatment and greater control of other sources of pollution from individual sites.

SEPA's new classification system for the Water Framework Directive takes account of water abstractions, impoundments, engineering works and invasive non-native species – all of which may impact ecological quality in ways not measured by the current classification schemes.

Information on the quality of individual water bodies can be accessed using the interactive map on the SEPA website.[24]

4.1 Changes to the classification system 2005–2007

In 2005 SEPA completed the first comprehensive assessment of the pressures and impacts on the water environment of the Scotland River basin District.[23] The report was a forward look at whether water bodies would be 'at risk' of failing to meet the 'good status' objective set out in the Water Framework Directive. The assessment was based on existing monitoring data and information on pressures affecting the water environment and gave SEPA an initial estimate of the extent to which the ecological quality of our water environment has been affected by human activities. An updated assessment based on improved monitoring data and pressure information was published in 2007 in the Significant Water Management Issues report.[24]

For the purposes of reporting under the Water Framework Directive, the water environment has been divided up into units called water bodies. A water body may be a single burn or loch, or it could be a stretch of a river, or an area of groundwater or coastline.[25] For more information see Annex 2.

A new monitoring programme began in December 2006 which meets the needs of the Water Framework Directive. SEPA's network of monitoring sites has been revised based on the environmental risk assessment in order to target its monitoring efforts. The results provide the baseline for the new classification scheme and will help to direct our priorities for river basin planning over the next 18 years. The revised monitoring programme integrates monitoring across groundwater, rivers, lochs, estuaries and coasts to produce a coherent view of the pressures and impacts on the water environment in Scotland.

There are strong and direct links between pressures on land and freshwater systems and the subsequent impacts on groundwater and the marine environment. Monitoring has been targeted to assess the extent of these impacts. The revised monitoring programme and classification system are based on the best scientific information available and will be updated as new tools become available or are revised. Further details of the revised monitoring programmes can be found on SEPA's website.[26]

Assessing the state of our water environment is a substantial task. The classification results reported in this section are based on sampling and analysis results from over 1,500 riverine sites, over 700 coastal and estuarine sites, 160 loch sites and almost 200 groundwater sites across Scotland. The operational monitoring sites are displayed in Map 2.

Key message

Effective management of pressures depends on a good understanding of the pressures and the risk that they pose across the whole water environment. SEPA's new monitoring network is designed to assess environmental impacts from the mountains through to the sea.

[22] www.sepa.org.uk/publications/water_publications.aspx
[23] www.sepa.org.uk/water/river_basin_planning.aspx
[24] www.sepa.org/water/water_publications/swmi.aspx
[25] Rivers less than 10km2 and lochs less than 0.5km2 are not reported in this plan. Monitoring of these small water bodies depends on requirements.
[26] www.sepa.org/water/monitoring_and_classification.aspx

4.2 The new classification schemes

Scotland's previous classification schemes focused on describing the pollution levels of the water environment. As required by the Water Framework Directive, the new classification scheme for surface waters now assesses:

- the quality of the aquatic ecosystems within our rivers, lochs, estuaries and coastal waters;
- the extent to which they have been adversely affected by the full range of pressures on the water environment – from water resources and physical habitat to pollution and invasive non-native species.

This new scheme assesses the condition of each river, loch, estuary and coastal water and assigns it a 'status' from high, good, moderate, poor to bad.

- If a water body is classified as high or good status, then it has a healthy ecology which deviates only slightly from natural conditions. The water body is an important natural heritage asset and can support a wide range of uses such as recreation, fishing and drinking water supply.
- If a water body is classified as moderate, poor or bad, then the ecology is adversely affected and the range of uses which can be supported is reduced.

There are five main elements of the classification scheme, these are:

- the presence of pollution, such as chemicals in the water;
- biological factors, such as aquatic plants and animals;
- the amount and flow of water;
- morphology (the physical condition of the watercourse, its banks and bed);
- the presence of non-native species, such as American signal crayfish.

Each of these elements incorporates specific parameters that are tested to assess its condition against individual environmental standards. The Water Framework Directive requires all the elements to meet the environmental standards before a water body can be considered to be at good status.

SEPA has also developed a classification scheme to assess the impacts on the chemical quality and water quantity in our groundwater. Groundwater bodies are assigned to either good or poor status for both chemical quality and water quantity.

The classification standards used are consistent across the UK. SEPA has also been working with other Member States to try to ensure Scotland's classification schemes are comparable with those of Europe.

These new schemes (as required by a Direction from Scottish minsters) enable SEPA to describe, for the first time, the extent to which the quality and quantity of our surface water and groundwater resources have been affected by human activity.

The results on the current condition of our rivers, lochs, estuaries, coasts and groundwaters are based primarily on monitoring data collected during 2007. However, as the new monitoring programmes have only been in place for one year, SEPA has supplemented the limited new monitoring data with data from previous assessments (where relevant and available). This is to ensure the classification results reflect the best current understanding of the status of the water environment. As more monitoring data are collected, SEPA expects its confidence in classification to progressively increase over the next five years.

The Water Framework Directive requires standards for physico-chemical parameters such as phosphorus or nitrogen to be set to protect the functioning of the ecosystem; physico-chemical parameters must not fail the good/moderate boundary. For the purposes of regulation, the UK Technical Advisory Group for the Water Framework Directive (UKTAG) has set standards for physico-chemistry which allow water bodies to be classified into high, good, moderate, poor and bad.

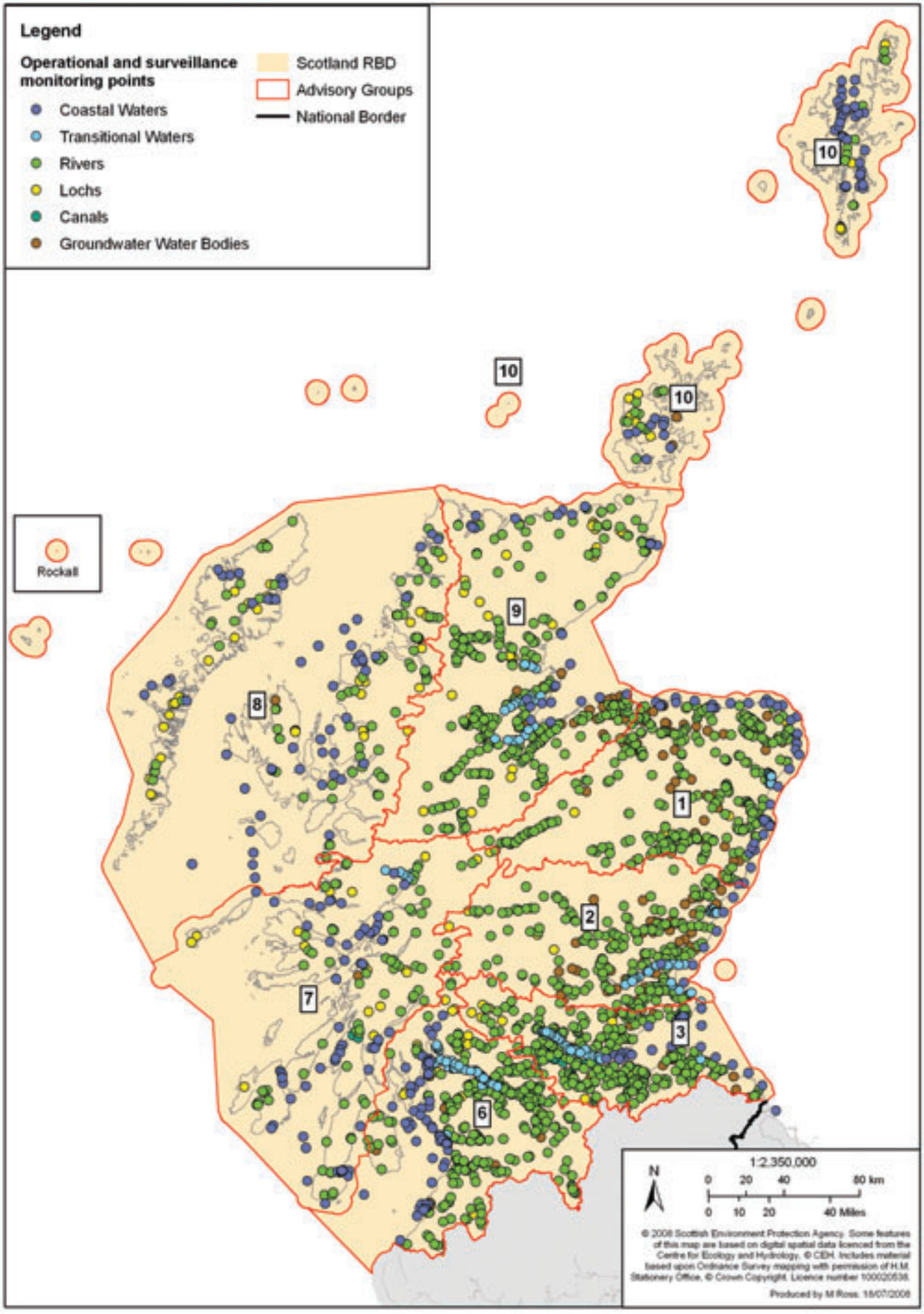
As physico-chemistry is a supporting element, it cannot be used to downgrade a water body to poor or bad unless this is confirmed by biological evidence. Consequently some water bodies may be classified as poor or bad status just for their physico-chemical parameters but, if the biological and hydromorphological elements are moderate or better, the overall status will be moderate.

By the time the final plan is produced we will have another year's monitoring data. Classification in the final plan will be based primarily on data collected during 2007 and 2008.

Key message

Major improvements in the water quality have been achieved over the past few decades as sources of pollution have been addressed. The Water Framework Directive requires a step change in our understanding of the water environment as impacts associated with abstraction, impoundment, engineering activities and invasive non-native species are brought into the classification scheme. The result is that more water bodies will be identified as impacted than under the old classification scheme.

Map 2: Operational and surveillance monitoring points in the Scotland river basin district



4.2.1 Designation of heavily modified water bodies and artificial water bodies

Some of our rivers, lochs, estuaries and coastal water bodies are not achieving good ecological status because substantial modifications have been made to their physical characteristics for such uses as:

- water storage (eg for drinking water supply or hydropower generation);
- flood defence;
- navigation;
- land drainage.

Restoring these water bodies to good status could have significant adverse effects on the important social, economic or environmental benefits provided by such uses. Where this would be the case and where there is no environmentally significantly better means that could reasonably be used to provide the benefits, the Water Framework Directive allows us to designate the water bodies as heavily modified (HMWBs). Those water bodies created by people where no water body previously existed (eg canals) are designated as artificial water bodies (AWBs). Further information on the reasons for designation of HMWBs/AWBs is provided in Annex 4.

The classification system for HMWBs and AWBs takes into account the modified nature of these water bodies. They are assessed as good ecological potential for water quantity, water flow and physical habitat (morphology) depending on whether reasonable effort has been made to maximise the quality of the ecology and habitats. The five classification status classes for HMWBs and AWBs reflect not only the level of mitigation measures for water levels and flow and physical habitat but also the chemical quality of the water (Table 2).

Table 2: Classification status classes for HMWBs and AWBs

Ecological potential class	Basis of classification
Maximum	It is judged that all practicable mitigation measures have been applied to ensure the hydrology and morphology of the water body are maintained in as good a condition as possible. Water quality is high.
Good	All practicable mitigation measures are in place. Water quality is good.
Moderate, poor or bad	All practicable mitigation measures are in place but the biological and/or physico-chemical quality is below good. The status reflects the quality of these elements. OR The operator has not provided the expected mitigation measures.

The assessment of the quality of the HMWBs and AWBs in the Scotland river basin district involves three stages:

1. Classification of the hydrology and morphology of rivers, lochs, estuaries and coasts in order to assign each water body a status of high, good, moderate, poor or bad.
2. Designation as HMWB or AWB where appropriate with an assessment of the ecological potential of these water bodies.
3. Classification of other biological and physico-chemical parameters for each HMWB or AWB.

This approach to determining ecological potential is new for Scotland and it has not yet been possible to assess all HMWBs or AWBs in terms of their ecological potential. Any HMWBs or AWBs that have not been assessed for their ecological potential will be assessed by the final plan.

Further information on the process used to designate HMWBs and AWBs in Scotland can be found in Annex 4.

4.3 The current condition of our water environment

Before considering the designation of heavily modified and artificial water bodies, the initial classification results indicate that 55% of waters in the Scotland river basin district are at good or better status (20% at high). The remaining 45% are classified as less than good status with 22% classified as poor or bad status (Annex 2).

Combining these classification results with those for heavily modified and artificial surface water bodies and those for groundwater bodies gives an overall assessment of the scale of improvement required in the Scotland river basin district (Table 3). This assessment indicates that 60% of water bodies in the Scotland river basin district are classified as good or high ecological status or potential. This means the plan needs to set objectives to improve the condition of approximately 40% of the water bodies in the Scotland river basin district. In addition approximately 140 HMWBs/AWBs need to be assessed in terms of ecological potential.

The overall results for surface waters (including heavily modified and artificial water bodies) are summarised in Map 3a and for groundwaters in Map 3b. A breakdown of the HMWB results by rivers, lochs, estuaries and coasts can be found in Annex 4.

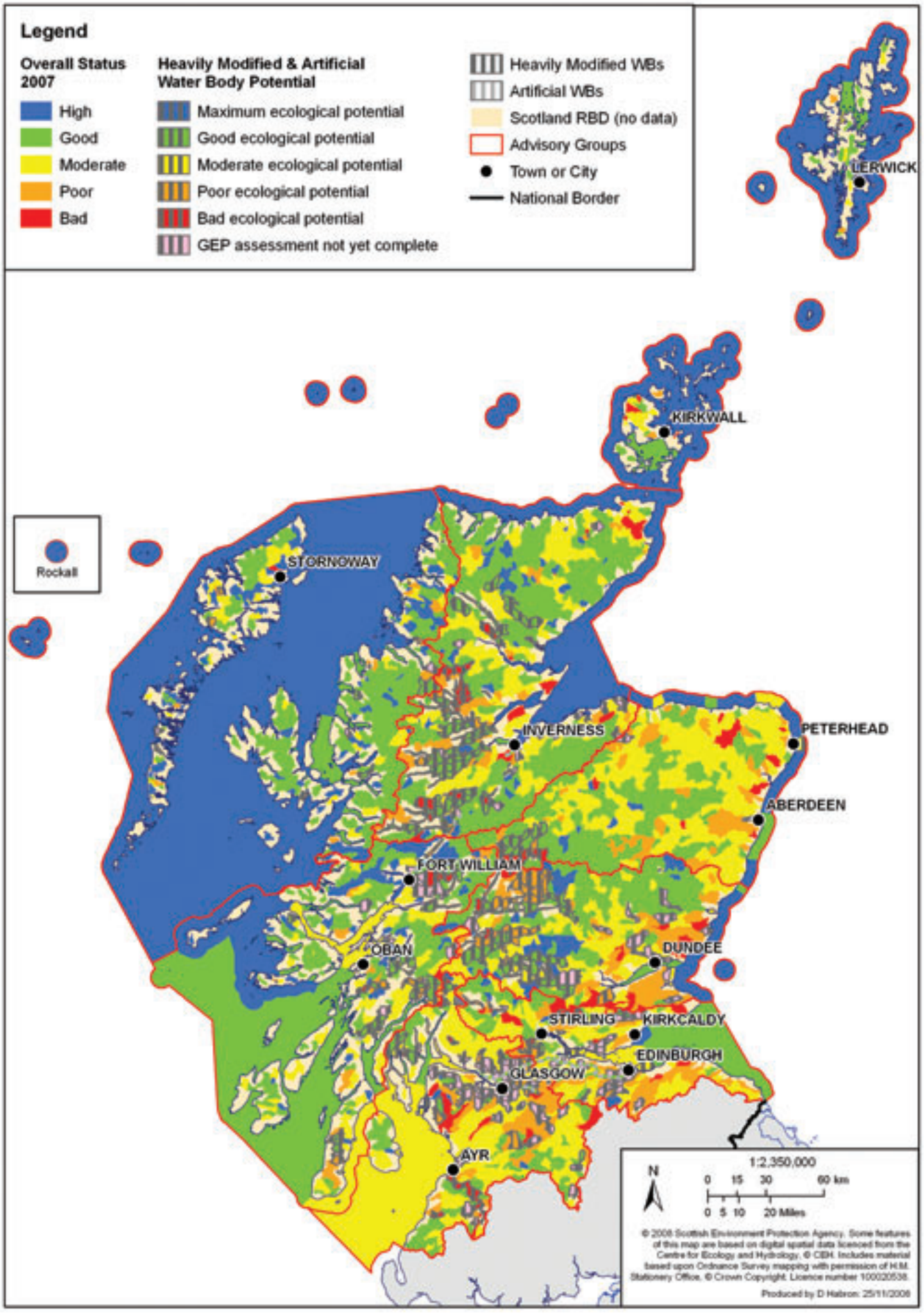
Table 3: Classification results for surface water bodies, heavily modified water bodies, artificial water bodies and groundwaters in the Scotland river basin district, 2007

		Number and length/area of water bodies in each status/potential class					
	Total number of water bodies (length/area)	High/ Maximum	Good	Moderate	Poor	Bad	Not yet assessed
Rivers	1709 (17,823km)	181 (1,052km)	723 (7,956km)	529 (6,101km)	217 (2,099km)	58 (624km)	
Lochs	209 (599km^2)	83 (168km^2)	60 (197km^2)	35 (179km^2)	24 (36km^2)	7 (20km^2)	
Estuaries	33 (552km^2)	12 (251km^2)	6 (158km^2)	15 (143km^2)	0	0	
Coastal waters	435 (45,660 km^2)	256 (32,325km^2)	145 (8,994km^2)	34 (4,341km^2)	0	0	
Groundwater	275 (66,568km^2)		206 (54,853km^2)		69 (11,715km^2)		
HMWBs	381	2	144	9	67	31	128
AWBs	40	0	27	0	0	0	13
Total	**3,082**	**534**	**1,312**	**622**	**377**	**96**	**141**
Percentage		**17%**	**43%**	**20%**	**12%**	**3%**	**5%**

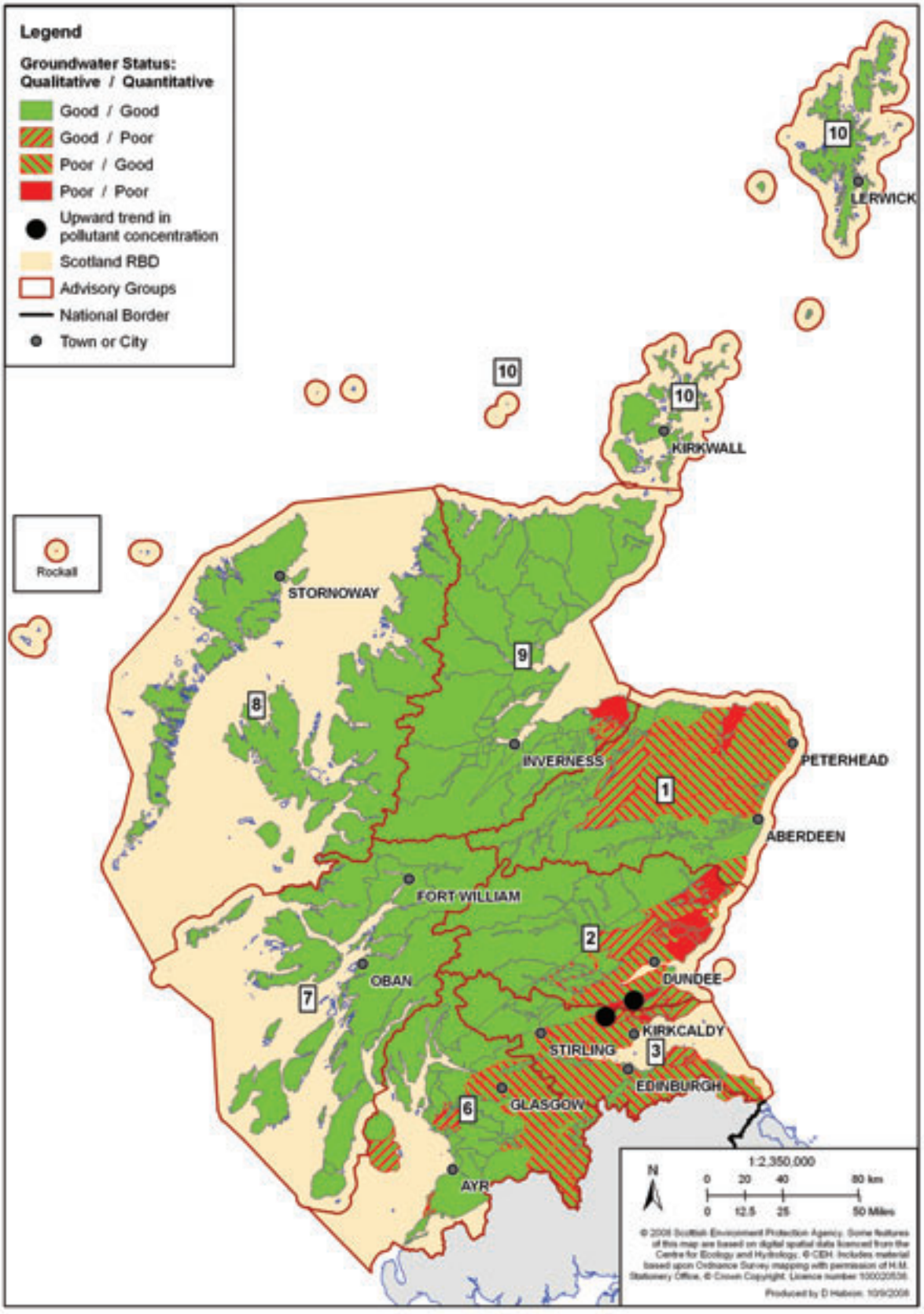
Key message

The initial results indicate that 60% of water bodies in the Scotland river basin district are classified as good or high status or ecological potential. This means the plan has to set objectives to improve the condition of approximately 40% of the water bodies in the district as well as protecting all our waters from deterioration.

Map 3a: Classification status and ecological potential results for surface water bodies, 2007



Map 3b: Classification results for groundwaters, 2007



The map distinguishes between groundwaters that are:

- good for both qualitative (water quality) and quantitative (water quantity) status (green);
- good for qualitative status and poor for quantitative status (hashed left-to-right);
- poor for qualitative status and good for quantitative status (hashed right-to-left);
- poor for both qualitative and quantitative (red).

4.3.1 Condition of our protected areas

Many water bodies in the Scotland river basin district fall within protected areas. These areas require special protection under other national or European legislation designed to either protect their surface water or groundwater, or to conserve habitats or species that directly depend on those waters. They may be part of a water body (eg bathing waters) or may be a group of water bodies (eg freshwater fish waters). Protected areas are often assessed for additional pollutants or quality elements that are not included in the WFD; for example faecal coliform levels are assessed within bathing waters. A summary of the condition of our protected areas in 2007 is provided in Table 4.

Most protected areas relate to areas identified for protection under other legislation. Bringing the management of the water environment of these areas into the framework of the river basin planning process will help us streamline our monitoring and assessment work and to integrate their protection into the wider management of the river basin. This is a requirement of both the Water Framework Directive and the WEWS Act.

Further information on all protected areas can be found in Annex 5. A register of protected areas (as required by the Water Framework Directive and the WEWS Act) can be found on SEPA's website.[27]

[27] www.sepa.org.uk/water/register_of_protected_areas.aspx

Table 4: Summary of the condition of our protected areas in 2007*

		Number of protected areas	Number and percentage of protected areas achieving their objectives in 2007
Protected areas for species or habitats of international conservation importance	Special Protection Areas	104	101† 97%
	Special Areas of Conservation	131	109‡ 83%
Protected areas important for shellfish (shellfish growing waters)	Mandatory standards	106	106 100%
	Guideline standards		57 54%
Protected areas important for freshwater fish	Salmonid (mandatory standards)	94	93 99%
	Salmonid (guideline standards)		5 5%
	Cyprinid (mandatory standards)	2	2 100%
	Cyprinid (guideline standards)		0 0%
Protected areas for bathing	Mandatory standards	56	50 89%
	Guideline standards		28 52%
Protected areas for water supplies intended for human consumption		587	n/a
Nutrient sensitive areas§		80	n/a
Nitrate Vulnerable Zones (NVZs)§		3	n/a

* The table includes sites designated in 2007. There have been changes to the number of sites designated in 2008 that are protected for economically important fish (freshwater) and bathing waters.
† Number of Special Protection Areas where the status of the water environment is not a barrier to the achievement of favourable conditions.
‡ Number of Special Areas of Conservation where the status of the water environment is not a barrier to the achievement of favourable conditions.
§ Nitrate Vulnerable Zones (NVZs) designated under the Nitrates Directive and nutrient sensitive areas designated under the Urban Waste Water Treatment Directive are not assessed for compliance against environmental standards as with other protected areas. Improvements are considered in terms of the actions put in place to address the pressures on the Nitrate Vulnerable Zone. Consequently it is not possible to show compliance in this table.

Natura 2000 sites

Natura 2000 sites are a network of European sites protected for species or habitats of international conservation importance. The Natura network includes two types of area. Areas may be designated as Special Areas of Conservation (SACs) where they support rare, endangered or vulnerable natural habitats and species of plants or animals (other than birds) as set out in the Habitats Directive (92/43/EEC). Where areas support significant numbers of wild birds and their habitats, they may become Special Protection Areas (SPAs), classified under the Birds Directive (79/409/EEC).

There are 131 SACs and 104 SPAs in the Scotland river basin district, 90% of which are in favourable conditions. However, 22 SACs and three SPAs are currently in unfavourable conditions; most of these are in the North and West Highland areas and Argyll.

The most significant pressures affecting Natura 2000 sites are diffuse pollution, alien species and changes to physical habitat. However there are many sites where the pressure causing the unfavourable conditions is unknown.

Shellfish growing waters

In the Scotland river basin district, 106 coastal waters are designated as 'shellfish growing waters' under the Shellfish Waters Directive (79/923/EEC). These waters require protection to ensure the quality and productivity of shellfish (eg mussels and periwinkles) and must meet the mandatory environmental quality standards set out in the Directive. Guideline standards are also set which we must endeavour to achieve.

In 2007, our shellfish growing waters achieved 100% compliance with the Directive's mandatory standards and 54% (57) complied with the guideline standards.

The presence of faecal bacteria is the main contributor to failure of guideline standards. There are a number of potential sources of faecal bacteria including farm animals, wild animals and sewage discharges. Additional treatment of discharges may be required to meet bacteriological standards to ensure the quality of edible shellfish does not pose a threat to human health.

Further information on shellfish growing waters can be found on SEPA's website[28] and in Annex 5 on protected areas.

Freshwater fisheries

Under the Surface Waters (Fishlife) (Classification) (Scotland) Direction 1999, 94 salmonid waters and two cyprinid waters in the Scotland river basin district are designated as freshwater fisheries. This designation is designed to protect or improve the quality of running or standing freshwaters which support or, if pollution were reduced or eliminated, would become capable of supporting fish life.

These waters are required to comply with the physical and chemical environmental quality standards set out in the Freshwater Fish Directive (78/659/EEC). Member States are obliged to monitor the waters and demonstrate that fish populations are safeguarded from the harmful consequences of pollution. Compliance is assessed annually by SEPA (the designated competent authority) using monitoring results for the calendar year.

In 2007, all cyprinid waters and 93 (99%) salmonid waters achieved compliance with the mandatory standards laid out in the Freshwater Fish Directive. The one salmonid water that failed to comply with the mandatory standards was the Water of Coyle, which failed to meet the standards for ammonia. No cyprinid waters and only 5% of salmonid waters met the guideline standards in 2007.

Further information on freshwater fisheries can be found on SEPA's website[29] and in Annex 5 on protected areas.

Bathing waters

Bathing waters are areas protected for use as recreational bathing and must meet standards for microbiological quality in order to protect human health. In 2007, 50 of the 56 (89%) identified bathing waters in the Scotland river basin district met the EU mandatory standards and 29 (52%) met guideline standards. The failures were all due to not meeting standards for faecal coliforms.

It is disappointing that the compliance results are not as good as 2006 when full mandatory compliance was achieved, but this must be considered in the context of the extraordinarily wet weather recorded through much of Scotland during the 2007 bathing season. However, despite the heavy rainfall in 2007, 52% of bathing waters achieved the highest 'excellent' water quality status.

The revised Bathing Water Directive (2006/7/EC) came into force in March 2006 and will be enacted in the UK by regulations in 2008. Its main features are tighter microbiological standards to be met by 2015 (with monitoring beginning by 2012) and increased provision of public information. The revised Directive has four quality categories – excellent, good, sufficient and poor. The new 'good' standard is broadly equivalent to the existing guideline standards. By 2015 Member States have to ensure that all bathing waters are of at least 'sufficient' quality and to have put in place measures to increase the number of 'good' or 'excellent' bathing waters.

Further information on the quality of our bathing waters can be found on SEPA's website[30] or in Annex 5 on protected areas.

Drinking water protected areas

In line with the Water Framework Directive, the Scottish Government has identified drinking water protected areas within which public and private abstractions from surface waters and groundwaters must be protected. This requirement supersedes the obligations of the Surface Water Abstraction Directive (75/440/EEC). The need for additional water treatment within these areas should also be reduced.

For the first river basin management plan, SEPA is working with Scottish Water to assess risks to protected areas serving large public water supplies. The outputs of this work should be available in time for inclusion in the final river basin management plan in 2009. Further information on drinking water protected areas can be found in Annex 5.

[28] www.sepa.org.uk/water/freshwater_fisheries.aspx
[29] www.sepa.org.uk/water/freshwater_fisheries.aspx
[30] www.sepa.org.uk/water/bathing_waters.aspx

Nutrient sensitive areas

Nutrient sensitive areas consist of Nitrate Vulnerable Zones and polluted waters designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive areas under the Urban Waste Water Treatment Directive (91/271/EEC).

Further information on nutrient sensitive areas can be found in Annex 5 on protected areas.

4.4 Summary of the main reasons for failing to achieve good status in 2007

The status of water bodies may be less than good because of the effects on them of one or more failing parameters. The classification results indicate that the following are the main environmental problems in Scotland:

- nutrient enrichment of our rivers, lochs, estuaries and groundwaters;
- changes to the quantity of water and flow levels of our rivers and lochs;
- changes to the physical habitat of our rivers and lochs;
- barriers to fish migration in our rivers and lochs.

In addition the following require further discussion:

- specific and priority substances;
- faecal coliforms in our bathing water protected areas.

Figure 4 gives details of the number of water bodies affected by the main problems identified above. Further information on the classification of individual parameters for all water bodies can be found in Annex 2.

Figure 4: Number of water bodies failing environmental standards for specific parameters in 2007

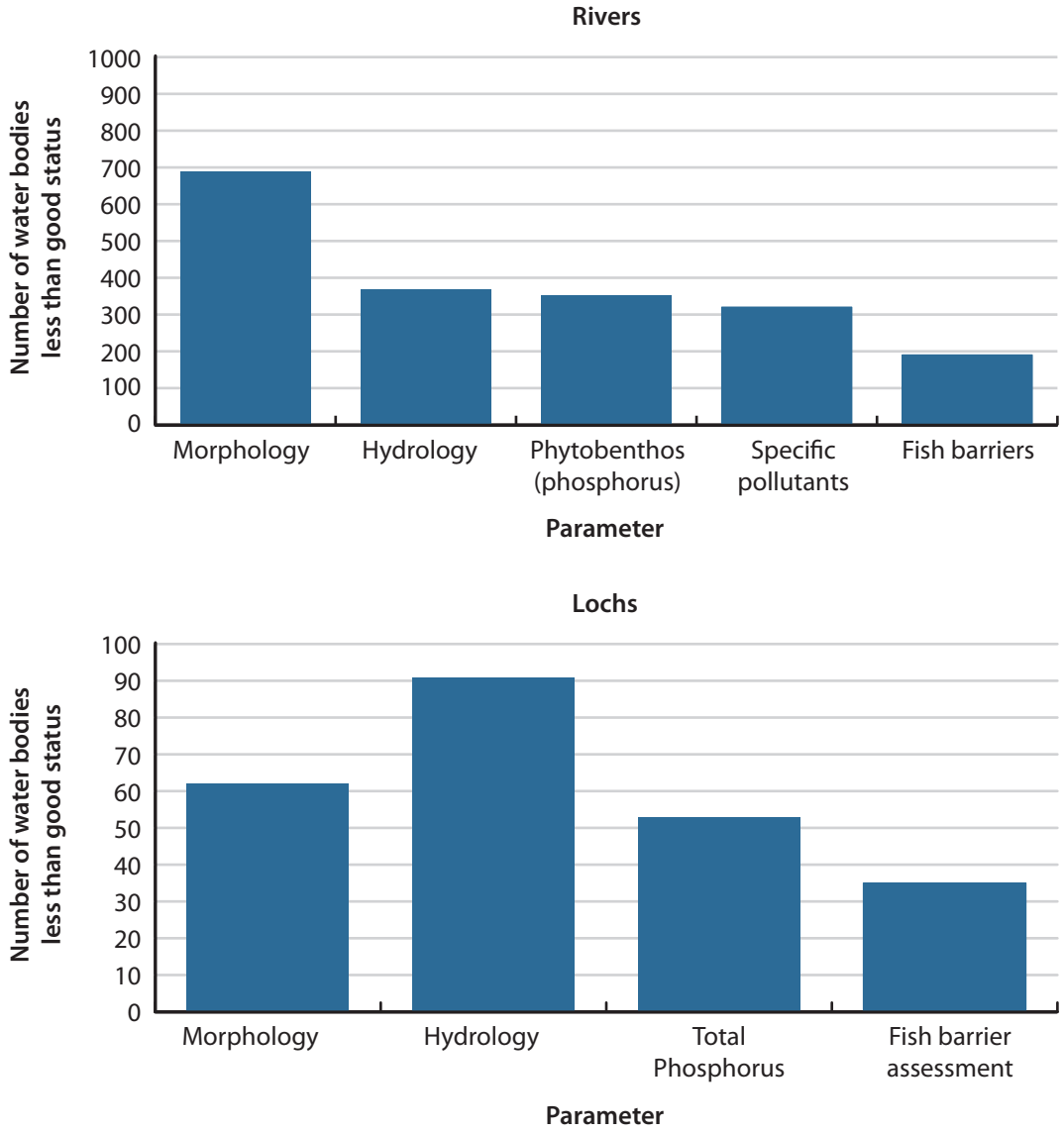
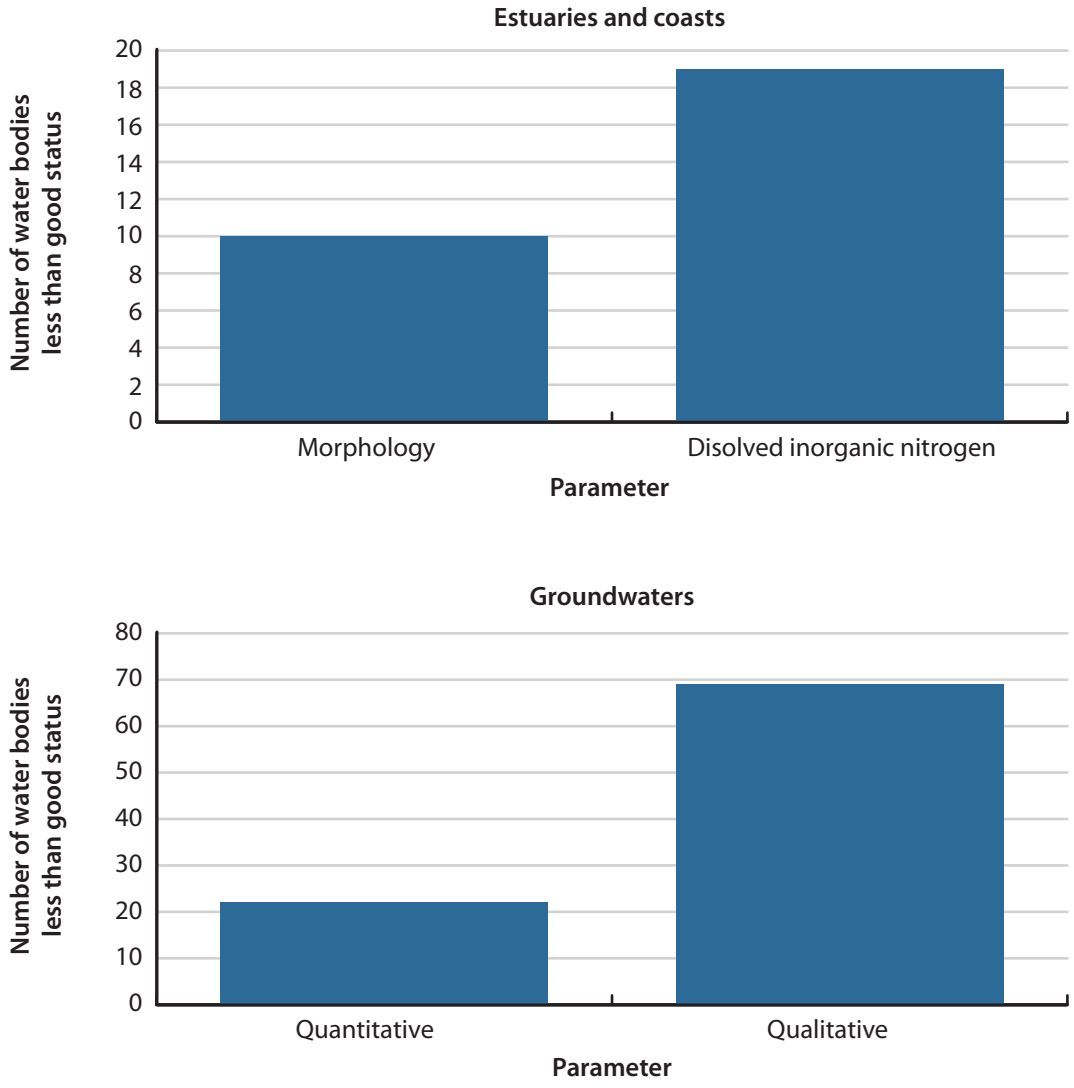


Figure 4: Number of water bodies failing environmental standards for specific parameters in 2007 (continued)



4.5 Reviewing the new classification output

We recognise there are gaps in the new classification scheme and work is being undertaken to fill these gaps. Over the course of the first river basin management plan, action will be taken to:

- develop biological tools to monitor the impacts of hydromorphological pressures;
- develop a fish monitoring and classification tool;
- improve the assessment of the impacts of hazardous substances;
- develop our understanding of the pressures and impacts on wetlands.

Further information on these gaps can be found in Annex 2.

SEPA has begun the process of reviewing the classification outputs in order to validate the classification tools. The following areas have already been identified as requiring assessment.

- The morphology classification is the newest component of the classification scheme. Extensive validation work will be undertaken during the period leading up to the publication of the first river basin management plan.
- The number of water bodies being classified as impacted by acidification is much lower than expected. This is associated with the absence of a tool to classify acid-sensitive species (taxa). Although the monitoring data are available, the acid-sensitive taxa classification tool is still under development. In the interim we will use the methodology specified in the Scottish Government Direction to improve our assessment of acidification impacts.

In addition, SEPA has started collating individual water body results which local knowledge suggests may be incorrect and is checking whether the classification process has been applied correctly in these cases. The Area Advisory Groups will have an important role in checking the classification results for sense.

The development of new tools will progressively improve the classification results over the next six years. The actions required to deliver these improvements are described in Sections 7–11.

Key message

The new Water Framework Directive classification scheme will, for the first time, describe the full range of pressures on Scotland's water environment and produce a step change in our understanding. The scheme will be progressively developed as new tools and data become available.

Consultation question 1: Do you agree with our assessment of the ecological status/potential of individual water bodies (available on the interactive GIS map[31]) in the Scotland river basin district?

[31] www.sepa.org.uk/water/river_basin_planning.aspx

Section 5 Environmental objectives

The setting of environmental objectives for the water environment is central to the river basin planning process. Environmental objectives are set on a water body by water body basis for all surface water bodies and groundwater bodies. The objective is the status that the water body is expected to achieve by the end of the plan period.

This plan identifies objectives until 2027 but the focus is on what can be achieved by 2015. Given that 40% of our water bodies are at less than good status, we think that achieving good status in all water bodies by 2015 is not realistic; it would be technically infeasible or result in disproportionate burdens on those who would have to pay. Consequently we are proposing to prioritise improvements over successive planning cycles so that the pace of improvement is reasonable and practicable.

For the 2015 objectives we have used a series of planning assumptions to help assess the degree of improvement we might expect from national measures such as Water Environment and Water Services (Controlled Activities) (Scotland) Regulations 2005 (CAR) and the diffuse pollution General Binding Rules (GBR) under CAR. These assumptions are set out in Annex 3.

Our aim is to achieve good status for all water bodies by 2027. The objectives for 2021 and 2027 currently represent the best estimate of the potential for improvements based on available measures and information. It is expected that additional measures will be identified during the development of the second and third river basin management plans which will help us to achieve our aim.

Key message

As part of setting environmental objectives it is necessary to achieve an appropriate balance between protecting the water environment and the interests of those who depend upon it. This plan sets objectives to deliver challenging but realistic improvements in the water environment over the period until 2027.

5.1 Protecting and improving Scotland's water environment

Setting the objectives for the water bodies is guided by Water Framework Directive requirements and the Scottish Government's policies. Details on how the objectives are set are included in Annex 3 and a summary presented here.

When setting objectives it is necessary to take account of the following considerations to ensure that a balance between environmental improvement and sustainable development is reached.

5.1.1 Preventing deterioration

The minimum objective for all water bodies is to ensure the status of rivers, lochs, estuaries, coastal waters and groundwater is protected from deterioration. This objective will be applied to all water bodies no matter what their status. However, in specific circumstances, the Water Framework does provide for exemptions or reasons why this primary objective should not be followed. These are discussed in Section 5.1.3.

5.1.2 Aim to achieve good status

A key objective is to restore or enhance those parts of our water environment that are not at good status or good ecological potential. Such improvements will benefit our natural heritage and quality of life, as well as supporting a wider range of uses of the water environment allowing economic development and recreational use. Other benefits will include:

- the production of safe drinking water;
- increased abundance of our economically important species such as Atlantic salmon;
- Scotland's reputation as one of the highest quality environments in Europe.

5.1.3 Alternative objectives

The Water Framework Directive recognises that achieving good status for surface waters may not be possible within the first cycle because:

- the scale of improvements may take several cycles due to technical feasibility;
- carrying out the improvements by 2015 may be disproportionately expensive;
- natural conditions do not allow for timely improvements.

In such cases, as long as the water body does not deteriorate, the necessary improvement can take several cycles.

There are other exceptions where alternative objectives can be set. This includes the less stringent objective to meet good ecological potential if the water body is designated heavily modified or artificial.

5.1.4 Permitted development

Although protecting the environment is a priority, some developments of the water environment can provide important benefits to human health, human safety and/or sustainable development. Such benefits can include:

- public water supply;
- flood alleviation;
- hydropower generation;
- navigation.

It is often impossible to undertake such activities without causing deterioration of status. Where a proposed water use activity could provide significant benefits, its merits will be taken into account to decide whether to allow an exemption from the general objective of preventing deterioration of status.

Information is given in Annex 3 on the water bodies where we have allowed a deterioration in ecological status or ecological potential[32] prior to the publication of this draft plan. Information on any future exemptions will be included in the next update of the river basin management plan in 2015.

5.1.5 Protected areas

Protected areas may be part of a water body (eg bathing waters), a group of water bodies (eg freshwater fish waters) or terrestrial ecosystems dependent on the status of water bodies. These are designated under European legislation as requiring special protection.

Specific objectives and standards apply to protected areas which are additional to the objectives of protecting and improving the condition of water bodies and separate to the good ecological status objectives of the Water Framework Directive. The protected areas must meet the objectives set out by the legislation appropriate to their designation. Where more than one objective applies to a water body, the most stringent applies. The objectives for these areas are discussed in Section 5.4.

5.1.6 Identifying measures to achieve the objectives

We have based the proposed objectives on a wide range of existing, improved or new[33] mechanisms designed to promote and drive action by many different stakeholders. These mechanisms include regulation, economic incentives, sources of public funding and voluntary programmes. The proposed objectives aim to be ambitious but realistic.

For some issues, the process of setting objectives has shown that further measures would help to maintain and improve the rate of progress in improving Scotland's water environment. The Scottish Government and members of the advisory groups are therefore exploring whether there are other measures or additional sources of funding that could be put in place to produce further environmental improvements to maintain the trend of improvements. The Scottish Government's proposals are on continued improvements.[34]

5.2 Improvement objectives for 2015

The improvements in the overall status of water bodies we expect to be achieved by 2015 as a result of our proposed objectives are summarised in Table 5. Maps 4a and 4b also provide an overview of how we see our objectives for 2015 improving the state of the water environment in the Scotland river basin district.

These summaries give only a partial picture of the extent of improvements to be delivered. This is because the actions taken to improve some water bodies will result in their condition being significantly improved without their overall status changing. For example, we may be able to reduce pollution to an estuary and so significantly improve chemical water quality by 2015. However, other environmental problems such as improvements to morphology may have to be phased over a longer period of time. As a result the improvements in pollution will not be reflected by an improvement in overall status for 2015.

Information on the improvements to water quality, water resources and morphological conditions that we expect the plan to deliver are described in Annex 3. Information on the improvement objectives for individual water bodies can be accessed from the interactive map on the SEPA website.[35]

[32]Permitted under Article 4(7) of the Water Framework Directive
[33]As set out in this draft plan
[34]www.sepa.org.uk/water/river_basin_planning.aspx
[35]www.sepa.org.uk/water/river_basin_planning.aspx

Table 5: Summary of our expected environmental improvements for 2015*

		Number and length/area of water bodies in each status/potential class					
	Total number of water bodies (length/area)	High/ Maximum	Good	Moderate	Poor	Bad	Objective not yet set
Rivers	1,709 (17,831km)	192 (1,172km)	833 (9,131km)	461 (5,291km)	159 (1,525km)	53 (602km)	11 (111km)
Lochs	209 (599 km^2)	92 (243km^2)	61 (200km^2)	27 (103km^2)	20 (46km^2)	6 (4km^2)	3 (2km^2)
Estuaries	33 (552km^2)	12 (251km^2)	6 (142km^2)	12 (128km^2)	0	1 (<1km^2)	2 (31km^2)
Coastal	435 (45,660km^2)	265 (33,510km^2)	149 (10,022km^2)	21 (2,127km^2)	0	0	0
Groundwater	275 (66,568km^2)		223 (57,918km^2)		51 (8,523km^2)		1 (126km^2)
HMWBs	381	2	198	5	33	15	128
AWBs (canals)	40	0	27	0	0	0	13
Total	3,082	563	1,497	526	263	75	158
% of total 2015		18%	49%	17%	9%	2%	5%
% change from 2007		+1%	+6%	-3%	-3%	-1%	0%

*In the draft plan we have identified the environmental improvements compared with the 2007 classification. The final plan will use the 2008 classification results as the baseline against which to measure improvements.

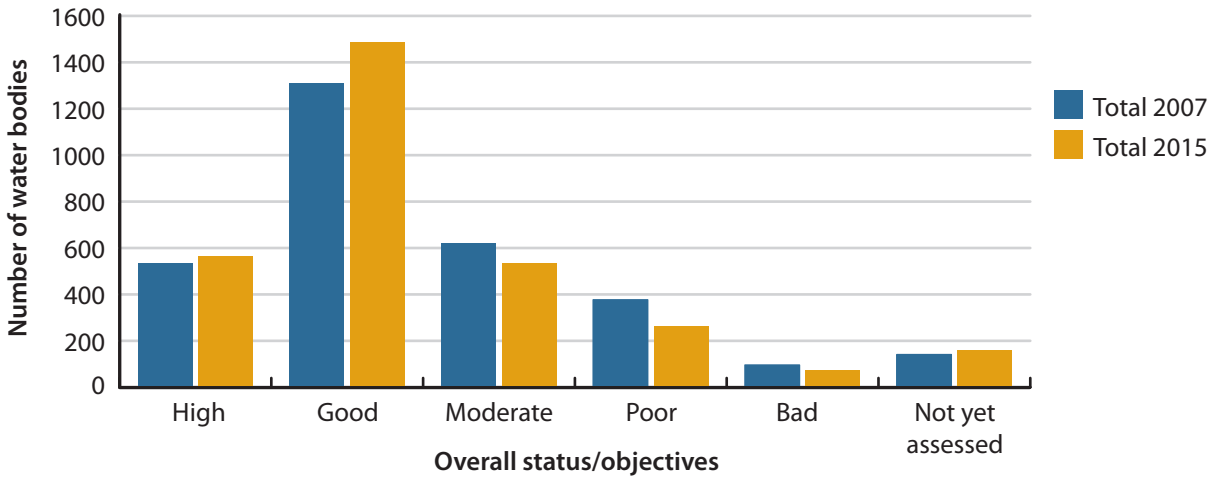
The results of the environmental objective setting for our water bodies (Table 5 and Figure 5) indicate that:

- 67% of our water bodies will be at good or high status by 2015, giving an overall environmental improvement of 7% from conditions in 2007;
- 28% will be at less than good status in 2015.

Objectives have not been set for 5% of our water bodies. Figure 5 shows a small increase in numbers not yet assessed between 2007 and 2015 because we have been able to classify more water bodies than we have been able to set objectives. These are predominantly HMWBs that are still to be assessed for ecological potential.

The objective setting process has also identified further measures which could help maintain the rate of progress in improving Scotland's water environment. These measures have been identified as summarised in Section 12 of this plan.

Figure 5: Predicted changes in overall status for all water bodies in the Scotland river basin district, 2007–2015

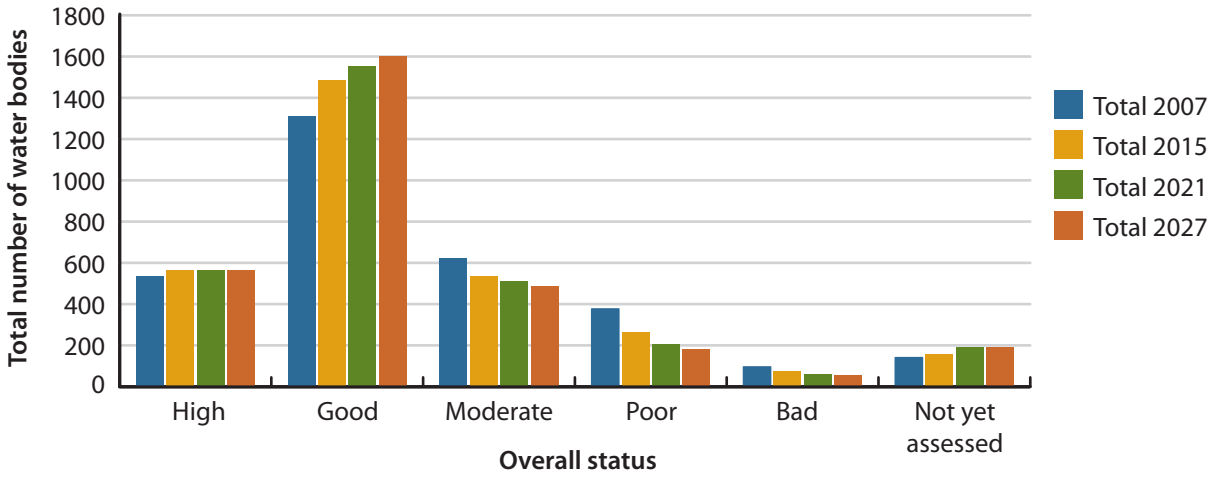


5.3 Improvement objectives for 2021 and 2027

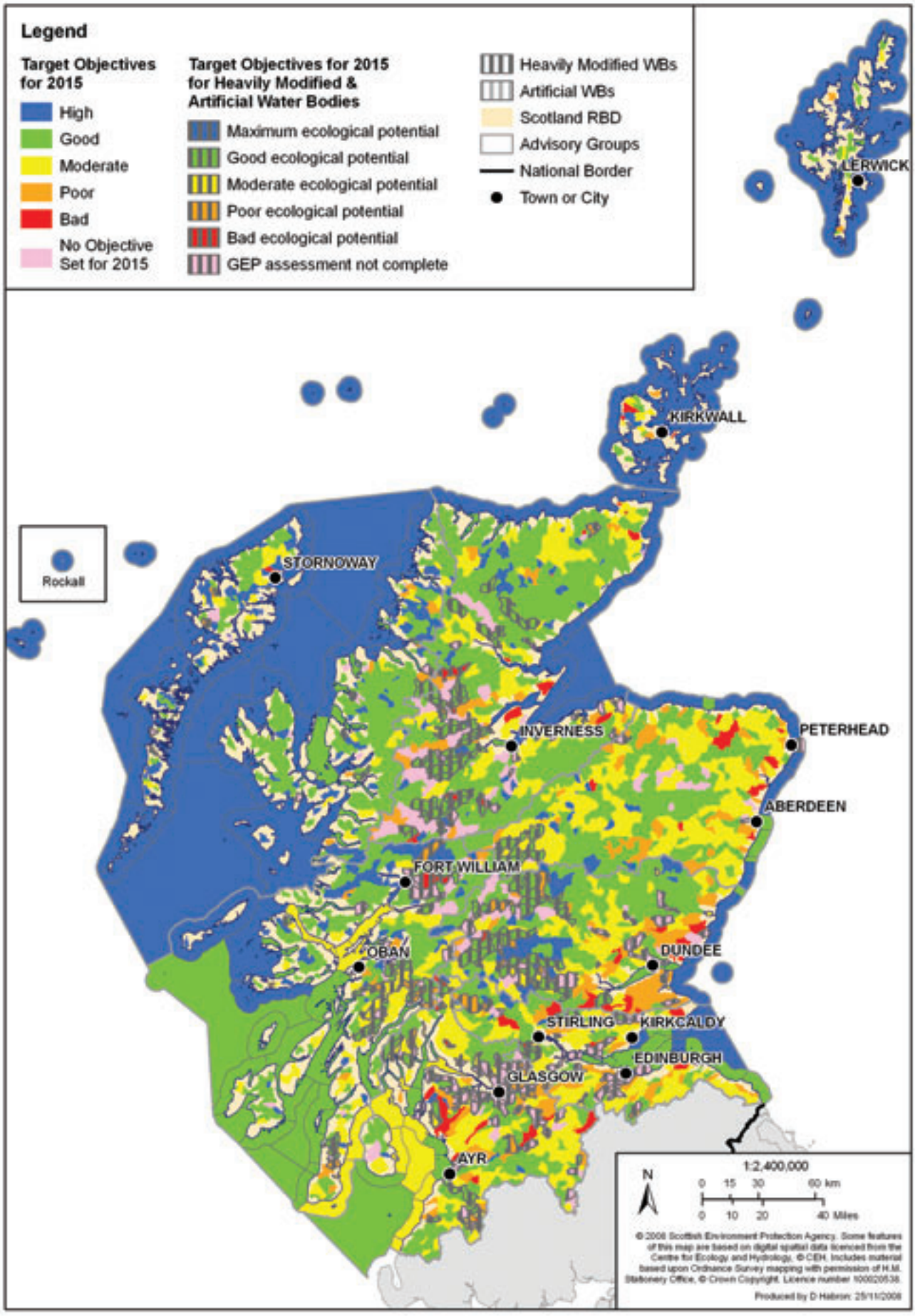
Where possible, as well as identifying priorities for improvement by 2015, we have proposed indicative objectives for 2021 and 2027. These are summarised in Figure 6. We will review and, if necessary, refine these indicative objectives in each successive planning cycle.

Maps 5a and 5b provide an overview of water bodies we currently expect to still be at less than good status in 2027.

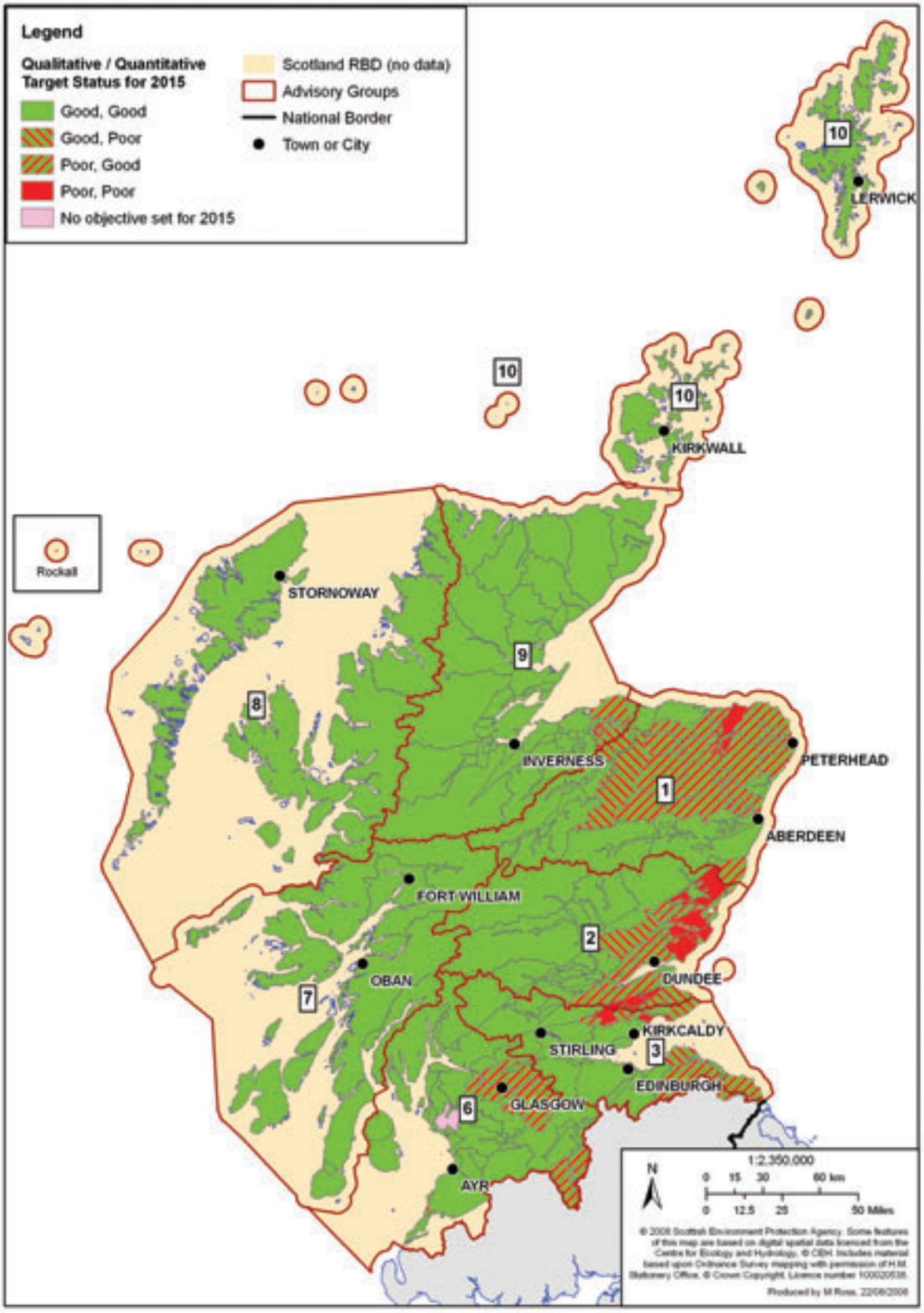
Figure 6: Predicted changes in overall status for all water baodies in the Scotland river basin district between 2007 and 2027



Map 4a: Status of surface water bodies and HMWBs/AWBs expected in 2015 from our improvement objectives



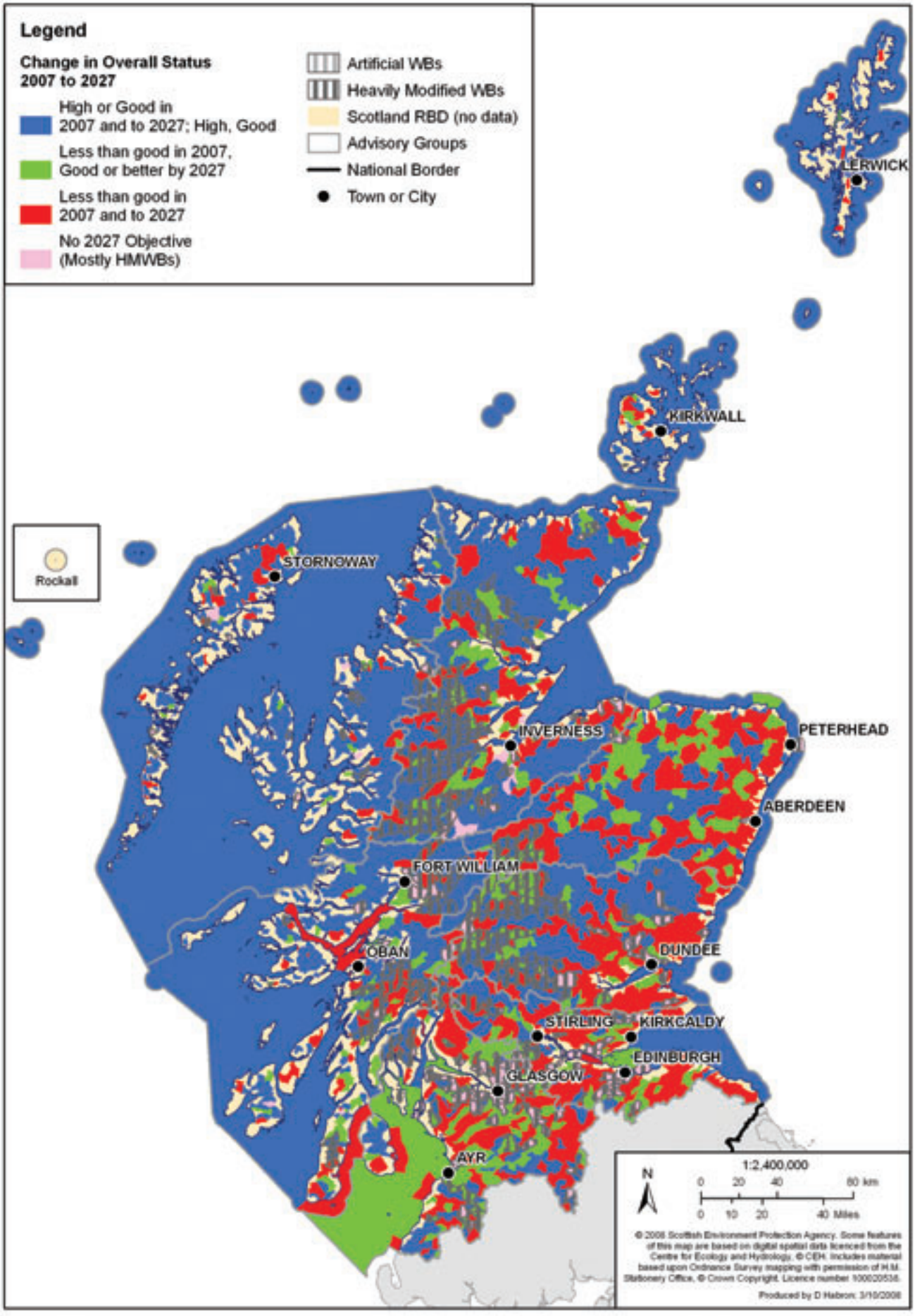
Map 4b: Status of groundwater bodies expected in 2015 from our improvement objectives



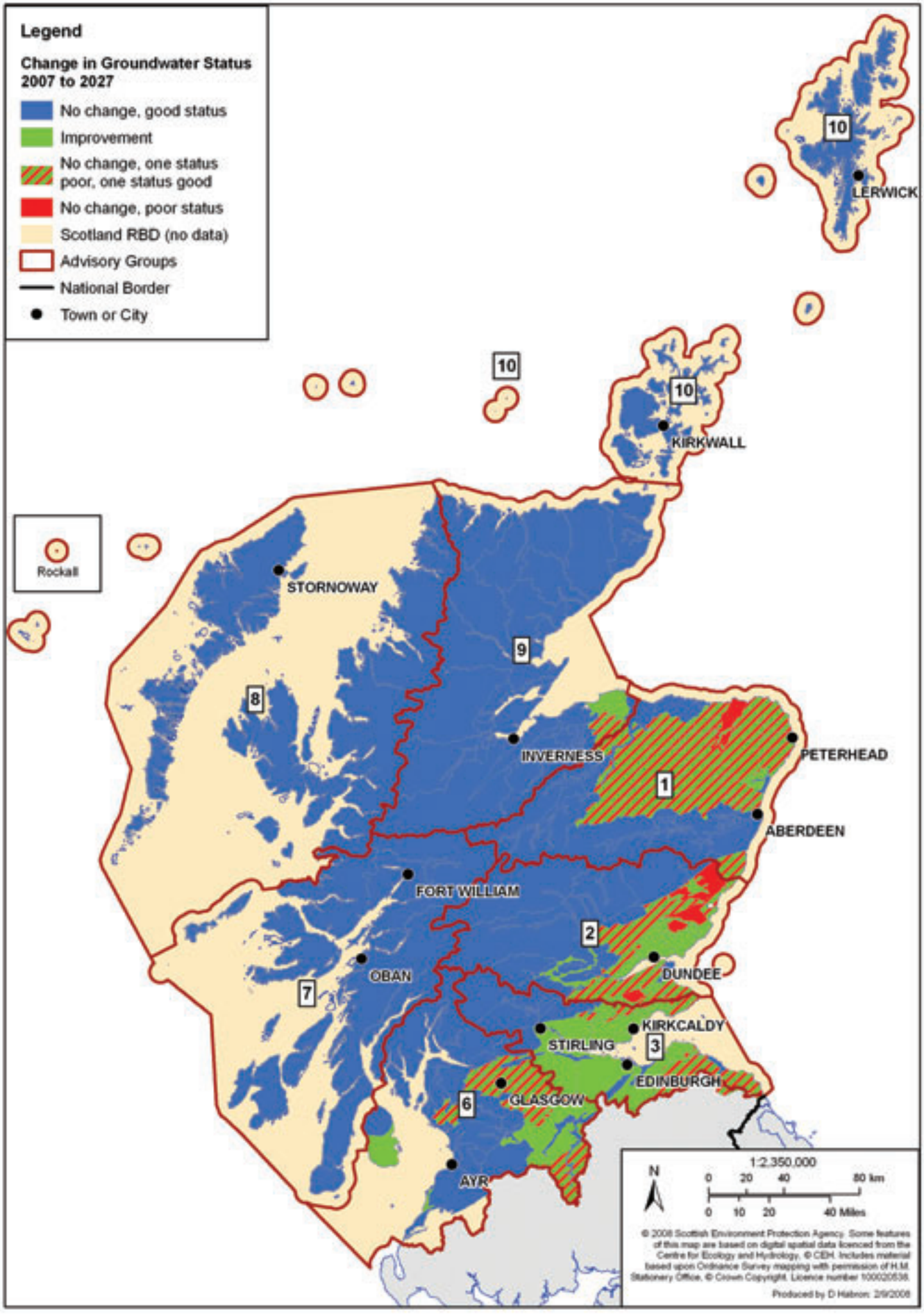
The map distinguishes between groundwaters that are:

- good for both qualitative (water quality) and quantitative (water quantity) status (green);
- good for qualitative status and poor for quantitative status (hashed left-to-right);
- poor for qualitative status and good for quantitative status (hashed right-to-left);
- poor for both qualitative and quantitative (red).

Map 5a: Surface water bodies expected to still be at less than good status in 2027



Map 5b: Groundwater bodies we currently expect to still be at less than good status in 2027



5.4 Objectives for protected areas

Protected areas are primarily areas identified because of their particular economic, environmental or social importance. The protection, and where necessary, improvement of these areas are therefore important objectives of the river basin planning process. Further information on the different protected areas and the objectives that apply to them is provided in Annex 5.

5.4.1 Special Protection Areas and Special Areas of Conservation

Initial assessments undertaken by Scottish Natural Heritage suggest that only two out of the 22 designated areas thought to be in unfavourable condition as a consequence of adverse impacts on the water environment, Moine Mhor and Loch Shiel, will recover to favourable condition by 2015. This partly reflects uncertainties about:

- the extent to which the unfavourable condition of the area is a consequence of adverse impacts on the water environment;
- the effectiveness of measures;
- recovery time.

This means that the numbers of SACs and SPAs meeting favourable conditions are both expected to increase by one between 2007 and 2015 (ie to 110 and 102 respectively).

5.4.2 Shellfish growing waters

Pollution reduction plans have been established to ensure progress towards achievement of the guideline standard for the bacterial quality of shellfish. These plans can be viewed on the SEPA website.[36] All shellfish waters currently comply with the required mandatory environmental standards. For 2015 we will aim to maintain this level of compliance while also significantly increasing the number of waters achieving guideline standards.

5.4.3 Freshwater fish

Full compliance with the mandatory standards specified in the Freshwater Fish Directive for all freshwater fish protected areas are expected to be achieved by the end of 2013 at the latest.

5.4.4 Bathing waters

To maintain currently high quality waters and improve compliance with current EU guideline standards, pollution reduction plans have been produced by SEPA for all bathing waters. These can be viewed on its website.[37] These plans will be further revised during the period covered by the first river basin management plan with the aim of ensuring the standards and objectives of the revised Bathing Water Directive are achieved.

By 2010 we expect all bathing waters to meet the applicable mandatory standards during all but exceptionally wet periods. We also expect a significant improvement in the number of such areas achieving guideline standards.

5.4.5 Drinking water protected areas, Nitrate Vulnerable Zones and nutrient sensitive areas

Further information on the objectives for drinking water protected areas, Nitrate Vulnerable Zones or nutrient sensitive areas designated under the Urban Waste Water Treatment Directive can be found in Annex 5.

Consultation question 2: This plan and Annex 3 sets out the objectives for the water environment for the next six years and beyond. To what extent do you agree with:

a) the level of improvements proposed by 2015?
b) the level of improvements proposed by 2027?

Consultation question 3: Are there water bodies where you think that the objective for the future should be different? If so, please provide details.

[36] www.sepa.org.uk/water/shellfish_waters.aspx
[37] www.sepa.org.uk/water/bathing_waters.aspx

Section 6 Achieving the objectives – developing a programme of measures

Developing a programme of measures to ensure that the environmental objectives are met is central to the river basin planning process. This section presents a summary of the measures that can be taken in relation to the key issues in this river basin district and the improvements expected from them. It builds on the work already achieved and the responses received as part of the consultation on the Significant Water Management Issues report.[38]

Annex 6 contains more detail on the process of selecting the most appropriate measure and the interactive map shows the measures applied on a water body by water body basis.

Key message

This plan brings together measures planned by a wide range of organisations across Scotland which will protect the water environment or deliver improvements. This is the first time this work has been co-ordinated across Scotland in an integrated way. We will be able to achieve our objectives more effectively and, as a result, achieve a wide range of benefits for the environment and the people of Scotland.

6.1 What is a measure?

The Water Framework Directive requires two kinds of measures to be put into place. A measure must:

- prevent deterioration in water body status or the condition of protected areas by ensuring existing water uses are appropriately managed and, where possible, ensure new water uses include appropriate mitigation and are located where the water environment can accommodate them; and/or
- improve the status of water bodies or the condition of protected areas by reducing, modifying or removing the reasons for failure.

6.2 No deterioration measures

These are measures that prevent a water body from deteriorating from its current status including mitigating the impacts of new pressures. They also include measures that prevent any deterioration in the condition of protected areas.

'No deterioration' measures may be achieved by simply observing best practice, following a General Binding Rule or implementing existing licence conditions. Many are ongoing actions ensuring the water environment remains at good status. These often unnoticed actions are carried out by land and water managers and represent a significant contribution to ensuring the quality and quantity of the water environment.

Where there is a potential new impact (eg a housing development), no deterioration measures can often be tailored to counteract a possible negative pressure; for example the installation of a sustainable urban drainage system (SUDS) in a new development to collect run-off from new roads and prevent pollution of watercourses.

No deterioration measures play an important part in ensuring the sustainable use of water.

6.3 Improvement measures

Where a water body is at less than good status, it is necessary to develop a programme of measures that actively improves its condition. Similar action is required where a protected area does not achieve the required conditions.

Improvement measures can involve a mix of regulatory and voluntary measures. In some instances the land or water manager responsible for implementing the measures will work with other agencies and voluntary bodies to ensure the improvements take place as quickly and as effectively as possible. One of the main functions of the Area Advisory Groups is to develop the partnerships necessary to support land and water managers.

6.4 Types of measures

A measure includes:

- the action used to reduce a pressure such as treating sewage effluent before it is discharged into the water environment;
- the mechanism for promoting or ensuring action is taken such as a regulatory requirement or a management agreement.

[38] www.sepa.org/water/water_publications/swmi.aspx

6.4.1 Existing measures

A range of measures are already available that can be used to promote or ensure action including regulatory mechanisms and existing sources of public funding. These contribute significantly to preventing deterioration and to improving the condition of the water environment. A number of these measures are associated with other European directives (eg Urban Waste Water Treatment Directive) but also contribute to achieving Water Framework Directive objectives. These measures are identified in this draft plan.

6.4.2 RBMP measures

Where existing measures will not deliver the level of protection or the scale of improvement required by the Water Framework Directive, we have developed new measures – called 'RBMP' measures – and/or modified existing ones. Regulatory RBMP measures include the Water Environment and Water Services (Controlled Activities) (Scotland) Regulations 2005 (CAR) administered by SEPA. In addition the National and Area Advisory Groups have proposed voluntary RBMP measures such as the removal of fish passes.

6.4.3 Continued improvement measures

The draft plan identifies only those measures within the scope of existing legislative provisions and levels of funding. Where additional measures could help to maintain the trend of progress in improving Scotland's water environment these are considered further in the Scottish Government's consultation on continued improvements.[39]

6.5 Priorities for action

We must ensure we prevent deterioration in status and in the condition of protected areas such as drinking water protected areas. River basin planning requires us to consider all types of pressures affecting the water environment. We believe we can achieve the most gain by focusing appropriate efforts on those issues we consider pose the greatest threat to our water environment.

The following sections continue the approach taken in the Significant Water Management Issues report. These sections look at the main water management issues contributing to classification failures and identify the measures required to protect and improve the affected water bodies. These issues have previously been agreed with our stakeholders to be the most significant.

In summary the pressure types are:

- abstraction and flow regulation;
- diffuse and point source pollution;
- changes to morphology (physical habitat);
- invasive non-native species.

This plan discusses these key pressures in detail. The measures identified for the full range of pressures on all water body types are detailed on the web-based interactive map.[40]

Consultation question 4: Have we identified the important existing measures that could be taken to address these pressures (Sections 7–11)? Please identify any important existing measures we have missed, including measures for individual water bodies (as detailed on the web-based interactive map).

Consultation question 5: Could you or your organisation, potentially working in partnership with others, help deliver existing measures or develop new measures?

Consultation question 6: We will need to work together to deliver the river basin management plan. Do you have suggestions on how we could work better together?

[39]A link to the document can be found on the SEPA website www.sepa.org.uk/water/river_basin_planning.aspx
[40]www.sepa.org.uk/water/river_basin_planning.aspx

Section 7 Abstraction and flow regulation

7.1 Current assessment of environmental impacts

Changes in water flows and water levels in rivers and lochs due to the abstraction of water or the damming of rivers can have impacts on habitats and wildlife. A large reduction in water levels can lead to a bare zone that is unsuitable for plants or fish spawning. Rapid changes to river flows downstream of dams can lead to stranding of fish. In contrast, stable flows below some dams may lead to sedimentation of fish spawning areas because they are no longer cleaned out by spates.

The classification data for 2007 show that over 20% of our surface waters are failing because of impacts on hydrology associated with low flows or levels caused by abstractions, or the regulation of flows downstream of reservoirs. Map 6 shows those water bodies failing hydrological standards prior to any assessment of good ecological potential for heavily modified and artificial water bodies.

A number of native species including sea trout, salmon, eels and lamprey migrate along rivers as part of their natural breeding ecology. These species have evolved to be able to travel over small structures in the water such as rocks but larger structures can block their passage. Sometimes this occurs naturally due to features such as waterfalls, but many blockages are man-made. The ecological quality of rivers and lochs is affected if fish can not access rivers they naturally would be able to live and spawn in. In some cases, a single barrier at the base of a catchment can cause a long stretch of catchment to be cut-off as the impact of the barrier has a 'knock-on' effect of preventing fish passage all the way upstream. Just under 10% of water bodies in the Scotland river basin district are affected by such barriers – see Annex 2 for further information.

The assessment of hydrological impacts is based on the use of environmental standards for rivers, lochs and estuaries issued as Directions by the Scottish Government. These standards or condition limits have been set for each status class on the basis of the best available information on ecological impacts as recommended by the UK Technical Advisory Group on the Water Framework Directive. To assess whether a standard has been met or not, SEPA monitors the environment and uses the information in CAR licences on abstraction levels and dam compensation flows to determine the degree of change from modelled natural river flows or loch levels. Table 6 shows:

- the number and length/area of our water bodies failing for hydrology in 2007 and expected to fail in 2015;
- the length/area of expected improvement between 2007 and 2015;
- the proportion affected by specific pressures.

Of the 369 rivers (3,884km) and 91 lochs (344km^2) failing hydrology standards in 2007, 90 rivers (960km) and 61 lochs (260km^2) are HMWBs assessed at good ecological potential.

The information in Table 6 shows that the three sectors (electricity generation, water supply and agricultural abstraction) contribute to the impacts on the hydrology of more than 25% of our rivers. The water levels and flows of our rivers and lochs are affected by other sectors (including distilleries and paper mills) but not to the same degree.

The measures discussed in the following sections are expected to contribute to an improvement in the hydrological condition of 46% of our rivers and 75% of our lochs. This improvement also includes the assessment of ecological potential for heavily modified water bodies.

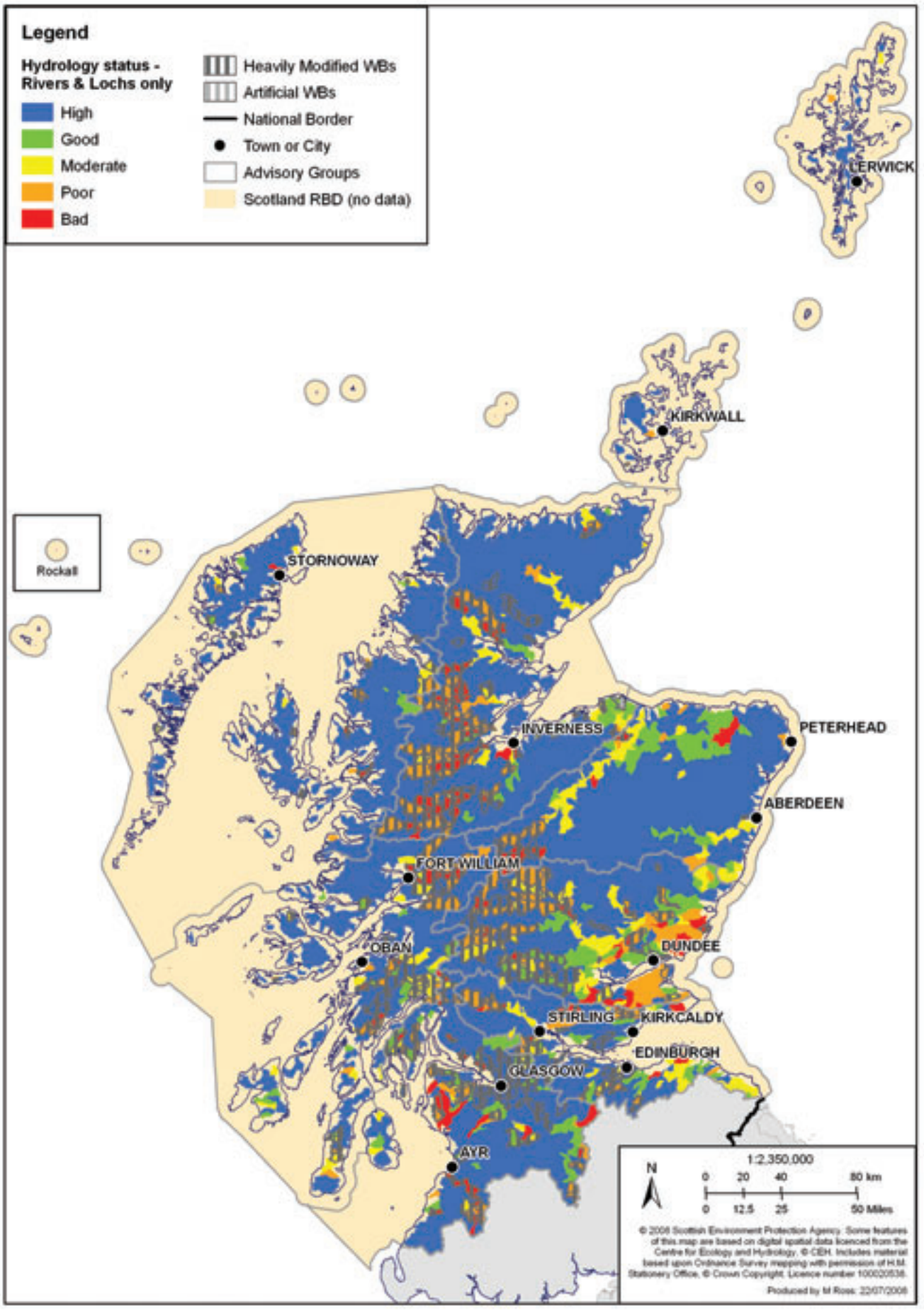
Further information on the environmental impacts of abstraction and flow regulation can be found in Annex 1.

Table 6: Pressures on hydrology and expected level of improvement, 2007–2015*

Parameter	Water body category	Number of water bodies (length/area) failing parameter in 2007	% of water bodies affected by:						Number of water bodies (length/area) failing parameter in 2015	Number (length/area) and percentage improved in 2015
			Electricity generation		Water supply		Agricultural irrigation			
			Abstraction	Flow regulation	Abstraction	Flow regulation	Abstraction	Flow regulation		
Changes to water levels and flow	Rivers	369 (3,884km)	30%	25%	26%	19%	28%	0%	200 (2,143km)	169 (1,742km) 46%
Changes to water levels and flow	Lochs	91 (344km^2)	9%	10%	9%.	8%	0%	0%	23 (77km^2)	68 (268km^2) 75%
Quantitative**	Groundwaters	22 (3,688km^2)	5%	na	27%	na	59%	na	19 (3193km^2)	3 (495) 14%

*The lengths failing in 2015 and the length improved take into account those water bodies meeting good ecological potential.
Na – not applicable
**Further information on groundwater results can be found in Annex 2.

Map 6: Classification status for surface water bodies for hydrology, 2007



7.2 Generic actions for the improved assessment of hydrological and fish barrier impacts

This section considers what generic actions are required to improve our assessments of hydrological and fish barrier impacts. These actions are summarised in Table 7.

SEPA has been progressively improving its assessment of hydrological impacts as the information it holds on licensed activities has improved. Over the period of the first river basin management plan, SEPA will take the following actions to progressively improve this assessment.

- Monitoring of actual abstraction and compensation flows will be required for those abstractions and dams with the greatest environmental impact. Actual abstraction and compensation flows will then be used to assess compliance with environmental standards.
- Biological tools that can be used to assess the ecological impacts of changes in hydrology will be developed. It is expected to take until 2011 until the new tools are available for use.
- Scotland's monitoring programme will be developed to directly monitor impacts and to incorporate SEPA's new biological monitoring tools.

Impacts associated with fish migration are based on a Fisheries Research Services (FRS) database of barriers to salmonid migration developed with the Fishery Boards and Trusts. The database is incomplete, with some areas of the country having only a small proportion of barriers recorded. In addition, the focus is on barriers to salmon and obstacles which are not problematic to salmon may be more problematic to other slower swimming species. Over the period of the first river basin management plan, the following actions will be taken to progressively improve this assessment.

- The Fishery Boards and Trusts will identify additional barriers to salmonid migration which will be added to the FRS database.
- A Great Britain steering group is developing a tool for assessing the extent to which barriers impede migration of a wide range of species. This tool is expected to be available for use from 2010 and will progressively improve our understanding of the impacts of barriers on fish migration.

An important component of the classification scheme for dams and weirs is the definition of ecological potential for those water bodies designated as heavily modified. Heavily modified and artificial water bodies are assessed as good ecological potential for water quantity, water flow and physical habitat (morphology) depending on whether reasonable effort has been made to maximise the quality of the ecology and habitats. The five classification status classes for HMWBs and AWBs reflect not only the level of mitigation measures for water levels and flow and physical habitat but also the chemical quality of the water.

SEPA, Scottish Water, British Waterways Board and the hydropower industry have assessed whether good practice measures are in place at heavily modified and artificial water bodies. This assessment was used to estimate the ecological potential of the affected water bodies. The results of this exercise and the rules used by SEPA and the hydropower companies are provided in Annex 4. Work to develop the indicative list of measures will be undertaken over the next year with stakeholders and operators.

SEPA expects the current view of the classification of ecological potential to change as our understanding of the linkages between ecology, hydrology and physical habitat improves with each river basin management cycle. Environmental objectives and resultant measures may therefore be revised in future cycles.

Table 7: Summary of actions required to assess hydrological and fish barrier impacts

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism	Support provider/ regulator
Assessment of impacts	Improved monitoring of assets	Operators	Monitoring plans as required by licence	SEPA
	Development of biological tools to monitor impacts of hydrological changes	SEPA	UKTAG research programme	SNH RAFTS Environment Agency NIEA
	Develop new assessment tool for barriers to fish migration	SEPA	UKTAG research programme	SNH FRS RAFTS Forestry Commission Scotland Environment Agency NIEA Loughs Agency
	Development of wetland inventory and tools to assess hydrological impacts	SEPA SNH	Scottish Wetland Forum	Local authorities RSPB WWF
	Application of new environmental monitoring tools	SEPA RAFTS	Scottish monitoring programme	SNH FRS
Improve definition of ecological potential	Improved definition of appropriate best practice measures at each asset	SEPA	Workshops to review appropriate measures	Operators Forestry Commission Scotland RAFTS FRS

FRS = Fisheries Research Services; NIEA = Northern Ireland Environment Agency; RAFTS = Association of Scottish River & Fishery Management Trusts; SNH = Scottish Natural Heritage; UKTAG = UK Technical Advisory Group

7.3 Abstraction and flow regulation from electricity generation

Between the late 19th and mid-20th centuries, large-scale hydropower schemes covering hundreds of square kilometres were created in Scotland. Many of these schemes divert water across catchments to dams which hold the water until energy generation is required. There are 23 major schemes in Scotland supplied by catchments covering over 8,373km² of mainland Scotland. A major advantage of large hydropower schemes is that they have storage and so can generate energy on demand. In some cases reservoirs also provide opportunities to develop new and diverse ecosystems which also provide social and recreational benefits.

A further 74 small-scale hydropower plants (installed capacity <2MW) are owned by private companies and individuals. These small-scale 'run of river' schemes may remove water from a river, pass it through a turbine and return it to the same river. Although these schemes contribute to renewable energy generation, they are not able to store water and thus are not able to offer the additional benefits of the large schemes which can generate on demand to meet peak loads.

As part of Scotland's contribution to combating climate change, the Scottish Government has set targets to increase renewable energy generation to 31% of electricity generated in Scotland by 2011 and to 50% by 2020. Hydropower is one of Scotland's largest sources of renewable energy and its further development is vital in order to meet Government's renewable energy targets and reduce carbon dioxide emissions.

Key message

Getting the balance right between supporting hydropower development and protecting and improving the water environment is a key challenge for this and future river basin management plans.

7.3.1 What causes the environmental impact?

New hydropower schemes can be designed to minimise their impact on the water environment by applying accepted industry standards of good practice in the provision of compensation flows and fish passage. Older schemes may not have been designed to these standards and can cause the following types of impacts on the hydrology of the water environment:

- reduced flow in rivers because of abstractions;
- increased flow in rivers due to inter-basin transfer;
- large changes in water levels in lochs and reservoirs due to abstractions;
- changes in the flow regimes (including rapid changes in water associated with power production but also unnatural flow variability across seasonal timescales) downstream of reservoirs and generating stations.

Other environmental impacts associated with hydropower generation include:

- barrier to fish passage at weirs and dams;
- morphological impacts associated with the level variation in lochs and reservoirs;
- morphological impacts associated with structures such as dams which prevent sediment movement down river systems;
- water quality and thermal impacts downstream of dams.

Information on the impacts of hydropower is available in the Significant Water Management Issues report.[41]

7.3.2 What action are we taking to deliver environment benefits?

SEPA is discussing with the hydropower industry how to deliver benefits for the water environment over the next three river basin planning cycles. The focus is on getting the balance right between promoting renewable energy generation and achieving benefits for the water environment. The challenge is to meet WFD objectives while aiming to ensure, if at all possible, that there is no loss of renewable energy generation.

First river basin planning cycle

For the first planning cycle, SEPA is working with the operators of hydropower schemes to develop a cost-effective and proportionate approach to the delivery of improvements. The initial focus will be on the following four major hydropower schemes in the Scotland river basin district:

- Scheme 1: Scottish and Southern Energy Tummel Scheme – River Garry;
- Scheme 2: Scottish and Southern Energy Ness Scheme – River Moriston;
- Scheme 3: Scottish and Southern Energy Conon Scheme – Glascarnoch River
- Scheme 4: Alcan Lochaber Scheme

The work will focus on providing compensation flows for rivers – many of which are currently virtually dry for much of the year. Stakeholders will be consulted during 2008–2009 on how these improvements might be achieved.

Planning environmental improvements in the longer term

The improved data held by the hydropower operators and SEPA over the period up to 2015 will allow the identification of further measures required to achieve environmental improvements. However it is important for SEPA and the hydropower sector to identify potential areas requiring further investment as soon as possible in order to allow effective planning of these measures.

We have started to identify which reservoirs and abstractions may require measures to deliver additional improvements over the period from 2015 to 2027. Our initial assessment focused on the provision of increased compensation flows and fish passage facilities at sites identified as heavily modified water bodies. Where measures are required, SEPA and operators have attempted to assess whether they would be likely to have a significant adverse impact on energy production.

[41] www.sepa.org/water/water_publications/swmi.aspx

7.3.3 What action are we taking to promote sustainable water use?

A study of the potential for further hydropower generation in Scotland by the Forum for Renewable Energy Development in Scotland (FREDS) identified a capacity of 709MW of financially viable hydropower development remaining in Scotland. The FREDS study looked at a range of potential constraints such as the capacity of the national grid and nature conservation designations, both of which reduce the practical potential of development. The assessment did not include an examination of other considerations with respect to amenity and recreational uses such as fishing and canoeing. Any additional considerations associated with the water environment would be examined by SEPA as part of the process of determining a CAR licence. Overall these additional considerations are unlikely to make a significant difference to the overall capacity that could be developed.

Scottish Ministers, SEPA, the Fisheries Committee, Fisheries Research Services and Scottish Natural Heritage are also working to simplify the regulatory process. The intention is to provide single guidance on information requirements for new hydropower developments and to streamline the decision-making process. This should allow operators to submit good quality applications which will avoid delays that currently often occur at the start of the process when additional information has to be requested.

Table 8 summarises the actions to reduce the impact of abstraction and flow regulation from electricity generation.

Table 8: Summary of actions to reduce the impact of abstraction and flow regulation from electricity generation

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Improve flows in rivers and levels in lochs Allow fish migration	Provide compensation flows and freshets	Hydropower companies	Licence reviews	SEPA
	Provide for fish passage at dams and weirs	Hydropower companies	Licence reviews	SEPA
Support new hydropower development	Provide information to assist in planning new schemes	FREDS	Maps showing potential for new hydropower development and distribution of other potentially conflicting water uses	Scottish Government SEPA SNH RAFTS Sport Scotland
Decision-making process for new hydropower schemes	Shorten the time taken to make decisions	Scottish Ministers and SEPA	Co-ordination between Scottish Government Energy Consents Unit, SEPA and Fisheries Committee Memorandum of Understanding between Fisheries Committee and SEPA Joint guidance issued by Fishery Committee, SNH and SEPA	Forestry Commission Scotland SNH Scottish Government FRS

FREDS = Forum for Renewable Energy Development in Scotland; FRS = Fisheries Research Services; RAFTS = Association of Scottish River & Fishery Management Trusts; SNH = Scottish Natural Heritage

7.3.4 What benefits will we see from these actions?

SEPA and the hydropower sector have identified options for delivering important improvements and preventing deterioration in the water environment. Over the next year SEPA will work with operators and other users of the water environment to develop these options. This work will focus on providing flows in rivers that are currently nearly dry and thus allow for fish migration. As well as improvements in ecology this work will lead to potential benefits for salmonid fisheries resulting from the opening up of rivers as nursery areas which will increase recruitment of fish.

Defining objectives for the period from 2015 to 2027 is difficult given the limitations in the data held by hydropower operators and SEPA. Indicative lists of sites where measures should be taken will be developed over the period up to the production of the final river basin management plan.

An important aim of this plan is to provide support for increased hydropower energy generation in the Scotland river basin district.

7.4 Abstraction and flow regulation from drinking water supplies

Scottish Water provides drinking water to 3.6 million people from sources in the Scotland river basin district. Scotland is fortunate that high quality sources of water are found in the upland areas close to the most densely populated urban areas. Most of Scotland's drinking water is therefore provided from rivers, lochs and reservoirs. Only about 4% of Scotland's public drinking water is abstracted from groundwater.

Some 150,000 people in Scotland depend on private supplies of water. Most of these supplies are derived from groundwater although some private drinking water supplies come from small upland burns.

Both surface water and groundwater drinking water sources are vulnerable to pollution which may pose risks to human health. To manage this risk, drinking water is treated resulting in additional costs. Protecting drinking water sources is a key objective of this plan which must support the work being undertaken by Scottish Water to develop Drinking Water Safety Plans. The location of drinking water sources means that the greatest threat to them is generally posed by diffuse pollution (see Section 8.3 on diffuse agricultural pollution).

Scottish Water is required to support all new development to provide drinking water supplies at reasonable cost. This may place demands on existing water resources that are not sustainable, particularly in rural areas where sources can be small and in isolated locations with few (if any) alternatives supplies.

Key message

We will use river basin planning to promote efficient use of water to ensure water resources are used wisely and water is not wasted. This will minimise existing impacts and the need for additional investment to develop new sources that could have adverse impacts on the water environment.

7.4.1 What causes the environmental impact?

New public drinking water supply schemes can be designed to minimise their impact on the water environment by applying accepted industry standards of good practice in:

- controlling the volume of water abstracted at low flows in rivers;
- the provision of compensation flows from reservoirs;
- the provision of fish passage.

Older drinking water sources may not have been designed to these standards and can cause the following types of impacts on the hydrology of the water environment:

- reduced flow in rivers because of abstractions;
- large changes in water levels in lochs (although reservoirs are created to enable variations in water levels);
- lack of natural changes in the flow regimes downstream of reservoirs because compensation flows are maintained at fixed flow rates;
- lower water levels in wetlands due to high levels of groundwater abstraction.

Other potential environmental impacts that may be associated with water supply include:

- barrier to fish passage at weirs and dams;
- morphological impacts associated with the level variation in lochs (reservoirs are created to enable level variation so morphological changes are an integral part of this);
- morphological impacts associated with structures such as dams which prevent or limit sediment movement down river systems.

Private drinking water sources tend to be small and do not normally have an impact on the environment. However, cumulatively they could lower groundwater levels or reduce flows in rivers, thus exacerbating naturally occurring low flow events.

Further information on the impacts of water supply is available in the Significant Water Management Issues report.

7.4.2 What action are we taking to deliver environment benefits?

The overall level of funding for Scottish Water is determined by ministerial decisions. The spending programme is identified and managed by a public planning process called Quality and Standards (Q&S). The current programme includes funding to mitigate the environmental impacts of Scottish Water's dams and abstractions at a specified list of sources by implementing improvement measures. This programme is being implemented through close liaison and technical working groups involving Scottish Water, SEPA, the Drinking Water Quality Regulator for Scotland and Water Industry Commission Scotland. It also includes a review with Scottish Natural Heritage to determine if the current abstraction regime is resulting in detrimental impacts on the designated features of any Natura 2000 site.

All Scottish Water's abstraction and impoundment activities are authorised by SEPA under the Controlled Activities Regulations. SEPA has identified a number of water resource zones where it considers the current abstraction and/or impoundment activity represents a risk to meeting good status. These zones are to be addressed either in the current Scottish Water investment period (2006–2010) or have been highlighted for inclusion in the next investment period (2010–2014) subject to ministerial approval.

The remainder of Scottish Water's licences will be reviewed over the first river basin planning cycle to determine whether the activities covered represent a significant impact on the environment. Further improvements will be prioritised as necessary following this review and promoted in the Quality and Standards planning process.

First river basin planning cycle

The change in environmental regulation introduced by the WEWS Act in 2003 initiated an assessment of environmental impacts caused by public drinking water abstractions. This led to the development of the Quality and Standards programme of work between 2006 and 2014 outlined below.

Much of the work required in the development of improvement schemes has focused on improving the understanding of how Scottish Water's assets affect the environment. As part of its monitoring programme, Scottish Water is undertaking a major programme of work to generate detailed records of abstraction activity by installing monitoring equipment on its licensed abstractions where the water treatment works supply over 50m^3/day. Similarly SEPA is improving its environmental monitoring so as to identify the range of impacts associated with drinking water abstractions and to prioritise the most 'at risk' sites.

The Drinking Water Quality Regulator is collecting information on the location of private drinking water abstractions. As this information becomes available, SEPA will assess whether there are likely to be cumulative environmental impacts. This assessment will inform the definition of measures in the second and third river basin management plans.

Drinking water sources and supply systems have been developed over many years and, in many cases, aging distribution networks are subject to high levels of leakage. A key priority for Scottish Water over the period up to 2015 will be to reduce leakage to the economic level of leakage (ELL). Reduction in leakage rates will help reduce:

- environmental impacts at those sites where over-abstraction occurs;
- pumping and treatment costs;
- energy use and therefore carbon dioxide emissions;
- the need to develop new abstractions/sources of water.

In addition, Scottish Water is undertaking targeted studies at 78 water resource zones[43] (WRZs), covering 40% of its raw water sources to determine whether environmental improvements can be achieved by 2010 by reducing abstraction and/or increasing compensation flows. These studies will:

- assess whether improvements to compensation flows to rivers below impounding reservoirs can be made without having significant adverse affects on water supply;
- consider options such as:
  - further leakage reduction;
  - looking for additional sources to supplement supplies or for entirely new sources of water;
  - changes to operational regimes to reduce the impact of the abstraction regime.

Scottish Water is also working to achieve required sustainability reductions in nine WRZs and to carry out investigations at a further 27 WRZs to meet the requirements of the Water Framework Directive in relation to increased compensation or reduced abstraction.

When these initiatives are complete, Scottish Water will have studied a total of 114 of our WRZs covering 72% of our drinking water sources. The remaining sources are deemed by SEPA not to be under significant environmental pressure.

[43]As of the end of June 2008, 24 of the 78 WRZs were still being studied by Scottish Water for completion by 2010. The remaining WRZs either do not require physical intervention or interventions are being implemented as part of other projects (eg water quality). The delivery of measures in these WRZs is subject to the value management process agreed by the Water Industry Commission for Scotland for this Q&S investment period. The delivery of measures for the next period (2010–2014) is subject to final determination by the Water Industry Commission for Scotland.

Scottish Water has also agreed to:

- investigate and, where required, improve fish passage at three named sites in Scotland river basin district by 2014;
- investigate and, where required, remove redundant structures at five sites by 2014 to reduce morphological pressures;
- undertake further investigations with SEPA to determine potential future candidate sites for similar work.

Note these figures are provisional and may change.

Planning environmental improvements in the longer term

The improvements in data held by Scottish Water and SEPA over the period up to 2015 will allow the identification of further measures required to achieve environmental improvements. It is important for SEPA and Scottish Water to identify potential areas requiring further investment as soon as possible to allow effective planning for these measures.

We have taken the first step by identifying which reservoirs may require measures to deliver additional improvements over the period from 2015 to 2027. This initial assessment focused on the provision of increased compensation flows and fish passage facilities at sites identified as heavily modified water bodies. Where measures were deemed to be required, SEPA and Scottish Water have attempted to assess whether these measures would be likely to have a significant adverse impact on the supply of drinking water.

7.4.3 What action are we taking to promote sustainable water use?

Drinking water protected areas

SEPA and Scottish Water have developed an environmental risk assessment as part of the development of Drinking Water Safety Plans and for the purpose of drinking water protected areas. This assessment identifies where action is needed to reduce the risk of pollution that could affect public drinking water sources and require expensive new treatment provision. SEPA and Scottish Water will provide this information to the Area Advisory Groups over the next year with the intention of developing new measures for the final river basin management plan.

During the period of the first river basin management plan, SEPA will develop similar risk assessments for private drinking water sources. This process is currently constrained by the very limited information available on the location of these sources.

Water resource planning

In collaboration with SEPA, Scottish Water has produced its first comprehensive long-term Water Resource Plan.[44] The aim is to define a long-term water resources strategy to secure the reliable supply of drinking water to protect public health and facilitate economic growth in a sustainable and cost-effective manner. The plan will be updated at regular intervals.

The Water Resource Plan and the river basin management plan for the Scotland RBD are thus interdependent as the former provides essential background context for development of the latter. In future revisions the Water Resources Plan will also be a means by which Scottish Water and SEPA can justify, economically, the required environmental spend to implement the measures identified in the river basin management plan to deliver WFD objectives.

Although Scotland does not generally suffer long droughts, the nature of many small rural water supplies without storage in lochs and reservoirs makes them vulnerable to relatively short drought events. Drought plans are therefore essential to ensure appropriate measures are in place and alternative sources identified (where appropriate) to maintain public supplies and minimise environmental impact. These plans will include an emphasis on efficiency measures including enhanced leakage reduction. SEPA will work with Scottish Water to ensure drought plans are in place and updated regularly.

SEPA and Scottish Water have been identifying where there is capacity for further development. Where no capacity exists, this may be because the level of abstraction already threatens to fail an environmental standard or Scottish Water's assets cannot deliver any additional water. Under these circumstances, SEPA and Scottish Water aim to work with local authorities to direct development away from such sites until investment provides additional water supply capacity.

7.4.4 What benefits will we see from these actions?

Scottish Water will be making a significant contribution to the river basin management plan, delivering important environmental improvements as well as preventing deterioration over the period until 2014. Work is continuing to determine exactly what measures will be implemented and, in addition, ministers will need to further consider and approve the investment planned for the period 2010–2014. Current projections indicate that, by 2015, this work could contribute to the improvement of almost 1,800km of river in terms of improved river levels and flows – much of which will be on heavily modified water bodies.

[44] http://www.scottishwater.co.uk/portal/page/portal/SWE_PGP_INVESTMENT/SWE_PGE_INVESTMENT/WHAT_PLAN_RES

The additional salmonid spawning area provided by the installation of fish passes is estimated to be approximately 50km in terms of river length. The removal of the redundant structures identified is expected to lead to morphological benefits of around 10km.

Defining objectives for the period from 2015 to 2027 is difficult given the limitations in the data held by Scottish Water and SEPA. Indicative lists of sites where measures should be taken will be developed over the period up to the production of the final river basin management plan.

The work undertaken by Scottish Water and SEPA described in this plan will achieve clear environmental benefits with flows being improved in rivers and fish migration extended. This will have associated biodiversity, amenity and fisheries benefits. Importantly this plan is also part of the process that will enhance the protection of drinking water sources from pollution, helping to ensure that Scottish Water can continue to provide high quality drinking water. Scottish Water's investment to reduce leakage and promote efficient water use by consumers will contribute to improvements in the water environment and reduce its carbon footprint.

Table 9 summarises the actions to reduce the impact of abstraction and flow regulation from drinking water supplies.

Table 9: Summary of actions to reduce the impact of abstraction and flow regulation from drinking water supplies

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Improve flows in rivers and levels in lochs	Reduce leakage rates	Scottish Water	Leakage reduction targets	SEPA and Water Industry Commission for Scotland
	Improve efficiency of use	Scottish Water	Guidance and publicity on industrial best practice Vision in Business for the Environment of Scotland (VIBES) competition on industrial best practice Information for customers on how to use water efficiently particularly in at risk areas.	SEPA
	Increase in compensation flows from reservoirs or reduction in abstractions from rivers and lochs	Scottish Water	Licence review as part of Q&S process	SEPA and Water Industry Commission for Scotland
	Consider use of alternative sources	Scottish Water	Licence review as part of Q&S process	SEPA and Water Industry Commission for Scotland
Allow fish migration	Provide fish passage	Scottish Water	Licence review as part of Q&S process	SEPA and Water Industry Commission for Scotland
Improve morphology of water environment	Remove redundant structures	Scottish Water	Licence review as part of Q&S process	SEPA and Water Industry Commission for Scotland
Minimising impacts of droughts	Identify mitigation actions	Scottish Water	Development of drought plans	SEPA
Protect drinking water sources	Extend protection for public and private drinking water sources	SEPA	Identify further surface water drinking water protected areas	Drinking Water Quality Regulator
	Reduce pollution in drinking water protected areas	Area Advisory Groups	Pollution reduction plans	SEPA
Promote sustainable development of public water supply	Provide for additional demand while minimising environmental harm	Scottish Water and SEPA (licensing)	Water Resource Plan – anticipate where demand will be	SEPA and Water Industry Commission for Scotland
	Direct development to areas where capacity exists	Local authorities	Development plans	Scottish Water and SEPA

7.5 Abstraction for agriculture

Abstraction of water for agriculture serves many purposes depending on the type of farming (eg water for crop irrigation, drinking water for livestock) but by far the greatest agricultural use of water is for irrigation. This occurs primarily along the east coast of Scotland to support the economically important production of fruit, vegetables and root crops (mainly potatoes). Climate change is expected to reduce rainfall during the summer along the east coast and, as a consequence, the requirement for irrigation is expected to increase.

The location of the main growing areas in the east of Scotland means that farmers frequently rely on small burns which, during periods of low flow, may not have sufficient water to support their abstractions. Typically, 5–20 farmers may be abstracting from the same relatively small catchments.

Key message

Abstraction for irrigation has increased substantially over the past 10 years and is expected to continue to increase. Regulatory controls on abstraction for irrigation have only recently been introduced but these will progressively reduce over-abstraction, improving the environment and ensuring more water is available for other abstractions. There is much that farmers can do themselves to reduce the impact of their abstractions.

7.5.1 What causes the environmental impact?

Agricultural abstractions for irrigation occur only during dry weather when river flows are low, typically using about 1,200m3/day. This is the equivalent to the water used by 6,000 people.

The main impacts associated with irrigation are:

- reduced flow in rivers and water levels in lochs because of abstractions;
- poorer water quality due to reduced flow and leaching of chemicals;
- low groundwater levels because of abstractions;
- barriers to fish passage at small dams constructed by farmers to allow the abstraction of water.

Further information on the impacts of irrigation is available in the Significant Water Management Issues report.[45]

7.5.2 What action are we taking to deliver environment benefits?

This river basin management plan provides information to help farmers to take appropriate action to minimise the impacts caused by over-abstraction.

Actions by farmers

Where a river is impacted by abstraction, farmers should consider the following options or combination of options.

- Work to ensure you do not waste water. Using water more efficiently by balancing irrigation with crop needs will reduce pumping costs and protect the environment.
- Reach an agreement with your neighbours over how to time your abstractions so as not to abstract at the same time as other farmers in the area.
- Seek alternative sources of water. Where this option is not available, assess whether a storage pond can be constructed. Filling the pond during the winter will reduce environmental impacts and provide security of supply. Part-funding for storage ponds may be available from the Scotland Rural Development Programme.

Action by others

SEPA will work with other partners within Scotland's Environmental and Rural Services (SEARS) to provide information to farmers in over-abstracted catchments on how to minimise environmental impacts. The effectiveness of this work will be enhanced by support from industry associations such as the Scottish Rural Property and Business Association (SRPBA) and the National Farmers Union of Scotland (NFUS). SEPA is developing a map-based approach to allow farmers to identify:

- those river catchments that are over-abstracted or have limited capacity;
- those with capacity for new abstractions.

SEPA will focus its regulatory efforts on achieving environmental improvements in catchments that are over-abstracted. SEPA will work with farmers to help them implement the actions listed above in order to achieve environmental improvements.

[45] www.sepa.org/water/water_publications/swmi.aspx

7.5.3 What action are we taking to promote sustainable water use?

The combination of climate change and the increase in food prices may increase the demand for irrigation. Limited water resources are available during dry periods when irrigation is required. It is therefore vital that this plan provides a framework for the efficient use of resources by farmers so that water is available downstream for the environment and other farmers.

The development of a map showing where there is available capacity will allow farmers to identify where applications for new abstractions under the Controlled Activities Regulations should be made.

7.5.4 What benefits will we see from these actions?

There are currently 369 rivers in the Scotland river basin district that do not achieve the environmental standards for hydrology; of these approximately 28% are affected by abstraction for agricultural irrigation.

This plan sets an objective to reduce by 20%, within each planning cycle, the amount of water licensed to current operators in locations where this will result in environmental improvement. Current projections indicate that, by 2015, this work could contribute to the improvement of almost 1,800km of river in terms of improved river levels and flows.

The consequence of the application of this objective will be:

- improved biodiversity;
- improved fish populations with resulting social and economic benefits;
- greater security of water supply for farmers.

Controls introduced under the Controlled Activities Regulations will also help prevent deterioration in the status of water bodies.

The changes proposed in this plan will increase the ability of the agricultural sector to mitigate the potential impacts of climate change (see Section 11). Importantly, the proposed measures also create capacity for the new abstractions required if the industry is to continue to expand.

Table 10 summarises the actions to reduce the impact of abstraction and flow regulation from agriculture.

Table 10: Summary of actions to reduce the impact of abstraction and flow regulation from agriculture

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Support devlopment of irrigation	Manage water resources to provide water for new entrants	SEPA	Provide map of available capacity	SEARS
Improve flows in rivers and levels in groundwater	Reduce licensed abstraction rates to levels currently used	Farmers	CAR licence review	SEPA
	Improve efficiency of use	Farmers	Information and advice Require efficient water use by CAR licence review	SEARS/SRPBA/NFUS/ SEPA
	Manage timing of abstractions	Farmers	Develop catchment agreements on timing of abstractions (CAR licence review)	SEPA
	Build farm storage ponds to store winter abstractions for summer use	Farmers	SRDP funding Advice on construction of farm storage ponds CAR licence review	SEARS SEPA

NFUS = National Farmers Union of Scotland; SEARS = Scotland's Environmental and Rural Services; SRPBGA = Scottish Rural Property and Business Association

Section 8 Pollution

8.1 Current assessment of environmental impacts

The classification results show that the main environmental problems are:

- elevated nutrient levels – which affect 20% of our rivers and lochs and over 50% of our estuaries (see Map 7);
- specific pollutants – which affect almost 5% of our rivers.

Our assessment of pollution impacts is based on the use of the environmental standards for rivers, lochs, transitional and coastal waters issued by the Scottish Government as Directions. These standards or condition limits have been set for each status class on the basis of the best available information on ecological impacts as recommended by the UK Technical Advisory Group for the Water Framework Directive. To assess whether a standard has been failed, SEPA compares the results of chemical monitoring for water bodies against these environmental standards.

In terms of elevated nutrient levels the most significant contributors to our polluted waters are:

- agricultural diffuse pollution – more than 60% of our rivers and estuaries and almost 40% of our lochs affected;
- sewage pollution – almost 50% of our rivers and estuaries and 10% of our lochs affected.

The agriculture and sewage treatment sectors also contribute to pollution of our water bodies from specific pollutants.

The following sectors discussed in this draft plan also contribute to the pollution of our water bodies:

- urban drainage;
- forestry;
- mining and quarrying;
- aquaculture.

Further information on pollution pressures can be found in Table 11.

In deciding whether to include a sector in this draft plan, we considered the scale of the impact associated with individual sectors and the issues that the river basin planning process has to address, (ie is it a significant water management issue for the Scotland river basin district). For example, the impacts associated with aquaculture are relatively small but the industry is expecting to progressively expand. Supporting this expansion while also protecting the water environment and other users of the water environment is a significant issues.

Point source pollution from manufacturing also has a small impact upon the water environment. However this sector is subject to strict regulatory controls that are progressively addressing environmental problems. Pollution from manufacturing has therefore not been included in this draft plan. Diffuse pollution from shipping has also not been included because the scale of its impact is also small. Information on pollution from manufacturing and shipping is available in the Significant Water Management Issues report.[46]

The following sections discuss the main pollution issues affecting the water environment. Diffuse pollution issues are presented first followed by point source pollution issues.

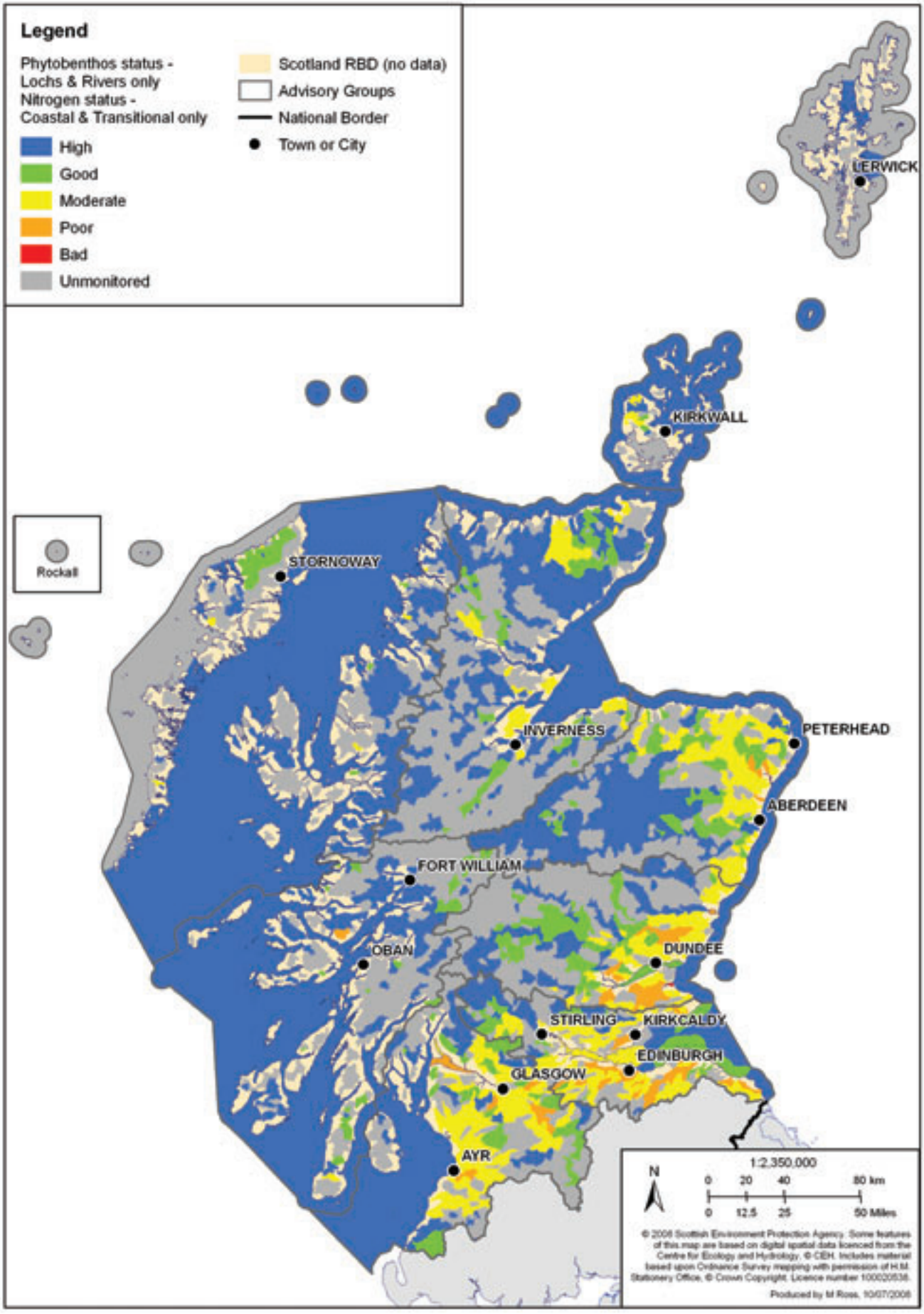
[46] www.sepa.org/water/water_publications/swmi.aspx

Table 11: Pollution pressures and expected level of improvement, 2007–2015

Parameter	Water body category	Number of water bodies (length/area) failing parameter in 2007	% of water bodies affected by:						Number of water bodies (length/area) failing parameter in 2015	Number (length/area) and percentage improved in 2015
			Diffuse pollution from agriculture	Point source from sewage	Diffuse pollution from urban development	Diffuse pollution from mining and quarrying	Diffuse pollution from forestry	Point source from aquaculture		
Diatoms (phosphorus)	Rivers	313 (3,746km)	64%	45%	11%	6%	2%	n/a	149 (1,772km)	164 (667km) 18%
Phosphorus	Lochs	53 (171km^2)	38%	11%	n/a	n/a	11%	8%	31 (57km^2)	22 (114km^2) 67%
Nitrogen	Estuaries	18 (195km^2)	61%	50%	n/a	n/a	n/a	n/a	12 (94km^2)	6 (101km^2) 52%
Qualitative*	Groundwaters	69 (11,715km^2)	93%	1%	0%	6%	0%	0%	52 (8740km^2)	17 (2975km^2)
Specific pollutants	Rivers	82 (935km)	24%	46%	10%	10%	n/a	n/a	44 (480)	38 (455km) 46%

* Further information on groundwater results can be found in Annex 2.

Map 7: Rivers and lochs failing for diatoms and estuaries (transitional) and coasts failing for nitrogen (indicating raised nutrient levels)



8.2 Generic actions for the assessment of pollution

This section considers what generic actions are required to properly assess pollution. These actions are summarised in Table 12.

We have considerable experience in Scotland of monitoring pollution by chemical analysis and the use of biological tools. Consequently we have a good understanding of the cause and impacts of pollution. The main areas of pollution assessment still requiring work are the impacts of acidification and hazardous substances (specifically priority substances and specific pollutants). Work by SEPA to improve the classification of acidification impacts will be completed in time for the final plan.

Over the past three years SEPA has been progressively improving its monitoring of hazardous substances.[47] Significant analytical method development has taken place allowing additional substances, which were not previously monitored, to be added to SEPA's WFD monitoring networks. This includes water quality surveillance monitoring, screening of discharges and the monitoring of fish and sediments to access long-term associated with bioaccumulation and persistence in the environment. This work will improve our understanding of the sources of hazardous substances and the parts of the water environment where they cause direct toxic impacts. SEPA expects it will take until 2013 until it has fully assessed the distribution of the hazardous substances liable to be present in Scotland.

The Water Framework Directive and the (proposed) Priority Substances (Article 16) Daughter Directive[48] impose environmental quality standards for:

- priority hazardous substances – discharges must cease by 2028;
- priority substances – pollution must be progressively reduced.

SEPA's monitoring programme will identify which point source discharges contain hazardous substances. Where the discharge from an industrial facility or sewage works contains a significant load of hazardous substances, SEPA will impose conditions that will require their progressive reduction or the eventual cessation of the discharge. The measures required to address these issues also involve the need for source control. Scottish Water will take a similar approach to licensed industrial discharges to sewer.

The actions described above will address point source pollution from hazardous substances. Diffuse pollution from hazardous substances can not be wholly addressed by SEPA or Scottish Water. These sources of pollution include:

- the use of hazardous substances in domestic products which eventually pass to sewer;
- the use of pesticides on agricultural land or in urban areas.

SEPA will collate information on the extent to which such sources of pollution affect the water environment. This information will be used to highlight requirements for market and application controls over the use of such products.

The Scottish Government consultation on continued improvements supports:

- UK-wide removal of phosphates from domestic detergents to reduce nutrient loading entering the water environment;
- the management of diffuse pollutants at a catchment scale.

These measures could support action by, and have benefits for, a range of sectors. Section 12 provides additional background to the consultation.

[47]As required by the Water Framework Directive, the (proposed) Priority Substances Daughter Directive and the Dangerous Substances Directive (76/464/EEC).
[48]Proposal for a Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy and amending Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and 2000/60/EC

Table 12: Summary of actions to assess pollution

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Information on sources of hazardous substances	Risk-based screening of discharges	SEPA	Scottish monitoring programme	
	Tracing sources of hazardous substances in sewers	Scottish Water	Action programmes where problem is identified	SEPA
Identification of environmental problems	Monitoring of hazardous substances in water, sediment and biota	SEPA	Scottish monitoring programme	
	Development of tools to assess chemical impacts on wetlands	SEPA Scottish Natural Heritage	Scottish Wetland Forum	
Reduction in pollution from sewage and surface water discharges	Develop publicity material	SEPA Scottish Water	Leaflets for householders	Waterwatch Scotland
Reduction in discharge of priority substances	Require operators/ consumers to reduce or cease the discharge of hazardous substances	SEPA Scottish Water	Licence reviews	
	Use of environmental data to identify products causing environmental problems	SEPA Environment Agency Northern Ireland Environment Agency	Product licensing	Pesticide Safety Directorate Health and Safety Executive
	Provide advice to operators on limiting use of hazardous substances	SEPA Scottish Water HAZRED	Site visits UK-level advice (www.hazred.org.uk)	Pesticide Safety Directorate Health and Safety Executive

8.3 Diffuse pollution from agriculture

Scottish agriculture has a major role in the protection and improvement of the environment with 75% of Scotland's land area, over 5.5 million hectares, used for agricultural production. Most of the agricultural area is used for livestock farming, although arable farming is a significant land use particularly in the east of Scotland. Agriculture depends on the good quality of Scotland's water, air and soil. Increasing global demand for food will lead to expectations that farmers maximise production. We need to find ways to support farmers so that they can increase production while minimising environmental impacts.

Diffuse agricultural pollution arises from land management activities including livestock grazing and crop production. Another significant contributor to diffuse pollution is farm steading run-off. Such activities can give rise to a release of potential pollutants which individually may not have an impact but together at the scale of a river catchment can cause environmental, health and economic impacts. Further information is provided in the Significant Water Management Issues report.[49]

Key message

Diffuse agricultural pollution is the most significant cause of pollution in rivers, lochs and groundwater in the Scotland river basin district. We now have an improved understanding of how diffuse pollution works and the measures needed to address it. New regulatory and financial mechanisms have recently come into effect. Supported by advice and guidance, these have the potential to deliver improvements in the water environment.

[49] www.sepa.org/water/water_publications/swmi.aspx

8.3.1 What causes the environmental impact?

The key pollutants from agricultural activities are:

- Nutrients (nitrogen and phosphorus) – where inappropriate applications of inorganic fertiliser, manure or slurry (often exceeding crop requirements) leads to leaching of excess nutrients to groundwater or runoff into surface waters.
- Sediment – loss of soil through the erosion of cultivated land or poaching by livestock.
- Organic matter, ammonia and faecal pathogens– caused by animal waste washed from farm steadings and fields as well as the direct access of cattle and sheep to rivers.
- Toxic substances (agri-chemicals, such as pesticides) – where applications or use occurs too close to water, spillages in farm steadings or where pesticide contaminated sediment is leached into groundwater or washed into surface water.

Information on the impacts of agricultural diffuse pollution is available in the Significant Water Management Issues report.[50]

8.3.2 What action are we taking?

Recent developments provide a major opportunity to address diffuse pressures at a national scale for the first time. As well as the river basin planning process these include:

- the diffuse pollution General Binding Rules (GBRs) under the Controlled Activities Regulations (CAR);
- funding under the Scotland Rural Development Programme (SRDP);
- cross-compliance under the Common Agricultural Policy Schemes (Cross-Compliance) (Scotland) Regulations 2004;
- the establishment of Scotland's Environmental and Rural Services (SEARS).

This plan proposes a phased approach to taking measures to reduce the impact of diffuse pollution.

1. A national approach of raising awareness, guidance and training is required in relation to the diffuse pollution General Binding Rules and other measures.
2. Identification of regions of Scotland where particular types of diffuse pollution problems are most severe. This will allow the organisations involved in SEARS and groups representing agriculture to target particular diffuse pollution control messages.
3. A more targeted approach that identifies 'priority catchments' for farm visits to identify hotspots, target measures and deliver one-to-one advice. A significant number of catchments may be high priority problem areas and current resources are limited. Consequently, a subset of five catchments will be selected for which catchment management plans will be drawn up.

Providing information for farmers

Achieving the plan's objectives will depend on farmers themselves taking the initiative to meet accepted standards of good practice to reduce diffuse pollution. To do this, farmers need information and support so that they can modify the way they manage the land.

The following actions are under way to help farmers meet good environmental practice.

- Guidance is being produced for land managers to help them comply with the legal requirements of the diffuse pollution General Binding Rules.
- The Code of Good Agricultural Practice (PEPFAA code)[51] and the CAR Practical Guide[52] are being updated.
- SEPA has produced a manual of Best Management Practices[53] to help provide advice to farmers on how to avoid diffuse pollution.
- The Scotland's Environmental and Rural Services (SEARS) project involves nine organisations that deliver rural services working more closely together to deliver an improved service to land managers.

In addition financial incentives to follow good practice are provided by:

- single farm payment cross-compliance obligations including a requirement to keep land in Good Agricultural and Environmental Condition (GAEC);
- financial support for specific measures provided under the Scotland Rural Development Programme (SRDP).

Further information on cross-compliance and the SRDP can be found on the Scottish Government website.[54]

[50] www.sepa.org/water/water_publications/swmi.aspx
[51] www.scotland.gov.uk/Resource/Doc/37428/0014235.pdf
[52] www.sepa.org.uk/pdf/wfd/regimes/car_practical_guide.pdf
[53] www.sepa.org.uk/bmp
[54] www.scotland.gov.uk/Topics/Rural/SRDP

Agricultural industry bodies such as Scottish Rural Property and Business Association (SRPBA) and the National Farmers Union of Scotland (NFUS) will have an important role in increasing farmers' awareness of environmental good practice. Examples of existing industry-led initiatives include the Pesticides Voluntary Initiative[55] and the Sheep Dip Pollution Reduction Programme.[56]

More focused actions by farmers

Some areas of Scotland are more seriously affected by diffuse pollution than others. An understanding of how the different types of diffuse pollution are distributed is essential to ensure we focus our efforts on appropriate parts of the country.

The pressures and impacts of diffuse pollution depend on several factors including rainfall, topography, soil type, geology and both the sensitivity and the use of the receiving water body. This coupled with the overall pattern of agriculture in Scotland – with arable farming predominating in the east and livestock in the wetter west – means that the impacts of diffuse pollution vary between geographic regions.

Nutrient pollution is generally found along the east coast and across southern areas to Ayrshire. The risks from pesticide pollution are largely associated with arable farming. Oxygen demand, ammonia and faecal pathogens are problems in livestock areas and can cause bathing water failures. Faecal pathogens cause shellfish growing waters to fail guideline standards along the north-west coast and in the islands.

Catchment management approach

SEPA plans to focus its current resources on five priority catchments where there are high levels of diffuse pollution which affect important parts of the water environment and a range of other users. By 2015, SEPA will develop catchment management plans which identify those parts of the five catchments with the most important sources of pollution and where advice and regulatory action will be targeted. The targeted actions in these five catchments are measures planned and incorporated into the objective setting process for this river basin management plan.

When implementing new catchment management plans, SEPA will use lessons learned from examples that have already resulted in significant improvements in water quality. These examples include:

- Ayrshire bathing waters;
- Loch Leven and Lunan Lochs catchment management plans;
- Voluntary initiative on pesticide control on the River Ugie.

8.3.3 What benefits will we see from these measures?

Projections of the rate of improvement delivered by the measures presented in Table 13 (see Annex 3 on objective setting) indicate a 10–20% improvement in pollution by 2015. We will review these planning assumptions for the final plan.

If we deliver the measures detailed in this plan, they will contribute to a projected reduction in elevated nutrient levels in over 600km of river as well as preventing the deterioration of all water bodies. Although there will also be a reduction in inputs to lochs and groundwaters, the length of time required to reverse the impacts of historic activities mean that a longer timescale is required to return these waters to good status.

Through the implementation of measures presented in Table 13 we should see:

- a reduction in nutrient enrichment and pollution from pesticides and organic waste;
- the quality of our bathing beaches protected and improved, providing greater opportunities for tourism and recreation;
- a reduction in the erosion and loss of soil from valuable agricultural land, reduced smothering of fish spawning gravels and consequent improvements in fish populations;
- improved protection for drinking water sources with resulting decrease in the cost of water treatment;
- protection and improvement of our valuable drinking and manufacturing water supplies and our shellfish waters.
- improved quality of water supporting a greater diversity of aquatic plants and animals in Natura 2000 sites and other water bodies;
- the improved appearance of our waterways.

8.3.4 What additional measures do we require?

The Scottish Government's consultation on continued improvements considers the need to prioritise work on catchments where diffuse pollution may cause failure against WFD standards and protected area obligations. This will build on SEPA's catchment management approach. Section 12 provides additional background to the consultation.

[55] www.voluntaryinitiative.org.uk
[56] www.sepa.org.uk/land/land_publications.aspx

Table 13: Summary of actions to address diffuse pollution from agriculture

Improvement required	Measure	Responsible organisations/sector	Delivery mechanism	Support provider/regulator
Reduction in nutrient inputs	Nutrient management plans In-field measures to minimise soil erosion Buffer strips Steading measures, eg constructed farm wetlands Woodland planting to protect water quality, eg riparian zone planting	Farmers	CAR General Binding Rules No. 18, 19, 20 and 21* Guidance and enforcement	SEARS SEPA
			Nitrate Vulnerable Zone Action Programme Regulations Guidance and enforcement	Scottish Government
			Education initiatives, promotion of guidance and advice	SRPBA, NFUS SAC/FWAG, SEPA, SEARS
			Trial catchment projects and demonstration farms	SRPBA/NFUS/ SEARS/SAC/ FWAG, SEPA
			Scotland Rural Development Programme measures and GAEC	Scottish Government, SEARS
Reduction in pesticide inputs	Crop protection management planning Sprayer testing Biobeds Buffer strips Constructed farm wetlands	Farmers	CAR General Binding Rules No. 23* Guidance and enforcement	SEARS SEPA
			Education initiatives, promotion of guidance, information provision and advice	SRPBA, NFUS SAC/FWAG, SEPA SEARS
			Voluntary Initiative for Pesticides	SRPBA/NFUS
			Scotland Rural Development Programme measures and GAEC.	Scottish Government, SEARS
Reduction in organic waste (organic matter, faecal pathogens, and ammonia)	Farm waste management plans Management of steading run-off, eg clean and dirty water separation Constructed farm wetlands Livestock tracks and gates Fencing of water margins	Farmers	CAR General Binding Rules No. 10, 18 and 19* Guidance and enforcement	SEARS SEPA
			Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) (Scotland) Regulations 2003 Guidance and enforcement	SEARS SEPA
			Education initiatives, promotion of guidance, information provision and advice	SRPBA, NFUS SAC/FWAG, SEPA SEARS
			Scotland Rural Development Programme measures	Scottish Government, SEARS
			Trial catchment projects and demonstration farms	SAC, FWAG, Agencies
Catchment based action	Focus advice and enforcement on identified problem areas	SEPA	Identification of priority catchments, source apportionment, targeting of measures Continue current catchment management projects	SEPA, SAC, FWAG, SRPBA, NFUS, SNH

* Water Environment (Diffuse Pollution) (Scotland) Regulations 2008
FWAG = Farming and Wildlife Advisory Group; NFUS = National Farmers Union Scotland; SAC = Scottish Agricultural College; SEARS = Scotland's Environmental and Rural Services; SNH = Scottish Natural Heritage; SRPBA = Scottish Rural Property and Business Association

8.4 Diffuse pollution from urban development

Rainwater falling on urban areas (roads, pavements, yards and roofs) washes pollutants into the drainage system and ultimately into the water environment. In addition, misconnection between the sewerage system and surface water drains can result in untreated wastewater entering the environment rather than going to wastewater treatment works.

Scotland has been in the forefront of addressing pollution from urban run-off with legal requirements for sustainable urban drainage systems (SUDS) for all new developments draining to the water environment. SUDS are a vital tool to reduce both pollution and the quantity of run-off. They mimic a more natural water cycle using a number of techniques including:

- reducing the area of impermeable surfaces to allow infiltration at source;
- using systems such as artificial ponds or wetlands to allow for some treatment and attenuation before the run-off is discharged back into the water environment.

Key message

Diffuse pollution from urban development has increased as urban areas have expanded and traffic increased. Sustainable urban drainage systems (SUDS) are now required for new developments that drain directly to the water environment. The challenge now is to address the historic legacy of drainage from existing urban areas. We need to develop integrated and sustainable surface water management plans for our urban areas.

8.4.1 What causes the environmental impact?

The key pollutants from urban drainage are:

- sediment (eg soils, grit and silt) washed off the streets during heavy rain and from construction sites;
- nutrients, organic matter, ammonia and faecal pathogens – associated with misconnection of sewers into surface water drains, sewer chokes and surcharges, and faeces from pets and urban wildlife;
- toxic substances resulting from the use of motor vehicles (oils, toxic metals, rubber, and exhaust particles), spillages and leaks from oil and chemical stores, and use of herbicides and pesticides).

Other environmental impacts associated with the volume of water that flows from our urban areas include:

- flooding is exacerbated by the rapid run-off of rain from impermeable urban surfaces;
- run-off to combined sewers exacerbates sewage pollution by causing storm overflows to operate more frequently and sewers to surcharge.

Information on the environmental, social and economic impacts caused by urban run-off is available in the Significant Water Management Issues report.[57]

8.4.2 What action are we taking?

For new developments a combination of local authority development plans, regulatory controls by SEPA and adoption rules developed by Scottish Water ensures that developers consider SUDS as the normal means of draining new developments.

SUDS are promoted in Planning Advice Note 61 *Planning and SUDS*[58] and are increasingly required as part of local authority development plans. Since 1 April 2006, SUDS have been required for all new developments under the Controlled Activities Regulations; this requirement is enforced by SEPA. Public SUDS are maintained by Scottish Water, which has recently produced technical standards for developers and others to use SUDS technology (*Sewers for Scotland 2*).[59] This publication specifies design criteria for SUDS so as to allow them to be adopted by Scottish Water.

The Sustainable Urban Drainage Scottish Working Party[60] (SUDSWP) has been instrumental in delivering and promoting SUDS in Scotland. A key remaining issue identified by this group is the use of SUDS for urban roads. SUDSWP is developing guidance ('SUDS for Roads') which will include design criteria for roads which will help local authority road engineers to reduce the flow and pollution load that passes from road to sewer.

Existing urban areas

Retrofitting SUDS into existing urban areas is difficult because of the limited availability of land. The challenge for this river basin management plan is to:

- promote good practice on urban drainage(as required by the General Binding Rules under CAR);
- encourage all stakeholders to take active responsibility for the drainage of surface water, thereby reducing pollution and helping to alleviate flooding.

[57] www.sepa.org/water/water_publications/swmi.aspx
[58] http://www.scotland.gov.uk/Publications/2001/07/pan61
[59] http://www.scottishwater.co.uk/portal/page/portal/SWE_PGP_CONNECTIONS/SWE_CORP_CONNECTIONS/SWE_CONN_SUDS
[60] Consists of representatives from the Scottish Government, local authorities, Scottish Water, SEPA and developers.

The following range of policy, regulatory and financial measures are proposed to progressively reduce urban diffuse pollution:

- **Providing treatment for polluting surface water discharges.** SEPA and Scottish Water have identified sites where land is available to construct treatment facilities at the end of surface water sewers. Typically this work focuses on highly polluting drainage from industrial sites at the edges of urban areas. Feasibility studies will be undertaken by Scottish Water to assess whether treatment can be provided for five surface water outfalls by 2010 and a further 14 surface water outfalls by 2014. In addition, substantial investment is being directed to reduce the contamination of surface water drains by sewage. A large-scale programme replacing dual manholes[61] has started. SEPA is working to identify additional sites for which scoping studies can be carried out to allow investment in future river basin planning cycles.
- **Integrated urban drainage.** Local authorities, Scottish Water and SEPA are committed to the provision of SUDS as a major element in addressing large-scale urban drainage problems. A good example is the Metropolitan Glasgow Strategic Drainage Plan which promotes the removal of surface water drainage to sewer where SUDS can be installed to allow direct discharge to the water environment. In particular, local authorities will incorporate strategic SUDS into plans for large-scale regeneration programmes such as the Clyde Gateway and the Ravenscraig steel works.
- **Education campaigns.** Scottish Water and SEPA will use publicity and trade effluent controls to promote best practice in preventing contamination of surface waters at industrial/commercial sites.

Measures to tackle diffuse pollution from urban development are summarised in Table 14.

Table 14: Summary of actions to address diffuse pollution from urban development*

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Reduction in pollution and flood risk	Provision of SUDS for urban roads	SUDSWP	SUDS for roads – design criteria for local authority road engineers	
	Improvements in surface water discharges	Scottish Water	Identification of improvement within Q&S Review of CAR licences CAR General Binding Rules	Scottish Government SEPA
	Development of regional SUDS as part of urban regeneration	Local authorities	Local authority development plans	Scottish Water SEPA
	Development of integrated drainage	Local authorities, Scottish Water and SEPA	Joint working groups such as the Metropolitan Strategic Drainage Plan	Scottish Government
		Local authorities	Development planning incorporating regional SUDS for major areas of regeneration	SEPA and Scottish Water
	Education initiatives to improve management of surface water	Scottish Water and SEPA	Publicity and visits by trade effluent control staff	Local authorities

*This table does not list the actions already being taken to ensure that new developments include SUDS. Instead it identifies new or developing measures required to make further improvements.

8.4.3 What benefits will we see from these measures?

The measures requiring SUDS for new development should prevent further deterioration in status caused by urban drainage.

Reducing urban pollution changes rivers, allowing them to become a community asset improving the quality of life for large numbers of people. This should be an essential part of urban regeneration. As well as delivering benefits for the water environment, SUDS can also directly enhance the urban environment by providing additional green space and enhancing biodiversity.

[61]A dual manhole is a manhole that is common to a surface water drain and foul sewer where the flows are separated by a low wall inside the manhole.

The rate of improvements for rivers already affected by urban drainage is difficult to assess. Investment by Scottish Water to treat surface water discharges should result in improvements in over 24km of rivers by 2010 and a further 34km by 2014. It is more difficult to assess the effectiveness of incremental improvements in infrastructure, urban design and behaviour. If the additional changes identified below are implemented by 2015, then it would be reasonable to project an improvement by one status class for all rivers affected by urban pollution by 2027.

8.4.4 What additional measures do we require?

A significant proportion of the impermeable areas in towns and cities are roads, car parks, yards and pedestrian areas. There is an opportunity to develop SUDS for these areas such as permeable surface as existing assets reach the end of their design life and are renewed. The 'SUDS for Roads' document will provide important design criteria to allow urban designers to include SUDS in appropriate places. During the period up to 2015 it will be essential to work with local authority engineers to evaluate the advantages of SUDS under these circumstances.

Introduction of SUDS to existing urban areas can only happen incrementally. Current practice means that major urban regeneration schemes incorporate SUDS. However, it has proved more difficult to promote SUDS at small-scale gap sites where space constraints may limit opportunities for SUDS.

Education for the general public is required to encourage adoption of measures to reduce surface water flows (eg use of water butts, porous paving and swales) and pollution (disposal of waste and spillages).

8.5 Diffuse pollution from forestry

Forestry is an important land use in the Scotland river basin district. In common with most of the UK the area of native ancient woodland is small but, in places, it is an important component of the riparian vegetation. However, the majority of the woodland cover is made up of large-scale non-native plantations.

Key message

The forestry sector has demonstrated that economic incentives and regulatory controls can dramatically reduce the adverse environmental impact associated with land management. Targeted action is now required to address key issues such as nutrient enrichment of very sensitive highland lochs and to achieve ecological improvements in those water bodies most at risk from diffuse pollution from forestry.

8.5.1 What causes the environmental impact?

It is widely recognised that the negative environmental impacts from forestry are generally much lower than those from other land uses such as intensive agriculture or urban development due to very low fertiliser and pesticide inputs, less intensive cultivation practices, and the infrequent and smaller scale nature of forestry management.

The three main potential causes of pollution from forestry are:

- acidification of watercourses exacerbated by forestry plantations scavenging atmospheric pollution;
- nutrient (phosphorus) input to highly sensitive upland lochs either from fertiliser application during tree planting or release due to the disturbance of soils during clear felling operations (can result in high levels of algal growth reducing light and oxygen levels and damaging the aquatic ecosystem);
- the input of suspended solids into waterways due to soil disturbance associated with road building, tree planting and clear felling (may cause smothering of fish spawning beds).

Further information on the impacts of forestry is available in the Significant Water Management Issues report.[62]

8.5.2 What action are we taking?

Linking the provision of forestry grants to compliance with *Forests & Water Guidelines* (2003)[63] has led to their successful application across the forestry sector. Until recently, however, there was no mechanism for requiring compliance with good environmental practice when forestry operations were being undertaken without a grant. The recently introduced General Binding Rules developed from the existing advice within *Forests & Water Guidelines* (2003) for diffuse pollution require all operators to comply with minimum standards of environmental good practice. A summary of key actions to address diffuse pollution from forestry is provided in Table 15.

Acidification

As discussed in Section 8.2, the classification scheme for 2007 does not include a full assessment of acidification. This will be available for the final plan. The impact of acidification shown by SEPA monitoring data will be used to inform the development of any projects or measures to ensure actions focus on those water bodies requiring improvement. Information on acidified water bodies can be found in Annex 2.

[62] www.sepa.org.uk/water/water_publications.aspx
[63] www.forestry.gov.uk/PDF/fcgl002.pdf/$FILE/fcgl002.pdf

Air pollution – the primary source of this issue – is slowly falling owing to the control of emissions. As a result, some waters are showing evidence of recovery. But this recovery is slow and, in some catchments, the presence of high densities of mature conifers may be delaying the process. As improvements arise, the rate of recovery may be improved by reducing the area of mature conifers, for example, by diversifying the age structure of plantations, replacing conifers with deciduous trees and leaving more open ground.

Under the auspices of the river basin planning process, Forestry Commission Scotland, SEPA and Fisheries Trusts are working together to identify catchments that are especially vulnerable to acidification.

Nutrient enrichment

This draft river basin management plan provides information to enable the identification of freshwater lochs at risk of additional nutrient input from forestry. In conjunction with SEPA, this information can form the basis for future planning within the forestry industry. This process will be updated as more information becomes available through monitoring and classification.

To reduce the nutrient loading into sensitive water bodies, it will be necessary to limit the scale of annual planting and felling operations based on the overall size of the catchment. This is supported by the guidance for best practice for sensitive catchments given in *Forests & Water Guidelines* (2003).

Nutrients tend to be 'bound up' with the soil particles and so can also enter the water body with any suspended solids released during forestry operations. This can be avoided by following best practice as discussed below.

Suspended solids

Forests & Water Guidelines (2003) sets out working methods which, when applied correctly, will prevent suspended solids entering the watercourse. It is important to ensure all forestry operators are aware of, and apply, best working practice through the provision of training – particularly raising awareness of the new General Binding Rules.

Table 15: Summary of actions to address diffuse pollution from forestry

Improvement required	Measure/action	Responsible organisations/sectors	Delivery mechanism	Support provider
Controlling nutrient inputs to lochs	Provide information on nutrient sensitivity of lochs	SEPA	GIS map showing available capacity in lochs	Forestry Commission Scotland
	Promote best practice in most sensitive catchments and ensure compliance with Forest & Water Guidelines and Diffuse Pollution Regulations*	Forestry Commission Scotland Private forestry companies Landowners SEARS SEPA	Forestry planning/ SEARS Information campaigns	SEPA
Controlling sediment inputs	Promote best practice in most sensitive catchments and ensure compliance with Forest & Water Guidelines and Diffuse Pollution Regulations*	Forestry Commission Scotland Private forestry companies Landowners SEARS SEPA		SEPA
Best practice measures in non-grant aided forestry management	Promote and raise awareness and ensure compliance with Forests & Water Guidelines and the diffuse pollution General Binding Rules	Forestry Commission Scotland		SEPA
Reducing impact of forestry and acidification	Identify catchments (or sub-catchments) vulnerable to acidification	Forestry Commission Scotland SEPA	Develop project for diffuse pollution – acidification	Landowners and private forestry companies

*Water Environment (Diffuse Pollution) (Scotland) Regulations 2008

8.5.3 What benefits will we see from these measures?

The benefits of reducing the impact of diffuse pollution from forestry can easily be identified and monitored. For example, we expect an increase in the diversity of plant and animal species as water acidity decreases. However, we do not anticipate that these benefits will be seen during the first river basin planning cycle due to the long recovery time required. Improvements should come into effect by the second river basin management plan with up to 25% of affected water bodies showing improvements in status.

Improvements expected over a number of river basin planning cycles include:

- the return of fish populations to water bodies where they spawned successfully prior to extensive forestry planting;
- greater diversity of plant and animal species;
- a reduction in the risk of algal blooms in upland nutrient-poor freshwater lochs;
- improvements in fish catches, increasing the economic and recreational value of rivers.

These improvements, particularly in upland lochs, will be important in maintaining Scotland's reputation for having a high quality environment.

8.6 Point source pollution from the collection and treatment of sewage

The public collection and treatment of wastewater is provided by Scottish Water, a publicly owned company. There has been extensive investment in the provision of wastewater collection and treatment in Scotland over recent years, protecting both public health and the environment. Public sewage treatment works currently serve 96.3% of the 4.8 million people in the Scotland river basin district. There are about 1,700[64] sewage treatment works and 3,300[65] combined sewer overflows (CSOs) in the Scotland river basin district.

There are localised and cumulative environmental problems in rural areas caused by the sewage from scattered houses, small hotels and industry which is typically treated in privately operated septic tanks or at small private treatment works.

Key message

The substantial investment by Scottish Water (and its predecessor bodies) in sewerage infrastructure over the past 20 years has resulted in major benefits to the environment and human health. The most serious remaining problem that now needs to be addressed is the upgrading of old combined sewers. These sewers are designed to overflow when volumes of surface water entering the sewers increase during heavy rainfall, but have the potential to cause pollution.

8.6.1 What causes the environmental impact?

The main pollutants from sewage discharges are:

- nutrients;
- organic matter, ammonia and faecal pathogens;
- toxic substances – from industrial effluent, household chemicals and road run-off;
- sewage-related debris.

Information on the impacts of sewage pollution is available in the Significant Water Management Issues report.[66]

8.6.2 What actions are we taking to deliver environmental improvements?

Capital investment by Scottish Water in sewers and treatment works is the main mechanism to address pollution caused by sewage. This investment is delivered via a public planning process called Quality and Standards,[67] which determines the investment objectives for an eight-year period in the context of ministerial decisions on the scale of charges that can be afforded by customers. SEPA is responsible for identifying environment targets and imposing conditions in licences which determine the level of treatment Scottish Water must deliver. The same licensing process is used to require improvements in private sewage discharges.

The measures for the period 2006–2010 have been agreed by ministers and are now being put in place by Scottish Water. Although provisional measures for the period 2010–2014 are included in this draft river basin management plan, they are still subject to further consideration and ministerial approval (due in 2009). The measures in this plan for delivery by 2014 are based on the position as of June 2008.[68]

[64]Scottish Water data
[65]Economic statistics, Scottish Government website (2008).
[66]www.sepa.org/water/water_publications/swmi.aspx
[67]See Annex 8 for details of the Quality & Standards process explaining how investments in the sewerage system are planned.
[68]Technical Expression version 5

First river basin planning cycle

Over the period up to 2015, Scottish Water will invest significantly in the sewerage network and wastewater treatment plants which, in turn, will improve the water environment. SEPA and Scottish Water are currently implementing and planning improvements under programmes due to be delivered by 2010 and 2014[69] respectively. In summary these are to:[70]

- improve treatment to reduce nutrient loads, oxygen demand and ammonia at 27 sewage works by 2010 and a further 82 sewage works by 2014;[69]
- upgrade 17 sewage works by 2010 and a further 21 sewage works by 2014[69] to reduce pollution incidents;
- reduce frequency of operation and/or remove sewage solids at 268 sewer overflows by 2010 and a further 162 combined sewer overflows by 2014;[69]
- provide first time sewerage for 10 villages by 2010.

Reducing pollution at source lowers the costs associated with its treatment and results in environmental benefits. This is especially true for hazardous substances, nutrients and sanitary litter.

It is vital that we all appreciate our role in controlling the pollution caused by what passes to the drains from our homes. For example, not using certain substances in domestic products (eg using phosphate-free detergents) reduces the need for treatment to remove them from sewage and reduces their concentration in sewage sludge. Scottish Water's 'Bag It and Bin It' campaign promotes the disposal of rubbish such as cotton buds in the bin rather than flushing them down the toilet; this keeps them out of the sewage stream altogether, preventing them from being discharged from CSOs during heavy rain or choking the fine screens at sewage treatment works – both of which can cause pollution.

Planning environmental improvements in the longer term

Over the next year SEPA will review the environmental investment required after 2015 and will be working with the Area Advisory Groups to prioritise the environmental problems so that indicative lists can be developed. These lists will prioritise schemes on the basis of the scale of the environmental, social and economic benefits that can be delivered. The output from this process will be the basis of SEPA's submission to the next Scottish Water investment round (Quality and Standards IV) and will be used to provide the basis of identifying indicative Water Framework Directive objectives for 2021 and 2027.

An important consideration in developing the future environmental investment plan will be to address drainage issues in Glasgow. These in combination with impacts from historical land use, culverting of burns into combined sewers and inadequate provision for surface water run-off affect the quality of the River Clyde. The sewerage network in Glasgow requires expansion in order to be able to handle satisfactorily the volumes of water draining to it, thus reducing the frequency of overflows and minimising health risks. This task will require significant attention in the future investment plan.

The regeneration of Glasgow is one of the main objectives of the National Planning Framework (the policy context within which this river basin management plan is developed) and addressing its drainage problems is identified as one of the key infrastructure investment requirements. Other drivers for regeneration included preparations for the 2014 Commonwealth Games. Delivering environmental improvements to the water environment of the Clyde catchment and the people of Glasgow will therefore be a primary objective for the 2021 and 2027 river basin management plans.

8.6.3 What actions are we taking to deliver sustainable water use?

Scottish Water has an important role in supporting development across Scotland. If developers wish to build houses or industrial/commercial sites in a city or town served by Scottish Water's sewerage systems then they must be able to discharge their effluent to sewer.

SEPA and the local authorities do not normally allow a development to avoid the costs of connection to the sewer by constructing a private sewage works that discharges directly to the environment. This prevents the potential environmental, health and public nuisance impacts that would result from large numbers of privately operated small sewage works in urban areas.

A Memorandum of Understanding signed by SEPA and Scottish Water sets out a process for identifying where there are potential constraints on development related to the capacity of the environment and Scottish Water's assets, and taking action to address these constraints.

Where a water body or a Scottish Water asset is constraining development, only very small-scale development that will not cause a significant increase in pollution is possible until such time as the required capacity can be provided.

[69]Subject to further consideration and ministerial approval.

[70]Delivery of measures to improve sewer overflows by 2010 is subject to a value management process agreed by the Water Industry Commission for Scotland under the Quality and Standards process for water resource zones in the Spending Review 2006. Delivery of measures by 2014 is subject to final determination by the Water Industry Commission for Scotland.

The web-based Strategic Asset Capacity and Development Plan (SACDP)[71] published by Scottish Water identifies the level of development (as equivalent housing units) that existing assets can support. The SACDP allows Scottish Water to work closely with developers and local authorities regarding where planned development would result in existing capacity being exceeded. This helps Scottish Water to then plan expansion of the system to support the timing of the development.

SEPA, Scottish Water and local authorities aim to provide information on potential constraints to allow developers to direct development towards areas where there is available capacity in the sewerage assets and the environment. Where this is not possible, Scottish Water will plan investment to provide additional capacity.

Where pollution is caused by sewage from small settlements without sewerage systems, it may no longer be possible to allow development without causing environmental damage and affecting the quality of life of local people. In such circumstances SEPA typically identifies the settlement as requiring the provision of a public drainage system under the Quality and Standards investment programme. The provision of 'first time sewerage' is an important mechanism to remove constraints on rural development.

Actions to address point source pollution from sewage collection and treatment are summarised in Table 16.

Table 16: Summary of actions to address point source pollution from sewage treatment

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism	Support provider/regulator
Reduction in pollution	Better discharge quality from treatment works Reduced frequency of operation of sewer overflows	Scottish Water	Identification of improvement within Quality & Standards Review of licence	Scottish Government SEPA
	Reduced frequency of operation of sewer overflows	Local authorities	Diversion of surface water flows from sewer during redevelopment of sites	SEPA
		Scottish Water	Introduction of effluent charging scheme for surface water in proportion to area drained	WIC
	Reduction in pollution at source	Scottish Water and SEPA	Education campaigns for domestic users and septic tank owners Trade effluent inspections and consent reviews	SEPA
Supporting development	Identify where capacity is limited	Scottish Water and SEPA	Memorandum of Understanding between Scottish Water and SEPA	Local authorities
	Provide capacity for future development	Scottish Water and SEPA	Memorandum of Understanding between Scottish Water and SEPA	Local authorities

[71] www.scottishwater.co.uk/portal/page/portal/SWE_PGP_CONNECTIONS/SWE_CORP_CONNECTIONS/SWE_CORP_STRATEGIC_PLANNING

8.6.4 What benefits will we see from these measures?

Investment by Scottish Water represents the single most important improvement programme for Scotland's water environment. It will deliver improvements in the quality of:[72]

- bathing beaches – providing greater opportunities for tourism and recreation (51km by 2010);
- shellfish growing waters – supporting the further development of the shellfish industry (15km by 2010 and 43km by 2014);
- waters designated for freshwater fisheries – resulting in greater fishery potential with associated local economic and recreational benefits (50km by 2010 and 356km by 2014);
- all rivers, lochs and estuaries – supporting a greater diversity of aquatic plants and animals which will support wider recreational and amenity use (1,270km by 2014[73]).

Improving the amenity value of rivers is especially important in urban areas where this can make a crucial contribution to urban regeneration. The economic benefits of this, together with the direct support provided to facilitating development, provide a substantial boost to the Scottish economy.

8.6.5 What additional measures do we require?

The quality of life for people living in small settlements is affected where local pollution is caused by inadequate sewerage provision. The lack of provision can also prevent development because the capacity of the environment to accept further discharges is already fully utilised. Where Scottish Water cannot provide a new sewerage system it is often difficult for local people to fund improvements to their sewerage systems. Private septic tanks are therefore an area for future investigation in terms of upgrading current infrastructure and/or connections to public sewerage infrastructure.

8.7 Point source pollution from mining and quarrying

Mining activities in Scotland have primarily been associated with coal, oil shale, fireclay and ironstone mining. There are currently no deep mines working in Scotland. Remaining coal extraction takes place in opencast sites.

Discharge of polluting waters from disused mines became a serious environmental problem with the closure of many coalmines between the 1950s and 1990s. The cessation or reduction of groundwater pumping when deep mines closed resulted in the rebound of groundwater within the abandoned workings. Once the minewater reaches the surface and comes into contact with air, a chemical reaction causes the formation of an iron pigment known as ochre.

Key message

Pollution from minewater discharges is caused by mines closed many years ago and there is no longer anyone directly responsible for controlling its source. SEPA and The Coal Authority have developed a priority list of discharges to rivers from abandoned mines that require treatment. The rate of progress is determined by the available funding.

8.7.1 What causes the environmental impact?

The main pollutants from urban drainage are:

- toxic substances – consisting of metals that dissolve into the groundwater in mines and can contaminate surface waters when minewater reaches the surface.

Information on the impacts from mining and quarrying activities can be found in the Significant Water Management Issues report.[74]

[72]Delivery of these improvements is subject to the value management process for Scottish Water Spending Review 2010 and the final determination of Spending Review 2010 agreed by the Water Industry Commission for Scotland. The lengths stated here are based on the estimations in the current Technical Expressions based on the method used for Ministerial Directions. They do not equate water body lengths.

[73]Refers to all environmental improvements as specified in Ministerial Directions excluding water resource improvements and subject to the value management process for measures to 2010 and final determination for measures to 2014.

[74]www.sepa.org/water/water_publications/swmi.aspx

8.7.2 What action are we taking?

Old mines

In recent years, The Coal Authority[75] has put in place a world-leading programme to provide treatment for discharges from abandoned coal mines.

SEPA maintains a list of abandoned mine discharges that cause environmental impacts. It has developed a priority list of discharges to rivers and is working closely with The Coal Authority to ensure treatment schemes are set up to tackle the most environmentally damaging minewater discharges. A number of preventative schemes have also been put in place to keep minewater levels within the abandoned workings deep below the surface to avoid breakout of polluting minewater. Local authorities have also been involved, facilitating the planning process and making land available for treatment systems. The Coal Authority is planning to invest in the construction of nine additional minewater treatment schemes in Scotland up to the end of the 2015–2016 financial year.

There are a number of discharges from abandoned mines that have not been selected for remediation schemes up to 2015 but which make a major contribution to the failure of the Water Framework Directive's good status objectives for the water environment. SEPA will discuss the provision of treatment systems for these discharges with The Coal Authority during the preparation of the second river basin management plan.

There are also discharges from non-coal mines that affect the status of the water environment. Where a responsible person can be identified SEPA can require the treatment of such discharges. Otherwise SEPA includes these discharges in its prioritisation of restoration measures.

Surface activities such as mineral processing, tailings and waste disposal are also a significant source of pollution. These sources are often spread over a wide area and many small discharges add up to a significant source of diffuse pollution. Such problems could be addressed:

- through initiatives taken by local authorities;
- under the contaminated land regime (Part IIA of the Environmental Protection Act 1990);
- through conditions placed on planning consents when sites are redeveloped.

New mining activities

Good regulatory controls govern new mining activities and the restoration of sites following the cessation of work.

- SEPA can require (through the Controlled Activities Regulations) controls on mine dewatering and its discharge from existing mines and quarries.
- Planning conditions imposed by local authorities minimise wider environmental impacts;
- The Coal Authority imposes conditions by guidance associated with licences for coal mining.

Actions to address point source pollution from mining and quarrying are summarised in Table 17.

Table 17: Summary of actions to address point source pollution from mining and quarrying

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism	Support provider/regulator
Provision of treatment for abandoned mines	Provide treatment for abandoned coal mine discharges	The Coal Authority	Minewater improvement programme	SEPA
	Provide treatment for abandoned non-coal mine discharges	SEPA	Restoration funding prioritisation list	The Coal Authority
Preventing new discharges from abandoned coal mines	Control groundwater levels by pumping	The Coal Authority		SEPA
Contaminated land and bings	Remediation of sites	Local authority	Part IIA Contaminated Land regime	SEPA
			Development control consents	SEPA

[75]The Coal Authority was established by Parliament in 1994 to undertake specific statutory responsibilities including those associated with property and historic liability issues such as treatment of minewater discharges.

8.7.3 What benefits will we see from these measures?

There will be no further deterioration in status caused by abandoned mine discharges.

Investment already agreed by The Coal Authority will lead to a reduction in polluted rivers. Treatment plants will also have additional benefits. Wherever possible these plants are designed to blend into the surrounding area, enhancing the amenity of the area for local people. Public access is encouraged by footpaths and bridges. They also increase biodiversity in the local area by creating new habitats. Some treatment sites have recorded over 100 species of birds within two years of beginning operation.

8.7.4 What additional measures do we require?

Continued funding is required to allow The Coal Authority and SEPA to provide treatment for pollution arising from historical mining activities.

An assessment of how to use ochre collected at waste treatment sites could allow it to be put to use rather than being sent to landfill.

8.8 Point source pollution from aquaculture

Over the past 20 years commercial aquaculture in Scotland has grown to become an increasingly successful economic sector and is now estimated to contribute over half the value of food exports from Scotland. The industry is dominated by salmon and sea trout farming in marine cages where production increased from about 5,000 tonnes/year in the 1980s to about 150,000 tonnes/year in 2006.

More tonnes of salmon are produced per kilometre of coastline in Scotland than anywhere else in the world. This enables Scotland's current salmon production to meet the needs of around 8–12 million consumers (about 25% of UK population) in terms of one oily fish portion per week.

The salmon and trout farming industry has impacts on both the freshwater and marine environment. This is an inevitable consequence of the farming of these fish species which, by biological necessity, spend part of their life cycle in freshwater and part in the sea. SEPA has responsibilities in both environments, thus providing an integrated approach to the regulation of the impacts of the aquaculture industry.

Key message

The aquaculture industry is well regulated and consequently its environmental impacts are relatively small (considering its extent). Many of the existing environmental impacts are a result of the location of inappropriate sites of farms that were developed before the industry's impacts were understood. This plan needs to address the challenge of how to support the continued expansion of the industry while minimising impacts on the environment.

8.8.1 What causes the environmental impact?

The main impacts of marine fish farms are:

- release of organic matter consisting of fish faeces and uneaten fish food which is then deposited on the sea bed;
- nutrients from fish faeces and uneaten fish food;
- residues of toxic substances including veterinary medicines to treat diseases and parasites;
- sea lice and escapes of farmed fish which can affect native freshwater fish populations.

Further information on the impacts of aquaculture is available in the Significant Water Management Issues report.[76]

8.8.2 What action are we taking to deliver environment benefits?

SEPA is responsible for regulating most aspects of pollution control and waste management in relation to freshwater and marine fish farming. This integrated approach has allowed the industry and SEPA to progressively address many of the environmental problems facing the industry.

[76] www.sepa.org/water/water_publications/swmi.aspx

Freshwater fish farms

For sites based in lochs, SEPA uses the site licence to set limits on the size and production of the farm based on the results of modelling the effects on the loch of fish farm discharges of nutrients. This is to prevent deterioration in its nutrient status. However, some fish farms were licensed before reliable models were available to predict the impact of nutrients on lochs and, consequently, some of these lochs have deteriorated in status. The aquaculture sector has applied mitigation measures including:

- the use of low phosphorus feeds;
- the use of more efficient feeding systems;
- selective breeding to improve the growth rate of fish strains used in farming.

It is not always practicable to move existing cage fish farms from lochs where discharges are made untreated to onshore tank-based facilities utilising river water where effluent can be treated before discharge. In some areas of the west coast and islands, there are large numbers of freshwater lochs but the rivers are small and can not support large fish farms. Limiting future development of farms to these rivers could significantly constrain development of the industry and its potential economic contribution to rural Scotland. This could result in a trend towards an increasing dependence on fish imports with the increased risk of the introduction of disease and parasites.

It is proposed to conduct strategic development planning along similar lines to the marine sector Location/Relocation programme. This would offer a sensible way to consider where cage fish farming should be moved from areas where it is causing unacceptable levels of impact. Any consideration of this proposal will include all sectors that input nutrients to the freshwater environment.

Marine farms

The existing environmental problems caused by marine cage aquaculture are largely a historical legacy due to farms being inappropriately sited in sheltered sea lochs, resulting in an impact on the marine environment and migratory salmonids. In recent years many operators have ceased production at older, less well-sited farms and have developed new sites or sought to increase production at more suitable sites where the environmental impacts are reduced. This mothballing of less suitable sites means that currently only a little over half of all licensed sites in Scotland are being used for the production of fish.

A number of initiatives are attempting to address the impacts of fish farms on migratory salmon and sea trout. These include the Tripartite Working Group and associated Area Management Groups[77] which have brought together fish farm, wild fish and public sector interests to negotiate area-based management agreements covering issues such as synchronised sea lice treatments for farmed fish and the rotational fallowing of farms or groups of farms. SEPA will be collecting information on marine and freshwater impacts including native fish populations in catchments potentially affected by marine cage fish farming.

8.8.3 What action are we taking to promote sustainable water use?

The aquaculture industry in Scotland has the ambition to:

- increase production through continual sustainable year-on-year growth;
- extend commercial production to marine species.

The result will be more vital food grown closer to home, reducing dependence on the fish catching sector and reducing global greenhouse gas contributions.

Scotland's north-west coast and islands have the potential to support the expansion of the industry provided regulatory controls prevent significant impacts on the environment or third party interests. The effective balance between regulation and the ambition of industry has provided sustained growth in Scotland over many years, avoiding the uncontrolled growth followed by crises which have constrained resources available to the industry in some other fish farming nations.

Freshwater farms

The final river basin management plan will provide fish farmers with the information to allow them to focus future proposals for the development on those freshwater lochs with the capacity to assimilate additional nutrient inputs without significant impacts on their status. Maps will be developed to identify:

- those lochs that currently have no capacity or limited capacity for development;
- those lochs where capacity may be available.

SEPA will work with the aquaculture industry to reduce nutrient inputs to the lochs. It will co-ordinate this work with other sectors (eg forestry) that may also be responsible for nutrient inputs to lochs.

[77] www.scotland.gov.uk/Topics/Fisheries/Fish-Shellfish/workinggroups/twg

Marine farms

New local authority planning controls over fish farm developments should ensure that future developments avoid sensitive locations. However, clear guidelines on the location of fish farms are needed to direct future development. Scottish Planning Policy SPP22 *Planning for Fish Farming*[78] advises on this and best practice guidance is being prepared on the future location of finfish and shellfish farms. Meanwhile the present locational guidelines provide a method to minimise the risk of nutrient enrichment on a water body scale. The results of recent research may augment that approach to provide a more comprehensive predictive modelling tool in due course.

Actions to address point source pollution from aquaculture are summarised in Table 18.

8.8.4 What benefits will we see from these measures?

Fish farming makes an important socio-economic contribution to communities along the west coast and islands. The integrated controls over fish farming developed by SEPA minimise environmental impacts, help prevent deterioration in both fresh and marine waters, and support the long-term development of the industry.

The long recovery time associated with freshwater lochs means that improvements are unlikely to be seen in the first river basin planning cycle. There is also a risk that, as our understanding of the impacts of marine cages on native freshwater fish improves, the number of rivers recorded as affected may increase. However it is much more likely that such changes will arise from other factors such as harvesting/angling effort, inappropriate stocking policies, poor habitat management and long-term climate change. Improvements should come into effect by the second river basin management plan with up to 25% of affected water bodies showing improvements in status.

Table 18: Summary of actions to address point source pollution from aquaculture

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Improve status of freshwater lochs	Develop relocation programme for freshwater farms	SEPA	Proactive strategy to move fish farms from impacted lochs	Local authorities , Scottish Natural Heritage (SNH), Scottish Government
Support for new freshwater fish farm development	Provide information to assist in planning new fish farms	SEPA	Maps showing potential for new freshwater fish farm development	SEPA, SNH
Information on impacts upon wild fish populations	Monitoring of freshwater fish populations in west coast and islands	RAFTS, FRS, SNH and SEPA	Development of monitoring strategy.	
Treatment of sea lice	Synchronised sea lice treatment and fallowing	Scottish Government Tripartite Working Group	Loch management agreements	Industry, FRS, SEPA, SNH
Improve status of marine lochs and marine fisheries	Move inappropriately located marine farms	Scottish Government	Relocation programme	Local authorities, SEPA, FRS, SNH
Support for marine fish farm development	Review of locational guidance	Scottish Government	Review of Scottish Planning Policy SPP22	Local authorities, SEPA, SNH, FRS
Decision-making process for new fish farms	Shorten the time taken to make decisions	Local authorities, SEPA	Co-ordinated approach between SEPA, local authorities, FRS and SNH	Scottish Government

FRS = Fisheries Research Services; RAFTS = Association of Scottish River & Fishery Management Trusts; SNH = Scottish Natural Heritage

[78] www.scotland.gov.uk/Topics/Built-Environment/planning/publications

Section 9 Changes to morphology

Changes to the physical habitat of our water environment include the straightening and deepening of rivers, building of embankments, removal of river bank vegetation and the reinforcement of banks to prevent erosion. These changes to our rivers can result in:

- a reduction of habitat diversity, reducing fish spawning grounds and wetlands;
- increased risk of flooding through loss of floodplains;
- adverse effects on the appearance of rivers, reducing their amenity value;
- a loss of trees and shrubs, which protect the banks from erosion and provide food and shelter for wildlife.

The classification data show that impacts on morphology contribute towards 32% of our surface waters failing good status standards. Map 8 shows the surface water body status classes for morphology for 2007 prior to the incorporation of ecological potential for heavily modified and artificial water bodies.

The assessment of morphological impacts is based on the use of condition limits for rivers, lochs, estuaries and coastal waters issued by the Scottish Government as Directions. These condition limits have been set for each status class on the basis of the best available information on ecological impacts as recommended by the UK Technical Advisory Group on the Water Framework Directive. To assess whether a standard has been failed, SEPA uses information on existing engineering works on surface waters and combined this with information on other impacts such as loss of bankside vegetation assessed on the basis of land use. The total amount of impact is then compared with the morphological condition limits.

Table 19 indicates the number and length or area of our water bodies failing for morphology in 2007 and 2015 and the length/area improved, as well as the proportion affected by specific pressures. Of the 687 rivers (7,220km) and the 62 lochs (364km^2) failing the morphology standards in 2007, 92 rivers (1,012km) and 42 lochs (222km^2) are HMWBs assessed at good ecological potential.

The information presented in Table 19 shows that 45% of the rivers and 37% of the lochs impacted by changes to the physical habitat (morphology) are affected by multiple pressures. These multiple pressures may include pressure from historical engineering activities, forestry, agriculture, and the operation of water supply and hydropower schemes. The pressure information also shows us that the following three pressures contribute significantly to the modified physical habitat of our waters:

- historical engineering activities affect 17% of our rivers and 11% of lochs;
- historical forestry planting practices affects 18% of rivers and 15% of lochs;
- electricity generation and drinking water supply both affect over 25% of our lochs;
- agricultural activities affect 8% of rivers.

Information on the environmental impacts of changes to the physical habitat can be found in Annex 1.

The measures discussed in the following sections are expected to contribute to an improvement in physical habitat of over 50% of our rivers and lochs. This improvement also includes the assessment of ecological potential for heavily modified water bodies both in 2007 and 2015. Measures to mitigate impacts from activities relating to electricity generation and drinking water supply are discussed in section 7.

Table 19: Pressures affecting morphology, 2007–2015*

Parameter	Water body category	Number of water bodies (length/area) failing in 2007	% of water bodies affected by:							Number of water bodies (length/area) failing in 2015	Number (length/area) and percentage improved by 2015
			Multiple pressures	Historical engineering activities	Urban development	Electricity generation	Water supply	Agricultural activities	Forestry		
Morphology (physical habitat)	Rivers	687 (7,220km)	45%	17%	3%	8%	7%	8%	18%	313 (3,252km)	374 (3,968km) 54%
Morphology (physical habitat)	Lochs	62 (364km^2)	37%	11%	0%	26%	31%	2%	15%	28 (154km^2)	34 (210km^2) 55%
Morphology (physical habitat)	Estuaries†	5 (53.4km^2)	0%	0%	0%	0%	0%	0%	0%	5 (53km^2)	0
Morphology (physical habitat)	Coasts†	5 (129km^2)	0%	0%	0%	0%	0%	0%	0%	5 (129km^2)	0

* The lengths failing in 2015 and the length improved take into account those water bodies meeting good ecological potential.
† All estuaries and coasts are affected by land claim

9.1 Generic actions for the assessment of morphological impacts

This section considers what generic actions are required to improve our assessments of impacts upon morphology.

SEPA and its predecessor bodies have produced pollution classifications for over 40 years. SEPA has produced hydrology classifications for the past three years based on Low Flows 2000 modelling.[79] This is the first year that SEPA has produced a morphology classification and it has been developed using a classification tool and a morphology database that has only just been completed. SEPA will work with the Area Advisory Groups to review the morphology classification results over the next year to ensure any problems with this new component of the classification scheme are addressed before the final river basin management plan is produced.

Over the period of the first plan we will seek to progressively improve the assessment of morphological impacts by:

- undertaking habitat surveys to improve the information held in the morphology database;
- developing biological tools that can be used to assess the ecological impacts of changes in morphology (we expect it to be 2011 before the new tools are available for use);
- further developing Scotland's monitoring programme to incorporate the new biological monitoring tools.

Another area requiring further work is the identification of heavily modified water bodies and the subsequent definition of ecological potential. SEPA has produced its first assessment of ecological potential for licensed activities that primarily affect hydrology such as hydropower, water supply and navigation. It has not been possible in the time available to assess ecological potential for unlicensed activities which have morphological impacts such as historic flood defence and land drainage. This work will be completed in the period leading up to the first plan.

The higher level of uncertainty associated with the morphology classification means that only a limited number of measures have been developed to address morphology impacts. Measures will focus on actions that result in:

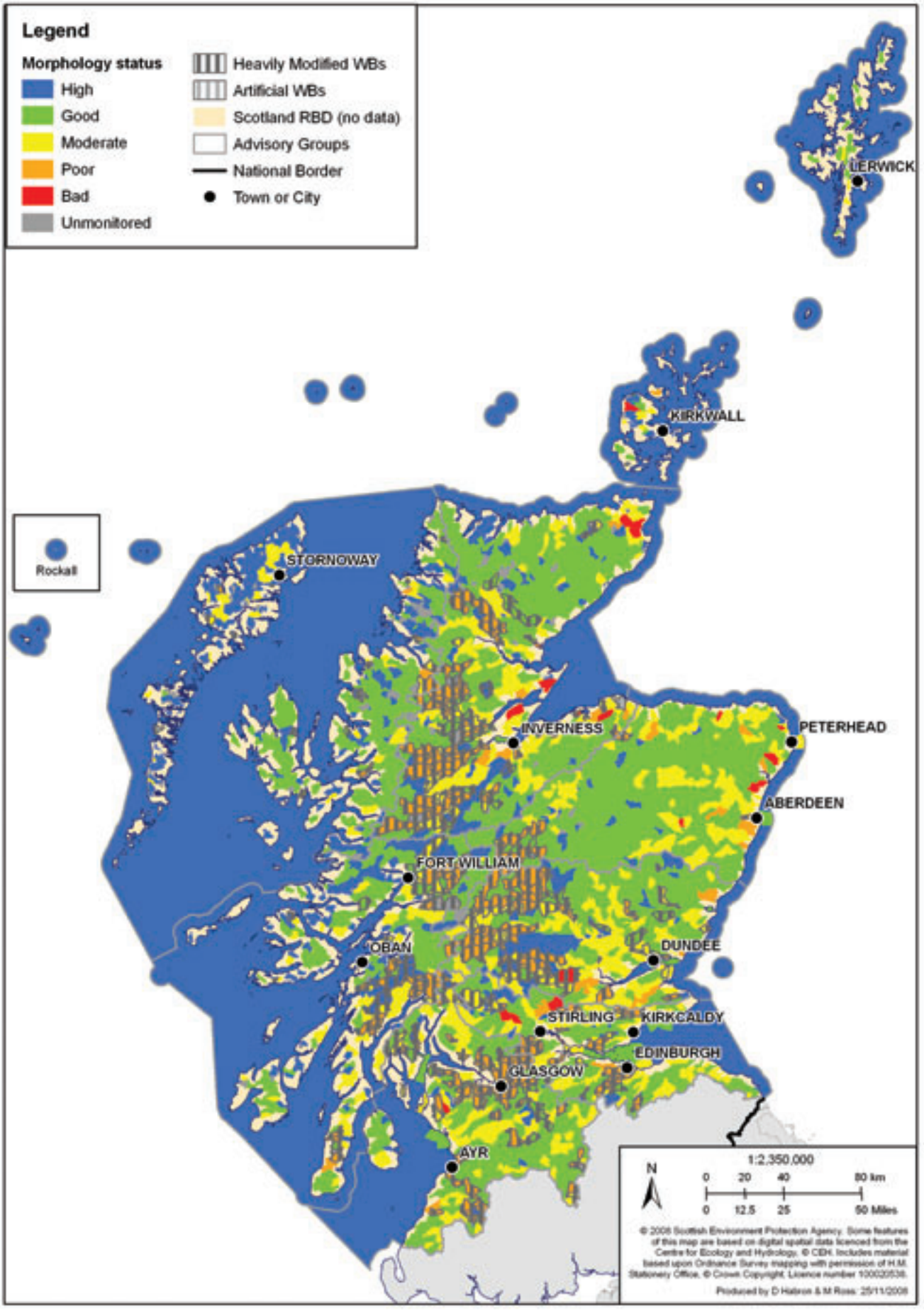
- multiple benefits such as:
  – buffer strips – these address agricultural impacts on morphology and diffuse pollution;
  – moving forests back from rivers – addressing morphological impacts and pollution from acidification;
- clear and predictable benefits such as removal of barriers to fish migration;
- improved understanding of the effectiveness of restoration measures (eg through pilot projects aimed at a selected number of river catchments).

Over the period of the first river basin management plan, we will develop further measures as our confidence in the classification process for morphology improves. We will not be expecting measures to be implemented solely to address issues raised by morphology classification where there is uncertainty over these results.

The Scottish Government consultation on continued improvements considers the development of a restoration policy framework to put in place on-the-ground actions that could make significant improvements to water bodies downgraded by historic engineering impacts to good ecological status under the Water Framework Directive. Such a framework could support action by, and have benefits for, a range of sectors. Section 12 of this plan provides additional background to the consultation.

[79]Developed over the past 20 years by the Centre for Ecology and Hydrology (CEH), the Environment Agency and SEPA.

Map 8 : Surface water bodies failing for morphology in 2007



9.2 Changes to morphology from historical engineering and urban development

Many of Scotland's rivers and lochs have a history of engineering interventions. These have had an important role in the growth of our economy. Embankments, erosion protection and dredging have allowed development and cultivation of land adjacent to rivers and lochs. Weirs have helped irrigate crops and generate energy. Bridges, culverts and other similar structures underpin Scotland's transport network.

Under natural conditions rivers create a shape, size and character that reflect a balance between local conditions and conditions within the wider catchment. Urban development and historical engineering activities have often affected this natural balance, resulting in damage to the physical habitat of our rivers and lochs.

The historical legacy of development is redundant structures in the water environment that no longer have a function. Removing or modifying these structures can benefit the water environment, potentially reduce flood risk and improve the amenity value of rivers (particularly in urban areas). Clearly there are a range of possible reasons why some redundant structures cannot be removed; for example they may be of cultural or historical value, or have a recreational or amenity use.

Key message

Engineering and urban development represent relatively permanent changes to the morphology of rivers which often remain once the reason for their construction disappears. There are few mechanisms for removing historic structures that are no longer needed. The challenge is to develop new mechanisms to remove, modify or repair redundant structures to deliver environmental, social and economic benefits.

9.2.1 What causes the environmental impact?

The wide range of interventions that cause the physical habitat of our rivers, lochs and coastal waters to change include:

- old weirs and dams used for historic water supplies and for industry (eg mills);
- flood defences;
- engineered structures to support transport networks and developments such as culverts;
- bank protection to prevent erosion and protect development.

Further information on the environmental impacts caused by historical engineering activities and urban development can be found in the Significant Water Management Issues report.[80]

9.2.2 What action are we taking?

A number of organisations are working to improve the physical condition of the water environment. Examples are given below.

- The Fishery Boards and Trusts have, for many years, worked to remove barriers to fish migration. This process is constrained by financial and access problems and the scale of the work varies across the country. The Fishery Management Plans being developed by the Boards will result in the removal of additional barriers over the three river basin planning cycles.
- Where there is a responsible person/organisation, SEPA can take regulatory action under the diffuse pollution General Binding Rules in the Controlled Activities Regulations to require the removal or modification of certain redundant structures. This applies particularly to redundant weirs, where SEPA can require the provision of fish passage or the removal of the weir.
- SEPA has secured funding of £1.1million from the Scottish Government to support actions to restore the physical water environment over a three year period between 2008 and 2011. The intention is to cover a wide range of restoration projects with multiple benefits. SEPA has so far approved proposals on the removal of approximately 10 structures that are barriers to fish migration. Over the period leading up to the development of the final plan, SEPA will work with the Area Advisory Groups to develop a range of proposals for restoration.
- Development of sites can result in the restoration of natural rivers or coast lines enhancing green space and restoring habitats. A common example is the removal of culverting to open up urban rivers when old industrial sites are developed for housing.
- Flood management schemes led by local authorities will in future have to consider a catchment scale approach to flood mitigation, looking closely at any man-made factors in the catchment that may be exacerbating flooding. This approach will allow opportunities to improve the morphology of individual or groups of rivers and lochs to be identified.

Implementation of this work will be prioritised over this and subsequent river basin planning cycles. But where long-term impacts have occurred, improvements to the physical habitat of our rivers, lochs, estuaries and coasts may be gradual and take time.

[80] www.sepa.org/water/water_publications/swmi.aspx

Information on projects being undertaken at a water body level can be found on the interactive map on the SEPA website.[81]

In some areas, surface waters have been altered to such a degree that attempting to return them to a natural condition would be economically or technically infeasible. Such water bodies are either given less stringent objectives or have been designated as heavily modified water bodies. These require mitigation measures that maximise their ecological potential as opposed to 'restoring' the natural condition (see Section 5.1.3).

New engineering works

SEPA has powers under the Controlled Activities Regulations to ensure new proposals for engineering work are undertaken only where the benefits clearly outweigh the environmental impacts. All new engineering works will need to include appropriate mitigation measures to ensure:

- there is no deterioration in ecological quality;
- the physical habitats of our waters are protected.

National and local planning policies and development control can be used to identify restrictions on urban development which will prevent further impacts on morphology. They can also be used to provide opportunities for restoration during redevelopment.

Actions to address the impact of historic engineering activities and urban development are summarised in Table 20.

Table 20: Summary of actions to address the impact of historic engineering activities and urban development

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Removal of fish barriers	Remove redundant structures	Fishery Boards and Trusts	Fishery management plans and voluntary initiatives	Scottish Government SEPA
		Responsible person	Action under CAR	SEPA
Habitat remediation or improvement	Improve physical habitat of surface waters	Non-governmental organisations Landowners Fishery Boards and Trusts	Partnership projects	SEPA Scottish Natural Heritage River Restoration Centre
		Developers	Development control and planning constraints	Local authorities, SEPA and other statutory agencies
Reduce hard engineering structures	Removal of man-made factors affecting flooding	Developers Local authorities	Flood management schemes	Local authorities Scottish Government SEPA
Catchment based action	Focus advice and improvement projects in priority catchments	SEPA	Identification of priority catchments	Scottish Government

9.2.3 What benefits will we see from these measures?

The measures undertaken to improve the morphology of our rivers and lochs will provide a wide range of benefits. Examples are given below.

- Removal of fish barriers will improve fisheries, generating a range of economic and recreational benefits.
- Removal or modification of man-made structures and enhancements to areas of flood storage may help to reduce flood risk.
- Restoration of the water environment will make a positive contribution to urban regeneration.

The controls available through the Controlled Activities Regulations, General Binding Rules and the planning process will also help us prevent further deterioration in status.

[81] www.sepa.org.uk/water/river_basin_planning.aspx

9.3 Changes to morphology from agriculture

Some of Scotland's most productive agricultural land is alongside rivers. However farming land in the vicinity of rivers can cause environmental problems; for example, rivers can erode into fields and floods can threaten livestock and damage crops. This has led farmers to straighten and deepen rivers, reinforce banks and construct flood defences. Alterations occur in areas where constraining or altering a river will bring economic benefits to a landowner (eg maximising the area available for agricultural production). However, the adverse impacts are often expressed at a catchment level affecting ecology and flood risk downstream.

Key message

Agricultural land alongside rivers has often been cultivated through centuries of investment to protect it from flooding and to improve drainage. Constraining the space available to a river can damage the availability and quality of habitat, create flooding and silt problems for downstream landowners, properties and communities. It is important to achieve the correct balance between the interests of individual landowners and the overall benefits to society.

9.3.1 What causes the environmental impact?

Impacts on morphology are caused by a range of engineering activities and from the way in which land is managed including:

- straightening and deepening of rivers to reduce flooding and draining of wetlands to allow for agricultural production on the floodplain and ease of machinery use;
- removal of natural vegetation to allow cultivation or grazing;
- bank protection to prevent erosion of agricultural land;
- flood embankments to enable cultivation of the floodplain.

Further information on the environmental impacts caused by agricultural activities can be found in the Significant Water Management Issues report.[82]

9.3.2 What action are we taking?

In agricultural areas, restoration can be achieved by giving rivers and lochs more space and allowing natural processes to do the rest. This can be done by fencing off river banks or through the removal of embankments.

Because this type of restoration work is so closely related to the way land is managed, there is a close link between the measures and mechanisms required to address diffuse pollution (see Section 8.3) and those required to address the morphological impacts from agricultural production. Indeed, addressing the morphological impacts of agricultural activities typically will also help to reduce diffuse pollution impacts.

The key mechanisms in the Scotland river basin district for delivering improvements are:

- ensuring the maintenance of a two-metre buffer strip between a river/loch and arable land as required by General Binding Rule No. 20). SEARS can help to deliver this action as part of the process of assessing compliance with General Binding Rules and raising awareness with farmers.
- using Scotland Rural Development Programme measures to fund moving agricultural production back from rivers;
- the provision of good practice information to farmers by SEPA and non-governmental organisations (NGOs);
- natural flood management measures promoted by NGOs (particularly RSPB and WWF) which increasingly look to agricultural areas for answers to flooding problems in downstream urban centres.

SEPA has powers under the Controlled Activities Regulations to ensure new proposals for engineering work are undertaken only where the benefits clearly outweigh the environmental impacts. Appropriate mitigation measures will be required for any proposals for new engineering work.

Actions to address changes in morphology from agriculture are summarised in Table 21.

[82] www.sepa.org/water/water_publications/swmi.aspx

Table 21: Summary of actions to address changes in morphology from agriculture

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Riparian vegetation	Buffer strips Fencing of water margins	Landowners	CAR General Binding Rule No. 20	SEARS
			Education initiatives, promotion of guidance and advice	SRPBA NFUS SAC/FWAG SEARS
			Trial catchment projects and demonstration farms	SRPBA/NFUS/SEARS/ SAC/FWAG
			Scotland Rural Development Programme	Scottish Government, SEARS
Habitat remediation or improvement	Improve physical habitat of rivers and lochs	Landowners Fishery Boards and Trusts	Partnership projects	SEPA Scottish Natural Heritage River Restoration Centre SRDP
Floodplain restoration	Set back flood embankments Enhance flood storage via restoration of natural processes Reduce maintenance of channels	Landowners NGOs	Partnership projects	SEPA Scottish Government
			Education initiatives, promotion of guidance and advice	SRPBA NFUS SAC/FWAG SEARS
Catchment based action	Focus advice and improvement projects in priority catchments	SEPA	Identification of priority catchments	Scottish Government

FWAG = Farming and Wildlife Advisory Group; NFUS = National Farmers Union Scotland; SAC = Scottish Agricultural College; SEARS = Scotland's Environmental and Rural Services; SRPBA = Scottish Rural Property and Business Association

The controls through CAR and the planning process will prevent further deterioration in status except in exceptional circumstances where proposals are of overriding public interest or the environmental impacts are outweighed by the benefits to human health, the maintenance of human safety or sustainable development.

9.3.3 What benefits will we see from these measures?

Measures to reduce the impact of agricultural activities will contribute to an overall improvement of almost 4,000km of river habitat by 2015. We have not yet developed targets for 2021 or 2027.

The measures undertaken to improve the physical habitat (morphology) of our rivers and lochs will provide a wide range of other benefits.

- Improving the riparian structure will stabilise banks and help to prevent bank erosion and increase the variety of habitat for fish.
- Providing buffer strips will improve the bankside vegetation structure, increasing the biodiversity of both the river banks and the river channel itself.
- The removal of man-made structures such as embankments and increases in the area of available flood storage may help to reduce flood risk.
- Reducing the maintenance of the channel may help to improve its habitat structure.

9.4 Changes to morphology from forestry

The large-scale programme of upland conifer afforestation in the middle decades of the 20th century caused a number of problems for the water environment and up until the early 1990s the planting of coniferous plantations did not leave space for rivers. This maximised the productive area but damaged the condition of rivers. More recently the Forestry Commission's guidance, *Forests & Water Guidelines* (2003), requires space for rivers planted with open deciduous trees.

Key Message

Change to the morphology of watercourses from forestry practice is an historic problem caused by planting policies in the early days of forestry development. Current best management practice as set out in *Forests & Water Guidelines* ensures space for rivers. Forestry Commission Scotland is assessing the prioritisation of felling to areas where there are impacts.

9.4.1 What causes the environmental impact?

Historic forestry practices have a number of impacts on the physical habitat of our rivers and lochs.

- Planting non-native conifers up to the banks of rivers results in the rivers being densely shaded as the trees mature.
- A reduction in deciduous trees and ground vegetation (due to shading) can affect the ability of the watercourse to support fish populations, thus reducing river productivity.
- The shallow roots of coniferous trees provide limited protection to river banks leading to increased erosion of the banks. This can result in a wider and shallower river and potentially the loss of spawning areas for fish.
- The creation of road networks and the use of machinery can result in the release of silt, smothering in-stream habitats and polluting the water column.

9.4.2 What action are we taking?

The UK Forestry Standard (UKFS)[83] and the Scottish Forestry Strategy[84] (2006) set out clear actions aimed at contributing to achieving good ecological status of the water environment.

The UK Forestry Standard is supposed by *Forests & Water Guidelines* (2003). Forestry Commission Scotland will continue to promote and ensure the effective implementation of *Forests & Water Guidelines* throughout the forestry industry to address the issue of conifer planting to the banks of watercourses. These guidelines apply equally to the public and private forestry sectors, and compliance is a condition of receiving grant aid.

The proposals for the management of forests and woodlands are set out in Forest Design Plans for the national forest estate and Forest Plans for the private sector. All the national forest estate is covered by Forest Design Plans and consideration is being given to amending these plans (where appropriate) to bring forward remedial action to ensure the removal of conifers on high-risk water bodies in order to meet RBMP objectives.

Where a private sector operation has a Forest Plan, Forestry Commission Scotland will use the five-yearly review process to target appropriate remedial action.

Consideration is also being given to the most effective approach to:

- raising awareness by land and forest managers of river basin planning issues;
- advising on the availability of financial support from the Scotland Rural Development Programme to help achieve RBMP objectives.

A summary of actions being taken to address morphological impacts from forestry is presented in Table 22.

[83] www.forestry.gov.uk/publications
[84] www.forestry.gov.uk/SFS

Table 22: Summary of actions to address morphological impacts from forestry

Improvement required	Measure	Responsible organisations/sectors	Delivery mechanism and support	Support provider/ regulator
Riparian vegetation	Removal of non -native conifers to create a buffer zone adjacent to rivers Planting/establishment of native broadleaves within the buffer zone	Forestry Commission Scotland Land managers	CAR General Binding Rule No. 20	SEARS
			Forest Design Plans/ Forest Plans	Forestry Commission Scotland
			Forests & Water Guidelines (2003)	
			Scotland Rural Development Programme	Scottish Government SEARS
Improved in-stream habitat	Allow space for rivers during new planting Management of machinery and during the creation of road networks	Forestry Commission Scotland Land managers	Forest Design Plans/ Forest Plans	Forestry Commission Scotland
			Forests & Water Guidelines (2003)	

9.4.3 What benefits will we see from these measures?

The actions in this plan will:

- address the historical issues of morphology pressures from forestry;
- prevent further deterioration of the status of rivers and lochs due to forestry morphology pressures;
- continue to deliver best practice forest management to protect and enhance the water environment.

This will contribute to an overall improvement of almost 4,000km of river habitat and almost 300km^2 of loch habitat across the Scotland river basin district.

Specifically the removal of non-native conifers from the banks of rivers and lochs and adherence to *Forests & Water Guidelines* will create a riparian buffer zone with the correct mix of tree species to:

- stabilise banks;
- modify water temperature;
- provide good feeding and breeding habitats to support and increase fish populations.

The establishment of a riparian buffer zone can also provide opportunities to reduce the impacts of diffuse pollution from agriculture and provide a buffer from the impacts of acidification (see Section 8.5).

9.4.4 What additional measures do we require?

At present there is no statutory mechanism in place to enable Forestry Commission Scotland to compel a private woodland owner who chooses not apply for Scotland Rural Development Programme funding to address river basin planning issues and remove non-native conifers from the banks of watercourses. Before the production of the final river basin management plan, Forestry Commission Scotland and SEPA will work together to identify the scale of this issue and assess whether this has the potential to impact on the achievement of WFD objectives.

Section 10 **Invasive non-native species**

Invasive non-native species are fauna and flora generally from outside the UK that successfully establish themselves in aquatic ecosystems, resulting in damage to natural biodiversity and creating potentially significant economic impacts.

Key message

Overcoming problems with invasive non-native species in order to achieve the Water Framework Directive's environmental objectives will remain a challenge. Complete eradication of an invasive species is costly and difficult to do once it is introduced and become established. Preventing introduction in the first place is by far the most cost-effective approach.

10.1 What does classification reveal about non-native species?

The classification data show that impacts of invasive non-native species contribute towards 17 water bodies (seven coastal waters, six lochs and four rivers) in the Scotland river basin district failing to meet good ecological status standards. Future classification is likely to identify more water bodies with impacts as additional species are added and monitoring programmes identify new records for invasive species.

In December 2007, the UK Technical Advisory Group provided an updated list of species[85] that should be taken into account when classifying water bodies in England and Scotland based on their impact on quality elements related to good status (ie biological and physico-chemical quality elements) and high status (ie hydromorphological quality elements). The following species are present and considered a high priority in the Scotland river basin district:

- Canadian pondweed (*Elodea canadensis*);
- Japanese weed (*Sargassum muticum*);
- North American Signal crayfish (*Pacifastacus leniusculus*).

Other high impact species on the UK Technical Advisory Group list cause problems at a local scale in the river basin district and need to be considered in future cycles of the river basin management plan. These include:

- invasive riparian plant species such as giant hogweed and Japanese knotweed;
- translocated species, ie those that moved into the Scotland river basin district from another area of the UK where they occur naturally.

10.2 What action are we taking?

Existing legislation, policy and initiatives mechanisms include:

- The Invasive Non-Native Species Framework Strategy for Great Britain: protecting pour natural heritage from invasive species[86] – published jointly by Defra, the Welsh Assembly Government and the then Scottish Executive in 2007;
- Section 14 of the Wildlife and Countryside Act 1981 – makes it an offence to release (or to plant) non-native species to the wild (further proposed amendments to Schedule 9 include a wider range of problem species);
- proposed use of Section 14A of the Wildlife and Countryside Act 1981 to ban the sale of species specified in an Order (list of proposals being consulted on);
- Control of Pesticides Regulations 1986/Plant Protection Products Regulations 1997 – use of herbicides to control invasive plants in or near water);
- The Prohibition of Keeping or Release of Live Fish (Specified Species) (Scotland) Order 2003;
- Aquaculture and Fisheries Act (Scotland) 2007;
- biodiversity action planning;[87]
- delivery of the Species Action Framework (co-ordinated by Scottish Natural Heritage).[88]

[85] Annex B of Recommendations on Surface Water Classification Schemes for the purposes of the Water Framework Directive (www.wfduk.org/UKCLASSPUB/LibraryPublicDocs/sw_status_classification)
[86] www.nonnativespecies.org/documents/Draft_StrategyV6.4.pdf
[87] www.biodiversityscotland.gov.uk
[88] www.snh.org.uk/speciesactionframework/

Measures specific to the first river basin management plan include:

- identification of appropriate actions to manage species that threaten high status sites and good status, together with identification of potential sources of re-infestation in the surrounding area;
- establishment of detection/surveillance/control strategies for problem species;
- risk assessment of pathways for entry of problem species into the Scotland river basin district;
- research and development to define species causing deterioration of good ecological status/potential and to identify new methods of control.

Area Advisory Groups are encouraged to identify the local priorities for, and the feasibility of, controlling or eradicating populations of high impact invasive non-native species where these put at risk ecological status or other Water Framework Directive objectives.

Area Advisory Groups are urged to promote an approach that:

- gives priority to measures to prevent introductions of invasive non-native species;
- establishes a network that can detect newly introduced non-native species and, where appropriate, undertake rapid action to prevent their establishment;
- develop longer-term mitigation measures such as containment or control for established invasive non-native species where these put at risk ecological status or other Water Framework Directive objectives.

10.3 What benefits will we see from these measures?

The benefits of this approach include:

- maintenance of the ecological status of water bodies;
- financial savings from the reduced need to carry out control programmes;
- prevention of negative economic impacts on fishing;
- more tourists attracted to the area by its pristine environment.

10.4 What additional measures do we require?

A review of legislation in Scotland is proposed that will ban from sale or release a large number of additional potential invasive species including a number on the UKTAG high impact list. This is a national measure addressing one of the main pathways for release of a number of aquatic plant species from, for example, garden centres.

The Scottish Government consultation on continued improvements is considering the need to undertake a programme of work to prevent the further spread of invasive non-native species which could downgrade water bodies from good status under the Water Framework Directive. Section 12 of this plan provides background to this consultation.

Section 11 **Climate change**

Climate change is evident in Scotland from observed trends in temperature, rainfall and snow cover. It is causing changes in the growing, breeding and migration seasons leading to shifts in species abundance and diversity. Precipitation patterns are changing with increased autumn and winter rainfall, and higher rainfall intensity in the east and west leading to increased flood risk. Sea level rises in conjunction with a potential increase in storminess will lead to greater coastal flood risk and erosion. Left unchecked, climate change will accelerate causing damaging effects on physical, biological and chemical processes with significant consequences for Scotland's environment, economy and society. Climate change is different from the other issues discussed previously in that it affects all aspects of managing the water environment.

Key message

The change in rainfall patterns, temperature and sea level due to climate change will have significant impacts on the water environment. Understanding these impacts is central to protecting the water environment.

11.1 What is the environmental impact?

Climate change has a wide variety of implications for the environment in Scotland (see Table 23). Rising water temperatures and changes in precipitation patterns are of particular importance to surface water ecosystems. Such changes are likely to affect how ecosystems function, especially in combination with changes in water chemistry. For example, warmer standing waters receiving greater nutrient run-off as a result of higher intensity rainfall events could exacerbate algal blooms and eutrophication. Significant changes in average temperature, precipitation and soil moisture are likely to affect water demand in most sectors – especially agriculture, forestry and public supply. Irrigation water needs are likely to increase across the east coast.

Groundwater supplies are less susceptible than surface water to short-term climate variability; they are influenced more by long-term trends. However, the reduced reliability of surface water flows in summer may lead to greater pressure on groundwater sources and levels may fall along the east coast during the summer. The lowering of groundwater levels will have knock-on consequences for river flows and the possibility of saline intrusion to aquifers. The surface water temperature will fluctuate more rapidly, with reduced volumes of water causing direct impacts on fish populations and indirect consequences by exacerbating the effects of pollution.

This section will be developed further for the final plan following the release of the climate change scenarios in the spring 2009. There is further discussion on climate change planning and links with river basin planning in Annex 8.

Table 23: Summary of the implications of climate change on the water environment in Scotland

Aspect	Implications
Pollution	• Higher river flows in the west and north will reduce the impact of pollution in rivers but increase loading of pollutants to the sea. This will increase the risk of the failure of microbiological standards in bathing waters and shellfish waters. In the east, point source discharges may no longer be adequately diluted during lower summer flows. • Higher rainfall with more intense episodes may increase loads of diffuse pollutants such as suspended solids from urban and rural areas. • Higher intensity rainfall will increase sewer overflow rates, leading to an increase in the discharge of sewage. Similarly discharges from abandoned mines may increase. • Lower summer river flows in the south and east, along with higher temperatures reducing the dissolved oxygen in water bodies, will provide less dilution for discharges, leading to increased sewage treatment costs. • Enhanced plant/algal growth due to increased temperature and increased nutrient run-off will exacerbate the effects of eutrophication.
Abstraction and flow regulation	• Resources for hydropower generation will generally increase in autumn and winter, especially in the west and north. However, the decrease in snow cover and melt along with lower summer rainfall may lead to resource reductions during the summer. • Increased likelihood of summer droughts will lead to reduced resources, but higher abstraction demands (particularly from irrigation) may compromise the security of drinking water supplies with the potential to cause salination of some aquifers in eastern Scotland.
Changes to morphology	• The possibility of more frequent and severe river flooding will increase requirements for flood defence schemes and sustainable flood management. • There will be higher rates of river erosion due to more intense rainfall and higher flows. In addition, degradation of the river habitat may reduce bank protection. • Higher rainfall will lead to an increased risk of slope failure causing local hazards and the input of sediments into watercourses. • Increased erosion from land can lead to siltation of fish spawning gravels and increased nutrient loading to lochs and the sea. • Rising sea levels will impact on low-lying coasts and estuaries, and may be exacerbated by larger and more frequent storm surges. This will cause increased coastal flooding in vulnerable areas and more coastal erosion
Biodiversity and invasive non-native species	• Higher temperatures, changing hydrological conditions and water quality may provide more favourable conditions for invasive non-native species and allow the spread of rare or non-native diseases including those of aquatic species. • Changes in seasonal cycles may have impact on the interactions between species; for example, reduced pollination, changes in migration timing leading to competition between species, and earlier or delayed fish spawning. • There will be changes in the abundance and distribution of native species and the length of the growing season. • Higher temperatures will be less favourable for some native species. • Habitats may be affected by changes in land use; for example, the introduction of new crops to suit new climates or increased production of biofuels. • Increased riparian and coastal erosion may adversely affect important native species.

11.2 Generic actions to address implications of climate change on the water environment

Generic actions required to improve our assessment of impacts of climate change on the water environment are presented in Table 24. These actions will help ensure we protect our waters from deterioration due to climate change and that we take into account climate change factors (both in terms of mitigation and adaptation) when developing and implementing measures to improve the water environment.

Table 24: Summary of key actions to address the implications of climate change

Action required	Measure	Responsible organisations/sectors
Take account of changes in flow regimes	Ensure CAR licences take account of new projected low flow regimes	SEPA
	Ensure flood management plans are adequate for projected new high flow regimes	SEPA Local authorities
	Assess the impact of new rainfall patterns on CSO inputs to water bodies	SEPA Scottish Water
	Assess the impact of new rainfall regimes on discharges from abandoned mines	SEPA The Coal Authority
Assess impact of new climate on flooding	Review historical hydrology data for climate driven trends	SEPA
Ensure groundwater abstractions are sustainable	Review groundwater abstraction licences to assess likely future water requirement and groundwater levels	SEPA
Understand climate change trends existing and future trends in run off of pollutants	Assess existing data for long term trends	SEPA
	Assess factors that influence whether pollutant concentrations are likely increase or decrease as a result of increased run-off	SEPA

Section 12 Identifying continuing improvements in meeting good status by 2027

Production of this draft river basin management plan has allowed us to identify significant progress towards meeting the environmental objectives of the Water Framework Directive. However our work has also identified where there are gaps in the measures to manage key pressures likely to have a continuing impact in fuure planning cycles.

The process of objective setting indicates that the following environmental problems in particular could benefit from additional measures to reduce their impacts:

- nutrient enrichment in our rivers, lochs, estuaries and groundwaters;
- changes to the physical habitat of our rivers/barriers to fish migration;
- invasive non-native species.

We expect **nutrient enrichment** will still be a problem for our rivers, lochs, estuaries and groundwaters in 2027. The objective-setting process indicates that without additional measures, 6% of rivers and 12% of lochs will not reach good status for nutrients by 2027. The main pressures contributing to elevated nutrient levels are diffuse pollution issues particularly from agriculture and urban related activities.

We still expect **changes to the physical habitat** of our rivers to be an issue in 2027. The objective-setting process indicates that, without additional measures, 28% of surface water bodies are not expected to reach good status for physical habitat by 2027.

There is a need for **ongoing management of invasive non-native species.** Although mechanisms are being implemented under the Framework Strategy for Great Britain, this action is focused on protected areas. There is a need to implement systematic monitoring and prevention systems for particular key species outside of protected areas where they may cause downgrades to status.

In order to deliver Ministers' aims for the sustainable management of Scotand's water evironment, Scottish Government policy is evolving to take into account:

- improving evidence as to the best course of action to sustainably manage the water environment and address the most significant pressures;
- cost-effective and proportionate action that could manage these pressures.

Other Scottish Government's policy initiatives such as marine, coastal planning and flooding related legislation will also enhance the management of the water environment.

Additional measures and actions will be considered to allow more effective management of the water environment. These are set out in the Scottish Government's consultation on continued improvements. Additional measures under consideration are:

- the introduction of 'low phosphate detergents' at a UK level to help reduce overall phosphate loadings;
- the need to prioritise work on catchments where diffuse pollution may cause failure against Water Framework Directive standards and protected area obligations by 2015, 2021 or 2027;
- the development of a restoration policy framework to deliver on-the-ground actions that could move water bodies downgraded by historic engineering impacts to good status;
- undertaking a programme of work to prevent the further spread of invasive non-native species which could downgrade water bodies from good status.

However we need to ensure the implications of the continued improvements measures are considered in terms of societal and cost implications as well as environmental outcomes. We will do this in two ways.

- The Scottish Government consultation on continued improvements,[89] will consider the extent to which these additional measures will have measurable environmental effects on management of the significant pressures at a river basin district or regional scale; the extent to which measures are proportionate and cost-effective; equity issues in terms of where burdens may fall; and which initiatives require further development in subsequent river basin planning cycle.
- The strategic environmental assessment report[90] for the draft river basin management plan will also consider the implications for wider management of the environment.

The implications for wider government policy, investment requirement and implications for Scotland's community and industry are considered as part of the associated impact assessment[90] for the draft river basin management plan and the Scottish Government's consultation on continued improvements.

[89]A link to the document can be found on the SEPA website www.sepa.org.uk/water/river_basin_planning.aspx
[90]A copy can be found from a link on SEPA's website (www.sepa.org.uk/water/river_basin_planning.aspx).

Section 13 Implementation of the Scotland river basin district management plan

River basin planning is a new process which requires the involvement of a wide range of organisations. As part of this planning process and the final river basin management plan, we need to develop and maintain an implementation plan that reflects the actions and efforts of all those involved. This implementation plan will be used to monitor progress and help us to assess the success of our measures.

13.1 Working together

Many organisations in Scotland are responsible for implementing actions that can help to protect or enhance the water environment. One of the most important aspects of river basin planning is that all partners make a positive contribution (individually or in partnership) and take ownership of the programme of measures.

Partnership working is fundamental to river basin planning and essential if we are to successfully deliver the objectives of this draft river basin management plan. Part of the process of developing this draft plan was therefore to collate actions being implemented by partners to allow these actions to be taken into account when setting water body objectives.

Nationally across Scotland, partner organisations help us to provide the means by which actions are implemented on the ground. The National Advisory Group has helped to identify current and potential future support mechanisms. These are captured in this draft river basin management plan and supporting annexes.[91] Important examples include:

- research into best management practice for diffuse pollution;
- campaigns for the efficient use of water;
- partnership habitat restoration projects;
- sector guidance, eg for hydropower or land managers;
- awareness raising for invasive non-native species.

The Area Advisory Groups have identified local actions (existing and planned) that are – or will be – implemented by individual land managers, voluntary organisations (eg catchment management groups), local authorities and national organisations working at a local level (eg RSPB Scotland). These organisations have developed projects to address specific local issues which make an important and direct contribution to improving watercourses and ensuring the water environment does not deteriorate.

The river basin planning process provides an important opportunity to identify, prioritise and develop new measures to improve the way we protect and restore the water environment. We are working with our advisory groups to identify new measures we could develop through partnership initiatives.

13.2 Integration of plans and programmes

A number of existing plans contribute to the management of water bodies and act as drivers for change to the water environment, eg by providing grant schemes or directing where land use or development change should take place.

We have identified nine planning processes as significant for the Scotland river basin district. These are listed in Table 26 which identifies the links from each process to river basin district priorities and summarises important strategic actions during the first river basin planning cycle to link planning processes and help achieve the Water Framework Directive's requirements. Annex 11 contains a detailed discussion of the links between river basin planning and other planning processes in Scotland.

Consultation question 7: To be effective this plan has to influence other planning process. Have you suggestions on how to improve the way this plan links to other planning processes?

[91] www.sepa.org.uk/water/river_basin_planning.aspx

Table 25: Relevant national frameworks, plans and strategies

Type	Strategic actions linking to river basin planning
Land use planning	
The second National Planning Framework for Scotland (NPF2)* recognises that: • a high quality environment is an essential component of quality of life; • economic development must be integrated with environmental quality.	• Realise the strategic objectives in NPF2 related to the Water Framework Directive. • Ensure Water Framework Directive requirements are accounted for in Development Plans, planning policy, guidance and circulars. • Develop an approach to integrate river basin management plans and Development Plans, and to exchange information.
Agricultural planning	
A Forward Strategy for Scottish Agriculture: Next Steps† sets out goals and directions to help ensure a prosperous and sustainable farming and food industry in Scotland. The Scotland Rural Development Programme‡ encourages water quality and biodiversity measures.	• Identify priorities where delivery of environmental services by land managers would provide the greatest benefits for the water environment. • Provide grants to target funding of soil and water measures. • Implement and meet Good Agricultural and Environmental Condition (GAEC) in order to minimise loss of soil to watercourses.
Climate change planning	
Climate change planning must be fully integrated in the river basin planning and other linked land use planning processes.	• Provide information on how future climate change may influence the hydrological cycle. • Consider climate change when identifying, developing and implementing measures to protect or improve the water environment. • Consider how river basin planning measures can help with adaptation to climate change.
Coastal planning	
The integrated approach to protecting freshwaters, transitional and coastal waters established under the Water Framework Directive can help ensure strong links between river basin planning and any future national marine planning framework.	• Develop a national marine planning framework. • Provide a mechanism to link river basin management plans with statutory planning regimes in the marine and terrestrial environment. • Ensure the exchange information between river basin planning and any future national marine planning framework.
Flood risk management planning	
Future flood management plans will need to identify opportunities for flood management that will deliver other environmental benefits	• Ensure the integration of flood risk management planning with river basin planning and development planning. • Work with natural processes to deliver more sustainable options for flood risk management and deliver other environmental benefits. • Consider opportunities to utilise agricultural land in sustainable flood management.
Forestry planning	
Sustainable forest management underpins the UK Forestry Standard§ and the Scottish Forestry Strategy 2006.¶ The importance of protecting and enhancing water resources is recognised.	• Ensure Water Framework Directive actions continue to be part of forestry planning and that local actions are implemented effectively. • Ensure best practice guidance is aligned with Water Framework Directive objectives. • Help promote and target Scotland Rural Development Programme funding to deliver forestry measures to help protect and enhance the water environment.

*http://openscotland.gov.uk/Publications/2008/01/07093039/0
†www.scotland.gov.uk/Publications/2006/03/01142456/0
‡www.scotland.gov.uk/Topics/Rural/SRDP
§www.forestry.gov.uk/publications
¶www.forestry.gov.uk/SFS

Type	Strategic actions linking to river basin planning
Fishery planning	
Fishery Management Plans include actions to deliver environment improvements. Co-ordination with river basin planning will identify opportunities for partnership working to deliver shared priorities.	• Link environmental improvement measures in Fishery Management Plans to Water Framework Directive priorities. • Work in partnership to deliver shared actions to protect and enhance the environment.
All EU Member States are required to develop a national eel management plan. Member States must demonstrate 40% escapement compared with pristine conditions and, where escapement is thought to be less than 40%, measures must be taken to reduce mortality/increase production. A national eel management plan is being developed for the Scotland river basin district. Co-ordination between RBMP priorities and those of the eel plan should be complementary.	• Ensure that environmental improvements identified under the river basin management plan offer maximum benefits to the eel management plan. • Ensure that eel mortality is minimised where ever possible (eg at hydropower schemes) by including eel mitigation as part of good ecological potential requirements.
The European Union is a signatory to the North Atlantic Salmon Conservation Organisation (NASCO).** As part of the NASCO Implementation Plan, Scotland is required to provide a focus area report on the protection and restoration of salmon habitat. The river basin planning process will be valuable for identifying pressures and improvement measures that can meet the requirements of both the Water Framework Directive and NASCO.	• Link WFD characterisation to NASCO focus areas report on habitat. • Ensure the NASCO report identifies RBMP objectives where they represent benefit to salmon populations. • Ensure maximum benefits of RBMP improvement measures for salmon.
Natural heritage planning (Natura 2000 and biodiversity)	
Under the Water Framework Directive, favourable conditions are to be achieved by 2015 for water-dependant Natura 2000 sites. The UK Biodiversity Action Plan†† and Scottish Natural Heritage Species Action Framework‡‡ provide signposts to priority habitats and species relevant to the river basin district. Water Framework Directive relevant actions within the Scottish Biodiversity Strategy§§ will assist the integration of biodiversity objectives into the river basin planning process.	• Provide information on key areas for linked biodiversity and water improvement action. • Provide links with existing groups and initiatives taking forward action on biodiversity priorities. • Work to take forward measures to address pressures on Natura 2000 sites. • Develop common priorities in grant giving schemes (eg Scottish Rural Development Programme).
Water Treatment and Supply Planning	
Quality & Standards (Q&S) (a partnership planning process and the sector plan for the water industry) provides environmental benefits through investment in public wastewater and drinking water infrastructure. Drinking Water Safety Plans, along with the risk assessment process for their monitoring, can help identify where catchment-based measures are required to protect drinking water sources.	• Identify water bodies where improvements could be delivered through the Q&S process. • Plan and fund the implementation of measures to deliver environmental improvements and help achieve Water Framework Directive objectives. • Place emphasis on source control to reduce pollutants entering the sewerage network. • Place emphasis on catchment-based measures to protect water bodies used for drinking water supply, thus implementing Article 7 of the Water Framework Directive.

**www.nasco.int
††www.ukbap.org.uk
‡‡www.snh.org.uk/speciesactionframework/
§§www.biodiversityscotland.gov.uk/

Section 14 **Conclusions**

The following conclusions can be drawn from the draft river basin management plan for the Scotland river basin district.

1. Initial results from new monitoring and classification schemes indicate that almost 60% of surface waters in the Scotland river basin district are classified as good or high status or ecological potential. Our understanding of the status of waters in the district will continue to improve as new data and classification tools become available.
2. Five key water management issues can be identified for those water bodies not achieving good status/ecological potential or better in the district (see Box 1).

Box 1: Key water management issues for the Scotland river basin district

- Abstraction and flow regulation for electricity generation, drinking water supply and agricultural abstraction
- Diffuse pollution from rural and urban land
- Point source pollution from sewage, mining and quarrying and aquaculture
- Changes to the physical habitat (morphology) of a watercourse from engineering activities and agriculture
- Invasive non-native species

3. A wide range of measures including regulation, economic incentives and voluntary actions can help improve the water environment and prevent deterioration. These include existing measures and those put in place for the river basin management plan.
4. We believe that implementation of the programme of measures presented in the draft plan will mean that 67% of our surface water bodies will be at good or high status or ecological potential by 2015, giving an overall environmental improvement of 7%. The overall scale of improvements by 2015 is expected to rise slightly as some expected improvements have still to be taken into account.
5. If we implement this draft river basin management plan there will still be pressures to be addressed including:
   - nutrient enrichment of waters;
   - changes in the physical habitat of our rivers;
   - barriers to fish migration;
   - invasive non-native species.

   A set of additional measures and actions focusing on these remaining pressures will be considered as set out in the Scottish Government's consultation on continued improvements.
6. The draft river basin management plan has been produced for consultation. It provides the information, data and guidance necessary to allow all those with an interest in the water environment to provide consultation responses and to input to and support the river basin planning process. Consultation responses will be highly important for the development of the final plan.

14.1 Next steps in the development of the final plan

Between now and the publication of the final river basin management plan for the Scotland river basin district we will:

- continue to refine classification assessments and update with data collected in 2008;
- work together to continue to identify, develop and implement measures (actions) to deliver the plan's objectives;
- develop sector/implementation plans in partnership;
- consider all responses to this consultation on the draft river basin management plan for the Scotland river basin district along with the consultation responses to the strategic environmental assessment and impact assessment, and update the plan accordingly;
- revise the objectives and measures of the plan based on guidance from the Scottish Government following the outcomes of its on continued improvements and impact assessment consultations.

Once finalised, the river basin management plan will provide Scotland with a comprehensive framework for co-ordinating and integrating the management of our inland, coastal and ground waters.

Glossary

Term	Definition
Acidification	Refers to reducing the pH of something to make it more acidic. In terms of surface waters and soils, acidification generally refers to the enhanced changes due to the deposition of sulphur and nitrogen species as a result of human activity.
Algal bloom	An algal bloom is a rapid increase in the population of algae (microscopic and macroalgae) in an aquatic system. Algal blooms may occur in freshwater as well as marine environments. Some blooms may be recognised by discoloration of the water resulting from the high density of pigmented cells. Some algal blooms are the result of an excess of nutrients (particularly phosphorus and nitrogen). As the algae die off this dead organic matter becomes food for bacteria that degrade it using oxygen. When the dissolved oxygen content decreases, many fish and aquatic insects cannot survive. Algal blooms may also produce neurotoxins.
Biodiversity	The richness and complexity of plant and animal communities.
BOD (biochemical oxygen demand)	The amount of dissolved oxygen (in mg/litre) consumed by chemical and biological action when a sample is incubated for five days at 20°C in the dark. Allylthiourea (ATU) is used for suppression of oxygen consumption by nitrification.
Buffer strip	A 1–5 metre strip of agricultural land left uncultivated alongside watercourses to minimise erosion.
Catchment	An area from which surface run-off is drained away into a river.
Combined sewer overflow (CSO)	A combined sewer is a type of sewer system which provides partially separated channels for sanitary sewage and storm water run-off. This allows the sanitary sewer system to provide back-up capacity for the run-off sewer when run-off/rainfall volumes are unusually high, but it is an antiquated system that is vulnerable to sanitary sewer overflow during peak rainfall events.
Culvert	A culvert is a conduit used to enclose a flowing body of water. It may be used to allow water to pass underneath a road, railway or embankment for example.
Cyprinid	Family of freshwater fish including carps, true minnows and their relatives (e.g. barbs)
Diffuse pollution	Pollution arising from land use activities (urban and rural) dispersed across a catchment or sub-catchment, and which does not arise as a result of the discharge of an industrial, domestic sewage, deep mine or farm effluent (this is point source pollution).
Dissolved oxygen (DO)	Oxygen dissolved in a liquid, the solubility depending upon temperature, partial pressure and salinity. Expressed in mg/litre.
Ecological	From ecology which is the scientific study of systems of living organisms and the interactions among organisms their environment.
Ecosystem	Living organisms (species, populations and communities of plants and animals), their physical environment (habitat) and their inter-relationship within a particular system.
Estuary	Area at the mouth of a river where it broadens into the sea and where fresh and sea water mix to produce brackish water.
Eutrophic Eutrophication	The enrichment by nutrients, especially compounds of nitrogen and/or phosphorus, causing an increase in the growth of algae and plants that produces an undesirable disturbance to the natural balance of the ecosystem.
Faecal coliforms	A specific type of coliform bacteria found only in the gut, where they can aid the digestion of food, and consequently can be found in waters suffering recent contamination with human sewage or animal faeces. The number of faecal coliform bacteria found in 100 millilitres (ml) of water is used as an indicator of pollution by faecal material.
Foul sewer	Also known as a sanitary sewer, is a type of underground carriage system for transporting sewage from houses or industry to treatment or disposal. In some areas, foul sewers are separate sewer systems specifically for the carrying of domestic and industrial wastewater, and are operated separately and independently of storm drains, which carry the runoff of rain and other water which wash into city streets.

General binding rule (GBR)	A level of authorisation under the Controlled Activities Regulations
Groundwater	The term groundwater refers to all water that is below the surface of the ground in the saturated zone and which is in direct contact with the ground or subsoil.
Habitat	Place where an organism (e.g. human, animal, plant, microorganism) or population of organisms live, characterised by its surroundings, both living and non-living.
Inorganic	Composed of material other than plant or animal matter.
Invasive non-native species	Invasive species which are not native but which have successfully established themselves in our aquatic ecosystems, resulting in damage to our natural biodiversity and creating potentially significant impacts.
Leaching	Process by which water removes chemicals (e.g. from soil) through chemical reactions and the downward movement of water.
Macroalgae	Also referred to as algae or seaweed. Large aquatic plants found in freshwater and marine waters.
Macro-invertebrate	Also referred to as invertebrates or simply inverts. Any non-vertebrate organism that is large enough to been seen without the aid of a microscope and lives in or on the bottom of a body of water.
Measure	A measure is an action taken to improve or maintain the condition of a water body.
Minewater	Water escaping from a former mine. After mines are closed and flooded, iron next to the coal seams is washed out into nearby streams, where it reacts with oxygen, rusts and turns bright orange.
Morphology	Physical attributes that describe the shape, form and texture of river or loch environments, e.g. bars, sediment, riffles.
Nitrate	Soluble nitrate is an important limiting factor in the growth of certain bacteria in ocean waters. In many places in the world, artificial fertilisers applied to crop lands to increase yields result in run-off delivery of soluble nitrogen to oceans at river mouths. This process can result in eutrophication of the water, as nitrogen-driven bacterial growth depletes water oxygen.
Nitrate Vulnerable Zone (NVZ)	An area designated in accordance with the requirements of the Nitrate Directive 91/676/EEC, which aims to reduce water pollution caused by nitrates from agricultural sources. For more information see http://www.scotland.gov.uk/Topics/Agriculture/Environment/NVZintro
Nutrient	A nutrient is either a chemical element or compound used in an organism's metabolism or physiology. Oversupply of plant nutrients in the environment can cause excessive plant and algae growth.
Pesticide	Any substance, preparation or organism prepared or used (among other uses) to: protect plants or wood or other plant products from harmful organisms; regulate the growth of plants; give protection against harmful creatures; or render such creatures harmless.
Phosphate Phosphorus	Phosphorus is an essential component of living systems and is found in nervous tissue, bones and cell protoplasm. Phosphates are the naturally occurring form of the element phosphorus and are found in many phosphate minerals. In ecological terms, phosphate is often a limiting reagent in environments, and its availability may govern the rate of growth of organisms. Addition of high levels of phosphate to the environment can have significant ecological consequences (e.g. algal blooms).
Phytobenthos	Microscopic plants attached to the bottom of ponds, lakes, rivers and seas. This includes some diatoms which are particularly sensitive to nutrient enrichment.
Point source pollution	Pollution caused by a discharge from a fixed installation such as the end of a pipe, stack or drain.
Programme of Measures	The combination of national, regional and local measures being taken to improve or maintain the condition of water bodies in the river basin district.
Riparian	Relating to a river bank

Run-off	Portion of rainfall, melted snow or irrigation water that flows across the ground's surface and is eventually returned to streams. Run-off can pick up pollutants from air or land and carry them to receiving waters.
Saline	Water with a salt concentration greater than 18 parts per thousand (ppt)
Salmonids	Freshwater fish of the salmonid family (e.g. salmon, trout)
Septic tank	A septic tank is a small-scale sewage treatment system common in areas with no connection to main sewerage pipes. The term 'septic' refers to the anaerobic bacterial environment that develops in the tank and which decomposes or mineralises the waste discharged into the tank. Periodic maintenance is required to remove the irreducible solids which settle and gradually fill the tank, reducing its efficiency. A properly cared for system can last for decades and possibly a lifetime.
Sewage	The waterborne wastes of a community. Domestic sewage is derived from a residential area. An industrial sewage is from a mixed residential and industrial area. Storm sewage is that flowing to a treatment works in wet weather or discharged from storm overflows, when the sewage is diluted to a greater or lesser extent with rain water.
Sewerage	A system of pipes and appurtenances for the collection and transportation of domestic and industrial waste waters.
Sheep dip	The term sheep dip refers to a liquid formulation of insecticide and fungicide which shepherds and farmers may use to protect their sheep from infestation against external parasites. The sheep are completely immersed in the preparation. Sheep dips have been found to contaminate surrounding soil, creating environmental problems.
Silage	Silage is fermented, high-moisture forage that can be fed to ruminants (cud-chewing animals such as cattle and sheep). Silage must be firmly packed to minimise the oxygen content or it will spoil.
Sustainable urban drainage system (SUDS)	SUDS are designed to reduce the potential of flooding on new and existing urban developments. Unlike traditional urban stormwater drainage systems, they also help to protect and enhance ground water quality.
Water table	The water table is the surface where the water pressure is equal to atmospheric pressure. In undeveloped regions or areas with high amounts of precipitation, the water table roughly follows the contour of the overlying land surface, and rises and falls with increases or decreases in infiltration.
Wetlands	Areas that are inundated by surface water or groundwater at a frequency sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth or reproduction.

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