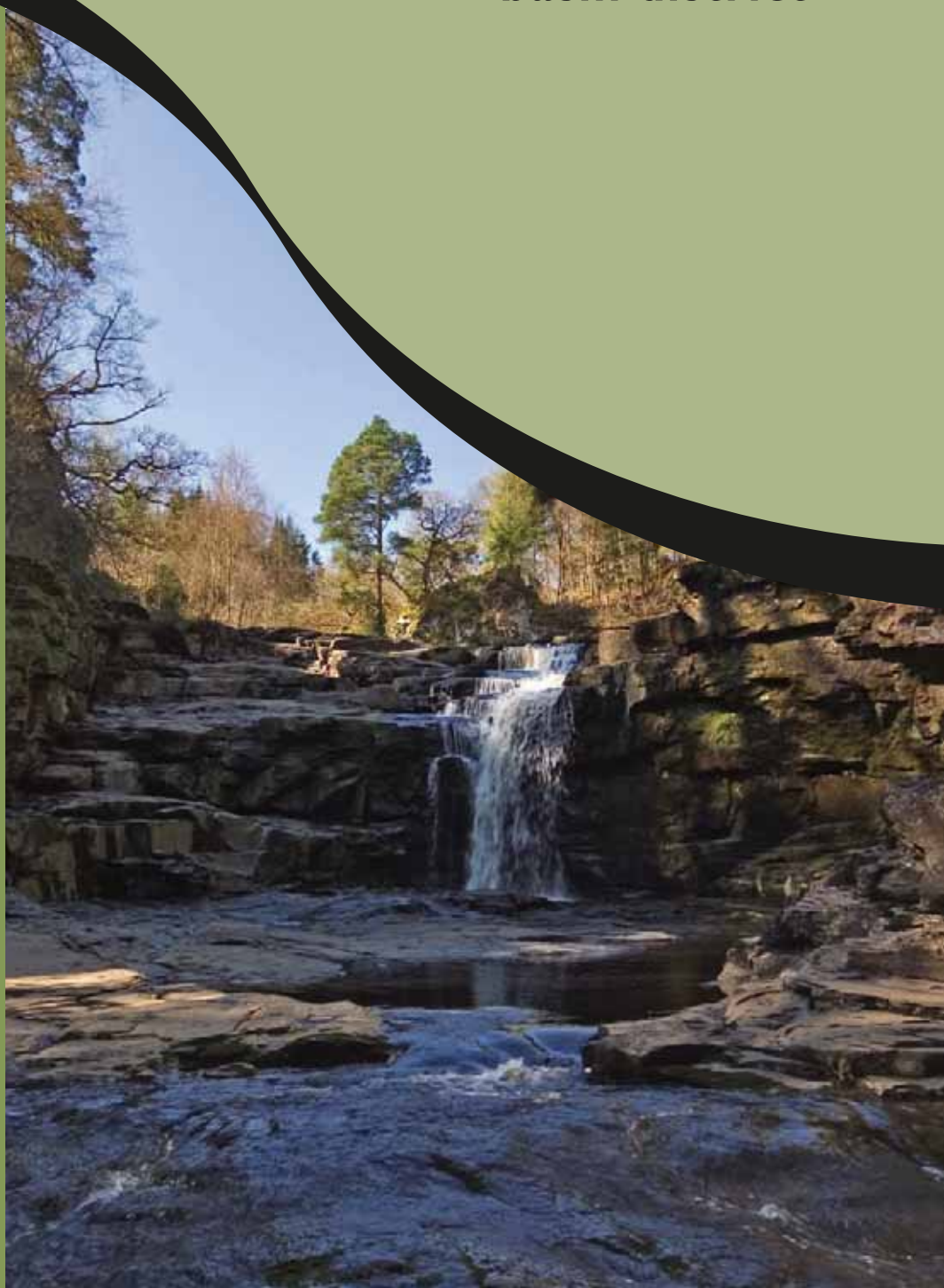
SEPA
Scottish Environment Protection Agency

Significant water management issues in the Scotland river basin district



Foreword

We are introducing a new way of managing the water environment in Scotland called river basin planning. This involves setting objectives to protect and improve the water environment while promoting its sustainable use.

Overall, Scotland's water environment is in good condition but a wide range of problems exist at a local level. Assessments indicate that about 40% of Scotland's waters fail the environmental standards required to support good ecology.

This consultation document is intended to identify the issues which we have to address to deliver environmental improvements. SEPA has developed this consultation with the Area and National Advisory Groups set up early in the river basin planning process. These advisory groups include representatives of the key organisations with an interest in the water environment. Together we have identified the environmental problems we need to address and have considered what actions are required.

Next year SEPA and the advisory groups will produce a draft river basin management plan based on this report and the feedback we receive from you.

We believe river basin planning provides a real opportunity to co-ordinate our work across Scotland to deliver agreed environmental objectives. It is an innovative approach which will deliver two important benefits.

- It will improve the quality of our environment.
- It will facilitate the sustainable use of the water environment by business and for recreation, which will have major social and economic benefits.

Please read those sections of this report applicable to you and consider how we can all contribute to the development of a better, greener Scotland.

Executive summary

The Water Framework Directive established new and better ways of protecting and improving our water environment, with the overall objective of achieving co-ordinated and integrated water management across Europe. One of the Directive's requirements is the publication of an interim overview of the significant water management issues in each river basin district. This overview builds on the work described in our earlier characterisation report and is an intermediate step in the preparation of the river basin management plan for Scotland.

This consultation document provides you with an opportunity to contribute to the river basin planning process in the Scotland river basin district. It seeks your views and opinions on the significant water management issues for the river basin district. A similar document prepared with the Environment Agency is available for the Solway Tweed river basin district.

The main focus of this report is the identification of the significant water management issues that we think put our ability to achieve the environmental objectives of the Water Framework Directive most at risk. These issues are summarised in the table below. The most common problems affecting our water environment are pollution, abstraction and modifications to the physical habitat. However it is also important to consider the increasing pressure from the presence of invasive alien species.

Summary of significant water management issues in the Scotland river basin district

Pressure type	Key sectors
Diffuse source pollution	Agriculture Forestry Urban development Sea and coastal water transport
Point source pollution	Collection and treatment of sewage Aquaculture Manufacturing Refuse disposal Mining and quarrying
Abstraction and flow regulation	Electricity generation Public water supplies Agriculture
Changes to morphology	Historical engineering Agriculture Electricity generation Urban development Land claim
Invasive alien species	All sectors

The report highlights the need for new and, in some cases national, measures to be implemented in order to achieve the environmental objectives of the Water Framework Directive. As well as your views on these and existing measures, we welcome your comments on our provisional identification of heavily modified and artificial water bodies in Scotland.

An interactive map available on our website (www.sepa.org.uk) provides an opportunity to identify the pressures affecting and measures to be applied to the water bodies across all of Scotland.

A short summary document, *An introduction to the significant water management issues in the Scotland river basin district*, is available separately from SEPA – both online and as a printed copy.

We will not be publishing a revised version of this report after the consultation period but will use the consultation feedback to inform the development of the draft river basin management plan. We have prepared this report slightly earlier than the Directive requires to allow more time for your responses to be taken into account when producing the first draft river basin management plan.

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1 Introduction

The Water Framework Directive (WFD) is a wide-ranging piece of European environmental legislation which came into force in December 2000. It established new and better ways of protecting and improving our water environment with the overall objective of achieving co-ordinated and integrated water management across Europe. A general introduction to some of the technical aspects of the WFD can be found in a previous consultation document, *The Future for Scotland's Waters*.[1]

The interim overview of the significant water management issues (SWMI) is an important statutory requirement of the Water Framework Directive for all river basin districts. This overview sets out the key issues affecting the water environment in the Scotland river basin district. The report builds on the work of the characterisation report (Article 5 characterisation and impacts analyses[2]) published in March 2005 and is an intermediate step in the preparation of the river basin management plan for Scotland. The WFD requires SEPA to make this overview available for public consultation. A similar report prepared with the Environment Agency is available for the Solway Tweed river basin district.

This consultation document provides you with an opportunity to contribute to the river basin planning process in the Scotland river basin district. It seeks your views and opinions on the significant water management issues for the river basin district. The consultation arrangements are set out in section 2.

We will not be publishing a revised version of this report after the consultation period, but will use the consultation feedback to inform the development of the draft river basin management plan. We have prepared this report slightly earlier than the Directive requires to allow more time for your responses to be taken into account when producing the first draft river basin management plan.

In addition to an overview of the significant water management issues, this document provides an update on further characterisation work, information on available measures and the development of new measures, and an indication of the number of water bodies that we do not expect to meet good status by 2015, particularly in relation to heavily modified and artificial water bodies. This is an opportunity for you to comment on these developing areas of work.

This SWMI report is supported by a short summary document and an interactive map on our website (www.sepa.org.uk). The interactive map provides an opportunity to identify the pressures affecting and measures to be applied to the water bodies across all of Scotland.

1.1 The river basin planning process

River basin planning is a strategic decision-making process that integrates the management of land and water within river basin districts. The river basin management planning process aims to improve and support sound and sustainable water management to deliver the requirements of the WFD while balancing the environmental, social and economic needs within the river basin district.

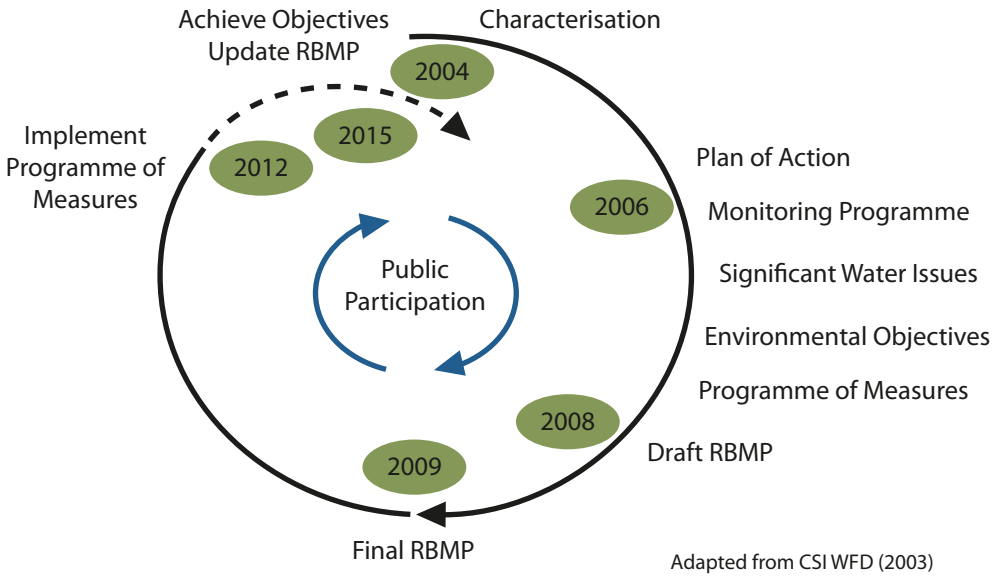
The river basin planning process started in 2004 with an analysis of the pressures and impacts affecting the water environment in the river basin district. The findings were published in March 2005 in the characterisation report required by Article 5 of the Water Framework Directive.[3]

River basin planning is a gradual cyclical process that involves public participation throughout. Characterisation is followed by a series of steps shown in Figure 1. These include publication of the river basin management plan and implementation of the programme of measures. This report is the next step leading towards the production of the first river basin management plan in 2009. The WFD requires an inclusive and participative approach during the production and implementation of the river basin plans and the SWMI report is an important opportunity for consultation.

Further information about the process of producing the river basin management plan is available at www.sepa.org.uk/publications/wfd/index.htm

[1] www.sepa.org.uk/pdf/publications/wfd/future_for_scotlands_waters.pdf
[2] www.sepa.org.uk/pdf/publications/wfd/Article_5_Scotland_River_Basin.pdf
[3] www.sepa.org.uk/pdf/publications/wfd/Article_5_Scotland_River_Basin.pdf

Figure 1: The river basin planning process



Adapted from CSI WFD (2003)
Best practices in river basin planning,
guidance on the planning process

The identification of significant issues and the measures to address these is an important further step towards the development of the river basin management plan for the Scotland river basin district. The plan will explain how the co-ordination of measures across Scotland will deliver cost-effective environmental benefits.

SEPA is responsible for the development of this plan. We believe consultation on the significant water management issues report is important to help develop the right balance between delivering environmental improvements and the resulting economic and social costs.

1.2 The role of the Area Advisory Groups

Stakeholder involvement is an important aspect of the WFD. The Area Advisory Groups (AAGs) have contributed to finalising the identification of the significant issues at a sub-basin level. The significant issues were discussed at AAG meetings where members were given the opportunity to add up to three significant issues which they could justify to be important at a local scale. In addition, the AAGs have provided us with measures relating to the sub-basins and members will be updating us regularly with measures at a water body level.

At a national level, the National Advisory Group (NAG) discussed the significant issues for the Scotland river basin district and agreed to the addition of issues as appropriate.

If we are to achieve improvements in the water environment and prevent further deterioration, it is important to ensure that the pressures impacting the water environment are sufficiently managed and controlled. SEPA will need to work with partner organisations to develop an efficient and effective programme of measures to address the issues affecting the Scotland river basin district. We will establish, as required by the WFD, a programme of measures by December 2009 with all measures effective by 2012.

1.3 Strategic Environmental Assessment

Many planning processes, including the development and adoption of river basin management plans (RBMPs), require a Strategic Environmental Assessment (SEA) to be carried out in line with the European Strategic Environmental Assessment Directive.[4]

The SEA will ensure information on the significant environmental effects of the RBMP is gathered and made available to consultation authorities and the public during its preparation and prior to its adoption. The SEA will assess the significant environmental effects of the strategic objectives and significant national and regional measures set out in the RBMP. As the RBMP itself sets out to protect and improve the water environment, the SEA will include an assessment of this as well as any wider non-water environmental impacts.

1.4 Next steps

Over the next 18 months, SEPA will work with the National Advisory Group and Area Advisory Groups to produce the draft river basin management plan for the Scotland river basin district. The Water Framework Directive requires the draft plan be published in December 2008 to allow for six months public consultation before publication of the final plan in December 2009.

Our work will focus on developing programmes of measures and environmental objectives for individual water bodies. As part of this process we will need to consider those water bodies that are not currently expected to meet the environmental objectives by 2015 and identify appropriate measures and/or objectives.

[4]Available at www.sepa.org.uk

2 Consultation arrangements

This report is aimed at those likely to be affected by or have an interest in developing the river basin management plan to achieve the Water Framework Directive's environmental objectives in the Scotland river basin district.

We wish to engage as wide an audience as possible and therefore welcome views from anyone who is interested in how the water environment is managed. We must receive your views on this consultation by 8 April 2008. All responses will be taken into consideration during the development of the draft river basin management plan, which will be published by the end of 2008.

We welcome your responses on the consultation questions listed below.

Please provide additional information to support your response.

2.1 Consultation questions

Significant water management issues

This consultation focuses on the significant water management issues we will have to deal with in the river basin management plan. These issues are described in sections 7 to 11.

Please consider the following consultation questions.

- Do you agree that these are the significant issues impacting the water bodies within the Scotland river basin district?
- Are there other significant issues at the river basin district level that have not been considered?
- Have we identified all the important existing measures that are being used to address these issues? Please identify any important existing measures that we have missed.
- Are there additional new measures that you think could make an important contribution to addressing a significant issue?
- Can you identify new or existing measures which **you** can help deliver?

Water bodies

The interactive map on the SEPA website (www.sepa.org.uk) allows you to look at the pressures, impacts and measures for individual water bodies. If you have comments on particular water bodies, it would be helpful if you could respond in the following format:

- Name and number of water body (from SEPA's website)
- Source of information, such as environmental monitoring data or personal observation
- Summary of information
- Potential measures which can be taken to improve the condition of the water body

Environmental objectives

We would also like your views on our provisional identification of heavily modified or artificial water bodies in the Scotland river basin district and their ability to achieve the Water Framework Directive's environmental objectives (see section 12.3).

Map 19 shows the results of applying the screening tool to each water body provisionally identified as heavily modified. You can look at these water bodies in more detail on the interactive map (www.sepa.org.uk).

- Are there water bodies that have been identified as heavily modified or artificial which you believe could achieve good ecological status?
- Are there water bodies that have not been identified as heavily modified or artificial that you believe should be designated?

2.2 How to respond

You can respond:

In writing: Significant Water Management Issues team
Scottish Environment Protection Agency (SEPA)
Clearwater House
Heriot Watt University Research Park
Avenue North
Riccarton
Edinburgh
EH14 4AP

By email: rbmp@sepa.org.uk

Via our website: www.sepa.org.uk

With regard to your response we will comply with the requirements of the Data Protection Act 1998 and use the information you provide only for this consultation. It will not be used, retained or distributed for any other purpose.

We will publish a digest of responses from this consultation on our website (www.sepa.org.uk) with details of how we will address issues raised. Please advise us if you wish your response to remain anonymous or not be attributable in the digest.

There will be no final publication of this consultation. Many issues will therefore need to be addressed through the river basin planning process.

2.3 Keeping you informed

The draft river basin management plan for the Scotland river basin district will set out a summary of the proposed measures for wider consideration. The consultation period for the draft plan must begin by 22 December 2008. If you wish to be kept informed about the draft river basin management plan, please register your interest at e-mailing rbmp@sepa.org.uk or contact us at SEPA, Clearwater House, Heriot Watt University Research Park, Avenue North, Riccarton, Edinburgh, EH14 4AP.

3 Introducing the Scotland river basin district

3.1 The Scotland river basin district

The Scotland river basin district (see Map 1) covers around 113,920 km^2 of land and water from Shetland in the north to Glasgow, Ayr and Edinburgh in the south. Around 4.8 million people live in the district, most in the central belt between Glasgow and Edinburgh. The landscape is varied – from the mountainous Highlands and the extensive coastline to the urban and industrial areas around Glasgow and Edinburgh.

The Highlands are mountain ranges of sandstone and granite, rising to Britain's highest mountain, Ben Nevis. Much of the Scottish uplands are characterised by large tracts of blanket bog which are more extensive in Scotland and Ireland than elsewhere in Europe. The oceanic climate and varied topography of the western Highlands and Islands give rise to a diverse and rich botany. The district supports important habitats and wildlife including 235 water dependent Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

Overall, the district has fewer environmental problems than most others in the UK. However, there are significant environmental problems in parts of the district – in particular around the larger population centres of Glasgow and Edinburgh. Although many large rivers and estuaries, such as the Clyde in the west and the Forth in the east, have seen marked improvements over the last 20 years, water quality problems remain. Land use in the north eastern part of the district is largely agricultural, which can give rise to a range of environmental problems.

The Scotland river basin district has a relatively high rainfall in relation to the rest of the UK, particularly in the west. About 90% of water supplies come from surface waters, the remainder from groundwater.

It is the quality of the environment of the district that attracts many tourists and supports particular industrial sectors. There are many excellent salmon rivers in the district and the generally clean waters supports sectors such as aquaculture and whisky manufacture.

More information about the Scotland river basin district is available on the SEPA website (www.sepa.org.uk/wfd/rbmp/index.htm).

3.2 Initial characterisation to assess pressures and impacts on the water environment

The Water Framework Directive requires us to undertake an assessment of the pressures and impacts on the water environment in the Scotland river basin district. The final report of this assessment (Article 5 characterisation report[5]) was published in 2005, following consultation in 2004. This report covers the following aspects of characterisation:

- identification of water bodies and their physical characteristics;
- identification of protected areas;
- assessment of the pressures and impacts on rivers, lochs, estuaries, coasts, groundwater and groundwater dependent ecosystems such as wetlands;
- identification of those water bodies at risk of not achieving the Directive's objectives.

To help prioritise future action, the characterisation and impacts analyses were reported using categories agreed across the UK (Table 1).

[5]www.sepa.org.uk/pdf/publications/wfd/Article_5_Scotland_River_Basin.pdf

Table 1: UK agreed reporting categories

Directive reporting category	UK reporting category	Action
At risk	Water bodies at significant risk (1a)	Consideration of appropriate measures can start as soon as practicable.
	Water bodies probably at significant risk (1b)	More detailed risk assessment to determine whether or not the water bodies in this category are at significant risk.
Not at risk	Water bodies probably not at significant risk (2a)	Focus on improving quality of information in time for second pressure and impact analysis report in 2013.
	Water bodies not at significant risk (2b)	Review for next pressure and impact analysis report in 2013 to identify any significant changes in the situation.

3.3 Further characterisation

We are committed to continually improving and refining the results of characterisation as new data and monitoring results increase our certainty regarding the pressures and impacts operating on water bodies. More information on the reasons for refinement of characterisation and the benefits is given in a report published by the Department for Environment, Food and Rural Affairs (Defra) and devolved administrations (www.defra.gov.uk/environment/water/wfd/pdf/character-nextsteps.pdf).

The main purpose of further characterisation is to provide a more accurate assessment of the pressures and impacts, and therefore better focused and more effective measures. This continued refinement has led to greater certainty as to which water bodies are 'at risk' of not meeting the environmental objectives of the WFD by 2015. It will enable monitoring programmes and the programmes of measures to be correctly targeted and as cost-effective as possible.

Further characterisation work has centred on those water bodies identified as being 'probably at significant risk' (1b) in the Article 5 characterisation report. A greater degree of certainty regarding the status of these water bodies was required to determine whether additional measures are necessary and, if so, what these would be.

Further characterisation methodologies

Before the implementation of the WFD, environmental assessments in Scotland focused on pollution pressures (particularly point source pollution) and were supported by extensive chemical and biological monitoring information. The WFD requires us to consider pressures that have not previously been taken into consideration when assessing the quality of the aquatic environment in Scotland notably abstractions, impoundments and morphological/engineering works.

Since the publication of the characterisation report in 2005, our understanding of the pressures and resulting impacts in the river basin district has improved mainly as a result of monitoring and the introduction of the Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR). In addition standards and classification schemes for some quality elements (e.g. nutrients) have been developed to give us a clearer idea of those water bodies currently failing good status. This has enabled us to refine our assessment of which water bodies are at risk and be more confident in the results.

The additional work on pressures and impacts has reduced our uncertainty surrounding the risk assessments of a number of water bodies. This has resulted in a significant reduction in the number of water bodies 'probably at risk' (1b) with corresponding increases in water bodies 'definitely at risk' (1a), 'probably not at risk' (2a) and 'not at risk' (2b). We intend to further refine the certainty of our risk assessment following additional monitoring and data collection. This should lead to an ongoing reduction in the number of water bodies 'probably at risk'.

Further information on characterisation methodologies can be found in Annex A.

Summary results of further characterisation

Overall, Scotland's water environment is in good condition but a wide range of problems exist at a local level. Assessments indicate that about 40% of Scotland's waters fail the environmental standards required to support good ecology (Table 2).

These impacts include:

- Rivers, lochs, estuaries and groundwater along the east coast, central belt and south west which are polluted by diffuse agricultural pollution;
- Urban rivers polluted by sewer overflows and contaminated run-off from roads;
- Rivers and lochs in the highlands affected by abstractions and the construction of dams for hydropower and drinking water supply;
- Rivers and estuaries where damage to the physical condition (morphology) has been caused by urban development and agricultural intensification across lowland Scotland;
- Estuaries, rivers and lochs where invasive alien species have replaced native species.

This means that the central belt, the east coast and the south west have the poorest environmental quality. Addressing these problems delivers local amenity and recreational benefits to communities which is particularly important for the regeneration of some of our more deprived urban areas.

Table 2: Summary of the length/area and number of water bodies at risk of failing good status in 2007 in the Scotland river basin district

Water category	Length/area at risk of failing good status in 2007 (% of total)	Total length/area of all water bodies	Number of water bodies at risk of failing good status in 2007 (% of total)	Total number of water bodies
River	9,083 km (44%)	20,819 km	828 (41%)	2,008
Loch	633 km^2 (66%)	961 km^2	162 (52%)	309
Transitional	425km^2 (70%)	605 km^2	21 (53%)	40
Coastal	3,025 km^2 (6.6%)	45,796 km^2	53 (12%)	449
Groundwater	20,805 km^2 (31%)	66,567 km^2	142 (52%)	275
Total	**-**	**-**	**1,206 (39%)**	**3,081**

Further information on the results of further characterisation can be found in Annex A.

Detailed information on the pressures and impacts affecting individual water bodies can be found on the SEPA website (www.sepa.org.uk).

3.4 Future characterisation work

Characterisation is an ongoing process: a characterisation and impacts analysis of the river basin district must be undertaken for every river basin planning cycle. Characterisation for the second cycle, which is due to be reported in 2013, will look at which water bodies are at risk of failing the environmental objectives by 2021. This second cycle will be based on information obtained from the new WFD monitoring network and it will be possible to assess the outcomes of measures.

The WFD monitoring network (www.sepa.org.uk/wfd/monitoring) became operational in December 2006 and no results are yet available for use in further characterisation. Monitoring results will be used for characterisation in future river basin planning cycles.

4 Significant water management issues

This section of the report looks at the process of identifying the significant water management issues in the Scotland river basin district (RBD). It introduces the work being undertaken to address these issues and assess whether the measures available are likely to be sufficient. We wish to promote discussion of how to develop further measures to deliver improvements. Detailed discussion of the significant water management issues in the river basin district can be found in sections 6 to 11.

4.1 What are significant water management issues?

The significant water management issues are the pressures acting on the water environment that we think put our ability to achieve the environmental objectives of the Water Framework Directive most at risk.

Issues may arise from:

- ongoing human activity (e.g. farming, abstraction);
- historic human activity (e.g. abandoned mines, contaminated land);
- new development (e.g. increasing demand for drinking water supplies).

The significant issues are those issues that will warrant the most attention at the river basin district level during the first river basin planning cycle (2009-2015).

Significant issues have been identified by considering the following three questions:

- To what extent does the issue impact adversely on the achievement of the Water Framework Directive's objectives for each category of water body in the river basin district?
- To what extent is the evidence that the issue is likely to impact on Water Framework Directive objectives based on sound and substantiated science?
- To what extent will measures already being implemented in the river basin district fail to address current issues by 2015?

The significant issues are identified here at the river basin district level. However, significant issues will differ geographically between the sub-basins and are therefore also presented by sub-basin.

4.2 Identification of the significant issues

We have identified the significant issues in the Scotland river basin district using:

- data gathered for the characterisation report;
- additional data gathered through further characterisation work;
- discussions with stakeholders through the Area Advisory Groups and National Advisory Group.

The pressures recorded against those water bodies that have been identified as being 'definitely at risk' (1a) and 'probably at risk' (1b) have been used to identify the significant issues.

Significant issues have been identified separately for each water body category (rivers, lochs, transitional, coastal and groundwater) because the pressures differ between the water body types. Artificial and heavily modified water bodies (see section 12.3) have been included in the relevant water body category.

The significant issues have been defined in terms of the pressure type and the source (i.e. industry sector or activity) of the pressure. For example, point source pollution from the collection and treatment of sewage, and morphology from land claim, etc. Describing the significant issues at this level of detail has enabled us to identify existing measures and gaps in these measures.

Although a pressure may not impact the entire length or area of a water body, the whole of the water body will fail to comply with good status if the Directive's objectives are not achieved in a significant part of the water body.

Significant issues have been identified in Scotland, in part, by assessing the length (rivers) or surface area (lochs, transitional, coastal and groundwater bodies) of 1a and 1b water bodies impacted by each pressure. The length/area of water bodies impacted by each pressure was calculated for each water body category. Pressures were said to be significant if they impacted:

- more than 15% of the total length of rivers at risk;
- more than 20% of the total area of lochs, transitional, coastal or groundwater bodies.

For the purposes of this report, these percentages have been used as a guide as to what is considered significant. Additional issues have then been added by the advisory groups (see section 1.2).

The characterisation data used to identify the significant issues are provided in Annex B.

4.3 Geographical variation

The significant issues vary across the geographical extent of Scotland due to the differences in land characteristics and population density across the country.

In rural areas, the significant issues tend to relate to industry sectors such as agriculture, forestry, water supply and electricity generation. In parts of the country where there are cities or large conurbations, the significant issues tend to be related to manufacturing industry, the collection and treatment of sewage, and urban development. These areas are also likely to be affected by a greater number of significant issues due to the pressure on the environment from development and human activity.

Significant issues have therefore been identified for the eight sub-basins within the river basin district using the same criteria and methods as for the Scotland RBD. In addition, the Area Advisory Group for each sub-basin was able to add a maximum of three issues which they considered to be significant within the sub-basin. This highlighted issues known to partner organisations to be severe but not necessarily widespread, or if not tackled at an early stage possibly disproportionately expensive to control.

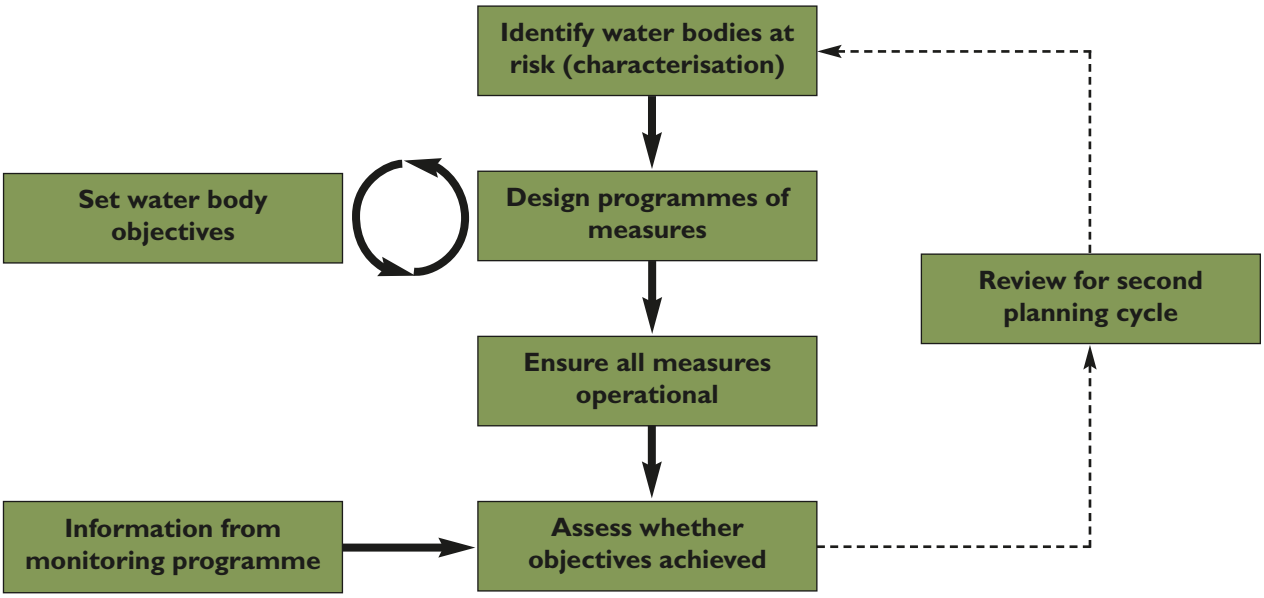
The significant issues identified for each sub basin are given in Annex C.

4.4 What is Scotland doing to address the significant issues?

The WFD requires a programme of measures (PoM) to be established for each river basin district. The measures implemented as part of the programme should enable water bodies to achieve the environmental objectives of the WFD. The PoM must be established by December 2009 and be made operational by December 2012.

The types of measures currently available to address the significant issues are described in section 4.5. It is vital to identify gaps where additional measures may be required at an early stage to allow time to develop and incorporate new measures into the PoM (Figure 2) for the first river basin planning cycle.

Figure 2: The programme of measures cycle



River basin planning requires us to consider all types of pressures on the water environment including those not previously considered in great detail. Consequently, this report identifies some significant issues for which we do not currently have effective management tools. There are also significant issues that have not previously been regulated, notably impoundments and abstractions. We now have the authority to regulate these pressures with the recent introduction of the Controlled Activities Regulations (CAR).

Environmental improvement should be seen as a result of measures coming into effect during the first river basin planning cycle.

All water bodies must meet the Water Framework Directive's environmental objectives. Identification of a problem as a 'significant issue' does not mean the issue is more important than any other issue. The draft and the first river basin management plans will address all the issues in the Scotland river basin district and not just those included here as significant. We hope that by looking first at those issues that cover the most area or length of water we can achieve the most gain.

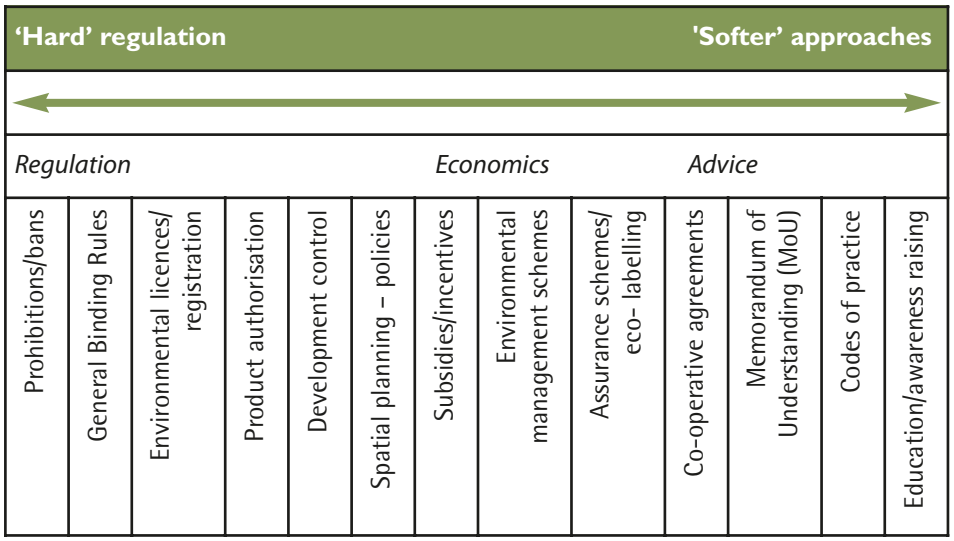
4.5 Development of measures

A measure is an action taken to reduce the negative impact of one or more pressures on one or more water bodies.

The scale and type of measure can vary. In terms of scale, measures can be applied at a variety of levels from a national level down to a single water body. These measures will be delivered by a wide range of organisations and initiatives across Scotland in order to meet the WFD's objectives to achieve good status and to prevent deterioration in the status of water bodies.

For each significant issue we have provided a list of the main measures currently available to mitigate or control the activity or pressure. These measures include UK and Scottish legislation and range from regulations through to guidance, voluntary action and support (Figure 3). For example, much work will be carried out through co-ordination of actions by responsible authorities or through partnership working. These may deliver small-scale environmental projects or large-scale partnership projects but, whatever the scale, all will contribute to delivering environmental improvements.

Figure 3: Continuum of measures



Extra national measures may be required to fill 'gaps in delivery' following the implementation of existing measures. In addition, new pressures may be identified as new and better data become available which will require the development of further national measures. The river basin planning process provides the framework for this second stage of identifying and assessing potential new national measures.

The Area Advisory Groups have contributed to the collation of existing measures through group and one-to-one meetings. We have identified the gaps where additional measures may be required to control each significant issue. Additional measures will be developed between responsible organisations where appropriate at UK, national and local levels.

The advisory groups will play a key role in the development of new measures to address significant issues.

We need to develop a cost-effective combination of measures that bring together the best tools to address a problem. This means thinking about utilising the full range of measures from regulation through to the provision of advice. The intention is to achieve maximum environmental benefits with the minimum financial costs and administrative burden. The river basin management plan has an important role in getting the balance right between the benefits delivered by environmental improvement and the costs imposed on those who use the water environment.

4.6 Measures to prevent deterioration in status

The Water Framework Directive requires measures to be put in place to prevent deterioration in the quality of water bodies. These measures are applied to all water bodies regardless of whether they are currently at risk, the aim being to prevent deterioration in water quality thereby ensuring they continue to meet the required objective.

Much of the operational work undertaken by SEPA and its partner organisations already aims to prevent deterioration in status. The main types of 'no deterioration' measures are regulatory including licences, registrations and General Binding Rules. We promote best practice along with numerous partner organisations in relation to a wide variety of different pressure types, in particular diffuse pollution and morphological activities.

5 Importance of climate change to the water environment

It is not possible to consider significant water management issues without taking climate change into account. This section provides an overview of the impacts of climate change.

The hydrological cycle, a fundamental component of climate, is likely to be altered in important ways by climate change. Changes in the amount, timing and distribution of precipitation and run-off will lead to changes in water availability. Changes in the timing, intensity and duration of floods and dry spells will have environmental, social and economic consequences.

5.1 Observed impacts

Climate change is already evident in Scotland from observed trends in temperature, rainfall and snow cover, higher river flows leading to flood risk, and rising sea levels causing erosion.

Overall, Scotland has become much wetter during the winter since 1961 while areas in the east are becoming drier in the summer months. Winter precipitation has increased by almost 60% in the north and west. Scotland's annual average precipitation has increased by 20%. Analysis of Scottish river flow data indicates an increase in high flow frequencies for western rivers over the past two decades, while in contrast in the east, values were highest in the 1950s and 1960s.

Average spring, summer and winter temperatures have risen by more than 1^{0}C since 1961. Over the same period, the number of days of frost (both air and ground frost) across the country has fallen by over 20% and the growing season length has increased significantly, with the greatest change occurring at the beginning of the season.

5.2 Predicted impacts

The scenarios (UKCIP02)[6] produced by the Hadley Centre (Met Office) and Tyndall Centre are a key component in UK national and regional climate impact assessments. The scenarios are based on four different emissions scenarios (low, medium-low, medium-high and high) based on future carbon dioxide concentrations of 525, 562, 715 and 810 parts per million (ppm) compared with the global atmospheric concentration of approximately 379 ppm in 2005.

Limitations in computing power, our understanding of complex interactions of the climate system and future greenhouse gas emissions mean that we cannot eliminate uncertainty from the model results. However, our ability to predict the likelihood of particular outcomes is improving. The next set of UK climate scenarios (UKCIP08) will encompass a wider range of scenarios in order to quantify uncertainties related to emissions, climate models and the downscaling techniques necessary to derive data that can be used for regional or catchment scale impacts studies.

The predicted major trends for Scotland are for milder and wetter winters with less snowfall, hotter and drier summers, more extreme weather events and rising sea-levels.

UKCIP02 predicted impacts for 2080 are as follows:

- 1.5–2^{0}C warmer in winter, up to 3.5^{0}C warmer in summer and possibly 4^{0}C warmer in autumn. Summers will become warmer with some significant heatwaves.
- Winters will become milder and wetter, with extremes of rainfall leading to serious flooding events.
- Precipitation will increase by over 30% in the east of the country and up to 20% in the west during the winter season. Daily rainfall experienced during the sort of storm that occurs only every two years will increase by at least 20% in winter.
- Precipitation will decrease by around 40% in the summer, particularly in the south and east of Scotland.
- Snowfall across much of Scotland will decrease by over 90%.

[6]See www.ukcip.org.uk and www.metoffice.gov.uk/research/hadleycentre/index.html for more information.

5.3 Consequences for the water environment

Climate change has a wide variety of implications for the environment as summarised in Table 3.

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 chemical pollution. 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, groundwater levels may fall along the east coast during the summer with knock-on consequences for river flows. 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.

Table 3: Summary of the implications of climate change on the water environment

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 beaches and shellfish waters. • Higher intensity rainfall will increase sewer overflow rates, leading to an increase in the discharge of sewage. • Lower summer river flows in the south and east will provide less dilution for discharges, with increased sewage treatment costs. • Enhanced plant/algal growth due to increased temperature will exacerbate the effects of eutrophication.
Abstraction and flow regulation	• Resources for hydropower generation will increase, especially in the west and east. • Increased likelihood of summer droughts will lead to reduced resources but higher abstraction demands (particularly from irrigation).
Changes to morphology	• More frequent and severe river flooding will increase requirements for flood defence schemes • There will be higher rates of river erosion where degradation of the river habitat has reduced bank protection. • Increased erosion from fields will lead to siltation of fish spawning gravels and increased nutrient loading to lochs and the sea.
Biodiversity and invasive alien species	• Higher temperatures may provide more favourable conditions for invasive alien species. • There will be changes in the abundance and distribution of native species and the length of growing season. • Higher temperatures will be less favourable for some native species.

6 Significant water management issues in the Scotland river basin district

6.1 What are the significant water management issues in the Scotland river basin district?

There are a wide range of significant issues affecting the water bodies of the Scotland river basin district. Many of these, such as diffuse pollution from agriculture and point source pollution from collection and treatment of sewage activities, affect a number of water body categories from rivers to groundwater. The significant issues for the Scotland RBD are listed in Table 4; supporting evidence can be found in Annex B.

Table 4: Summary of significant water management issues in the Scotland river basin district

Pressure type	Key sectors
Diffuse source pollution	Agriculture Forestry Urban development Sea and coastal water transport
Point source pollution	Collection and treatment of sewage Aquaculture Manufacturing Refuse disposal Mining and quarrying
Abstraction and flow regulation	Electricity generation Public water supplies Agriculture
Changes to morphology	Historical engineering Agriculture Electricity generation Urban development Land claim
Invasive alien species	All sectors

The most common problems affecting our water environment are pollution, abstraction and modifications to the physical habitat. However it is also important to consider the increasing pressure from the presence of invasive alien species.

The pressures highlighted in Table 4 originate from a range of sectors, as described in sections 7 to 11.

We still do not fully understand the links between some pressures and ecological status resulting from human activity. Similar uncertainty exists in terms of attributing some pressures to sources. This uncertainty will be reduced as further monitoring is undertaken and scientific understanding improves.

There are a number of issues that are significant at the sub-basin level but which have not been identified as significant at a national level. These issues are detailed in Annex C. It is important to recognise these issues and to press through the Area Advisory Groups to ensure they are addressed.

The identification of the significant issues and the associated review of existing measures have enabled us to identify those issues for which there are no appropriate management tools. The following sections provide more detail of the significant issues and what is being done to address them.

6.2 Pollution

Perhaps the most well-known issue affecting the water environment is pollution. Pollution can threaten the quality of all categories of water and during all parts of the water cycle. Pollution means that there is too much of a material (a pollutant) in the water that is harmful to water quality or aquatic plants or animals. A pollutant can be anything from a poisonous metal or pesticide to a nutrient which can choke waters with excessive plant growth, or even silt that can smother fish spawning beds.

Pollution comes from one of two types of sources:

- widespread sources (diffuse pollution), e.g. land use activities such as farming, forestry and urban areas;
- point sources, e.g. pipes discharging effluents from industrial sites, wastewater treatment plants or mines.

The significant issues relating to pollution pressures on the water environment in the Scotland river basin district are listed in Tables 5 and 14 for diffuse and point source pollution respectively.

6.3 Abstraction and flow regulation

Abstraction of too much water can be a problem for both groundwater and surface waters. If we remove too much water for drinking or commercial processes, we reduce the system's ability to dilute and cope with pollution. In extreme cases, river beds can dry up or salt water can be drawn into groundwater.

Dams or weirs, which modify or regulate flow regimes, are often built to support the water abstraction itself; they too can cause problems to waters downstream. In some cases, compensation flows are not provided below dams and the river runs dry. In addition, fish migration over dams may be restricted.

The significant issues relating to abstraction and flow regulation pressures on the water environment in the Scotland river basin district are listed in Table 25. The impacts of abstraction have recently been re-assessed against newly developed environmental standards, but further work is required to assess adequately the impacts of flow regulation on rivers and lochs.

6.4 Changes to morphology

Aquatic habitats are often modified physically to allow people to make use of waters or land. These modifications, often associated with engineering works, can directly remove habitat or indirectly change the natural flow or sediments of our waters. Examples include:

- drainage of land for development, agriculture or forestry;
- construction of flood defences or weirs to control river water levels;
- damming of lochs or loch providing storage for power generation or water supply;
- port developments or construction of coastal defences to prevent flooding or erosion.

The significant issues relating to morphology pressures on the water environment in the Scotland river basin district are listed in Table 33.

6.5 Invasive alien species

Our water environment also faces other threats. Invasive alien species is an example of an increasingly recognised issue. These species are non-native plants or animals that compete with, and may even over-run, our natural aquatic plants and animals.

The significant issues relating to invasive alien species in the water environment in the Scotland river basin district are listed in Table 41.

7 Diffuse pollution

This section describes four types of diffuse pollution identified as significant water management issues. Table 5 lists the lengths or areas of water bodies affected by each issue. The number of water bodies is given in brackets.

Table 5: Significant diffuse source pollution issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	4,025 km (313)	143 km^2 (27)	177 km^2 (10)	973 km^2 (16)	16,946 km^2 (129)
	Forestry	652 km (53)	170 km^2 (21)	–	10 km^2 (1)	–
	Urban development	1,044km (88)	1 km^2 (2)	77 km^2 (4)	98 km^2 (2)	–
	Sea and coastal water transport	–	–	129 km^2 (7)	1,031 km^2 (17)	–
	Total	**5,339 km (446)**	**286 km^2 (48)**	**299 km^2 (16)**	**2,052 km^2 (34)**	**16,946 km^2 (129)**

7.1 Diffuse pollution: 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. Approximately 80% of this area is grassland and is used for livestock farming, particularly the rearing of beef and sheep. Arable farming is also a significant land use, particularly in the east of Scotland. Agriculture depends on the good quality of Scotland's water, air and soil.

Agriculture is about much more than simply producing food. Farming contributes greatly to Scotland's landscapes, tourism, culture and natural heritage. In rural areas, agriculture employs 5% of the workforce and, in terms of gross value added (GVA), agriculture contributed approximately 1.3% to the Scottish economy in 2002. There are also important links between agriculture and other sectors, for example, the food industry.

Agricultural production has increased markedly since the 1950s, driven primarily by the need to boost food production and achieve food security after World War II. Production systems have relied on the use of fertilisers and pesticides, not all of which reach their intended target and can run-off or drain into rivers and groundwater resulting in a deterioration in water quality.

There are significant opportunities and challenges ahead for Scottish agriculture as the focus and level of farm support changes from production to competitiveness, environmental protection and wider rural development. Major opportunities exist in relation to:

- meeting the need for healthy, locally grown food;
- providing habitats to enhance biodiversity and access for recreation;
- addressing diffuse pollution and climate change.

Environmental impacts

Diffuse agricultural pollution arises from land use activities such as livestock grazing, cultivation of land to grow crops and from 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 impact on water quality. Much of this pollution is unintentional and good agricultural practice can help address the problem.

These types of pollutants can be transported to waters by a number of recognised routes. As a result, both land use and run-off management are important in the control of diffuse agricultural pollution.

Diffuse agricultural pollution can have the following types of impact:

- Losses of nutrients from fertilisers, animal manures and slurries applied to land result in the proliferation of plant growth. This can smother rivers and estuaries while, in lochs and coastal waters, plankton reduces light penetration and affects oxygen levels.
- Organic matter from animal manures, slurries and effluent from livestock feeds (e.g. silage) depletes oxygen levels in rivers. This, together with toxic components such as ammonia, reduces the number of animals and plants that can thrive in our rivers.
- Soil erosion can have a direct physical impact by smothering gravels in rivers and lochs, and reducing light penetration in estuaries and coastal waters. It is also important in the transport of other pollutants such as pesticides, nutrients and faecal pathogens attached to soil particles.
- Livestock manures and slurries, and access to watercourses by cattle and sheep, can lead to significant losses of micro-organisms from faecal matter to bathing and shellfish waters. This can affect the amenity value of the water environment and pose a risk to human health.
- Losses of pesticides and veterinary medicines (including sheep dip) during handling, use and washdown can cause severe impacts on plants and animals in rivers and can affect the quality of drinking water.

Diffuse pollution from agriculture is a significant issue for groundwater, rivers, lochs, transitional and coastal waters (Table 6). It is estimated that nearly half of those water bodies at risk of failing to meet the WFD's environmental objectives by 2015 are affected by diffuse pollution from agriculture. In rivers, diffuse agricultural pollution is now the single most important pollution pressure.

There are other rural sources of diffuse pollution, including forestry activities (see section 7.2), although the scale of their impact tends to be localised and smaller in extent.

Map 2 shows water bodies impacted by this significant issue.

Table 6: Extent of the impact of agricultural diffuse pollution in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✔	4,025 km	313
Loch	✔	143 km^2	27
Transitional	✔	177 km^2	10
Coastal	✔	9,73 km^2	16
Groundwater	✔	16,946 km^2	129

Socio-economic impacts

The costs of diffuse pollution from agriculture are met by a wide range of water environment users with the most important affected sectors being water supply, recreational water use, fisheries and shellfish production.

Public water supply

Between 2006 and 2010 Scottish Water will invest £487 million on improving the quality of drinking water and a further £19.4 million on measures to protect drinking water quality. This will improve drinking water quality – primarily from supplies in upland catchments chosen in the 19th and early 20th centuries because of their location upstream of significant sources of pollution. The intensification of agricultural production has introduced sources of pollution upstream of these abstraction points, which has resulted in deterioration in water quality. This, together with increasingly stringent potable water quality requirements, has necessitated the installation of progressively more sophisticated and expensive water treatment in order to protect consumers.

The most important pollutants affecting water supply are:

- microbiological contamination from animal waste;
- nitrate contamination of groundwater supplies;
- nutrients that affect levels of phytoplankton in reservoirs.

Examples of recent investment to address these problems include:

- a new water treatment works (WTW) for Glasgow costing £120 million and the upgrading of Invercannie WTW to address cryptosporidium at a cost of £11 million;
- the construction of a pre-treatment stage at Glenfarg WTW costing £7 million to provide additional treatment for drinking water because of the effects of eutrophication.

In addition, levels of pesticide within water sources can exceed permitted levels (e.g. in the River Ugie). If pesticide levels cannot be reduced consistently through management of their application to land, this will require additional treatment stages (estimated at around £15 million for the Ugie) to achieve acceptable levels.

Private drinking water

Diffuse pollution has a significant impact on drinking water quality in private water supplies. Key contaminants include nitrates, bacteria (e.g. *Escherichia coli*) and pesticides.

Private drinking water supplies in rural areas are often drawn from shallow groundwater wells and springs, which have a greater susceptibility to pollution. In 2001 the British Geological Survey (BGS) found that private supplies had a median nitrate concentration of 50 mg/litre (the maximum permitted in drinking water).

Diffuse groundwater impacts also vary geographically as a consequence of variable nitrate loading, leaching and dilution rates, and groundwater vulnerability. Data from the same BGS study found that 34% of all supplies sampled in the highest risk catchments failed the 50mg/litre limit in Fife; equivalent statistics were 12% for Edinburgh and East Lothian, 27% for Strathmore, 21% for Aberdeenshire Banff and Buchan, and 4% for Moray.

Freshwater fisheries

Freshwater fisheries are estimated to contribute £113 million to the Scottish economy. These fisheries – and the nursery and spawning areas required to support them – are widely affected by diffuse sources of pollution including:

- pollution from pesticides;
- choking of spawning beds with silt;
- the blanketing impacts of enhanced algal growth.

All three of these impacts are widely observed.

Designated shellfish and bathing waters

The shellfish industry contributes an estimated £15 million (first sale value) to the Scottish economy. Production is concentrated in 109 shellfish growing waters designated under European legislation. Standards, including standards for microbiological contamination, are set to ensure that shellfish are safe for consumption and failure of these standards has serious implications for shellfish growers. SEPA considers 60% of these growing waters to be affected by diffuse pollution.

Microbiological contamination from agricultural run-off can have an impact on human health. SEPA is responsible for the monitoring and protection of bathing sites identified under the European Bathing Waters Directive. There are currently 61 designated bathing waters in Scotland and 45% of these are subject to microbiological contamination caused by agriculture. The revised Bathing Waters Directive will become law in 2008 and further designations are anticipated. Some 12–15 sites are known to be possible candidates for additional designation and 50% of these are regarded as at risk from diffuse pollution.

How do we address this issue?

Research on the causes of diffuse pollution has been underway for over 30 years across the world and the main mitigation methods are now fairly well understood. Measures to control diffuse pollution are widely in place across Europe and North America where intensification of agriculture has resulted in similar environmental problems.

In Northern Ireland, regulations have been introduced controlling the use of phosphorus fertiliser to improve the quality of the water environment. In England, Defra's Catchment Sensitive Farming Programme[7] includes a network of catchment officers working with farmers in priority catchments to encourage best agricultural practice to minimise diffuse agricultural pollution.

[7]See www.defra.gov.uk/farm/environment/water/csf/programme.htm

In Scotland, Water Safety Plans (WSPs) will be developed for public water supplies by Scottish Water, in association with SEPA and Scotland's Drinking Water Quality Regulator (DWQR). These will be a planning tool providing protection for public water supplies. These will be aligned with/recognised within the river basin management plan and will support the identification of regulatory action under the Controlled Activities Regulations (CAR).

Economic incentives

Economic and market forces have driven agricultural intensification and the associated changes in technology, as well as advances in plant and animal genetics. Production systems have relied on the use of fertilisers and pesticides, not all of which reach their intended target and can run-off or drain into rivers and deeper groundwater resulting in a deterioration in water quality.

The Common Agricultural Policy (CAP) has historically focused on production without encompassing the environmental objectives of other EU policies. Following the most recent review of CAP, farm subsidies have been de-coupled from the need to produce crops or livestock. Farmers must now comply with certain environmental conditions before payments are made.

The scope for influencing economic drivers has traditionally been limited but, with past and future reform of CAP, this is changing and there is potential for ensuring the environmental objectives of the WFD are met. For example the new Rural Development Contract scheme, if widely implemented, will realise measures for addressing water quality and climate change.

As agriculture moves away from subsidised production, market forces will have an ever increasing role to play. Supermarkets also play a major role in how food is produced and this can help to ensure that food is produced in an environmentally sustainable way via farm assurance schemes.

Regulation

The WFD specifically requires the control of diffuse sources of pollution.

The nature of diffuse pollution is such that traditional regulatory approaches that focus on end-of-pipe control over pollutant loadings are not appropriate. There is no single piece of legislation aimed at mitigating diffuse agricultural pollution. At present the only regulatory controls over diffuse pollution are the Nitrates Directive and the General Binding Rules under CAR, which cover run-off from agricultural steadings.

However, regulation will play its part in controlling diffuse pollution and will need to focus on land management. The Scottish Executive recently consulted on the introduction of 'national' General Binding Rules (GBRs). These GBRs are based on widely accepted standards of good practice and are designed to be a risk-proportionate form of regulation that is free of bureaucracy.

SEPA strongly supports this approach and would like to see the GBRs (effectively a statutory baseline of good practice) implemented as soon as possible. But advice and awareness raising will be required to make them effective. Further targeted controls are also likely to be necessary in certain areas where GBRs are not sufficient to address either the risk or the impacts.

Advice and voluntary action

Advice, guidance and awareness raising on their own are unlikely to achieve the range of contributions to environmental protection and improvement asked of farmers. However, they will be an essential component of the package of measures necessary and will support regulatory practice and approaches.

Although a range of advisory material is available to farmers in Scotland, there is not enough advice delivered to farmers at the farm scale. A significant policy shift is needed to integrate environmental protection into farm support payments. We believe the provision of one-to-one advice via a network of SEPA catchment officers would provide an effective contribution to addressing diffuse pollution. This would help to facilitate the voluntary action already being taken by many farmers to address the issue of diffuse pollution.

Table 7 lists those measures currently available to address diffuse pollution from agriculture and additional measures that could be put in place.

Table 7: Measures to address impacts of diffuse agricultural pollution

What are we already doing about this?	
Regulation	• Nitrate Vulnerable Zone action programmes
Economics	• Farm Assurance schemes • Cross-compliance measures • Rural stewardship schemes
Advice	• Codes of practice and other guidance, e.g. Prevention of Environmental Pollution from Agricultural Activity (PEPFAA) Code,[8] Four-Point Plan,[9] Farm Soils Plan[10] • The Voluntary Initiative[11] • Catchment management plans • Farm advice from non-governmental organisations (NGOs)
What additional measures could we put in place?	
Regulation	• National General Binding Rules • Targeted rules
Economics	• Targeted support via Rural Development Contracts
Advice	• Revised guidance • Catchment officers to deliver one-to-one advice in priority catchments. • Further development of Good Environmental and Agricultural Condition (GAEC) • Pro-active 'on the ground' farm visits to promote compliance and good practice through the provision of advice
What additional measures do you think should be developed? What can you do to help?	

7.2 Diffuse pollution: forestry

By the start of the 20th century forestry cover in Scotland had fallen to below 5%, only half of which was native woodland. In common with the UK, this was the lowest figure in Europe. From the 1930s onwards government policy led to rapid reafforestation, mainly with non-native species, and Scottish forest cover is now 17% of the land area (compared with a European average of 33%).

Concerns over the biodiversity and landscape impacts of what was popularly termed 'blanket' afforestation has led to a change in emphasis, with financial incentives now encouraging greater structural and species diversity through an increase in the use of native species and more provision for open space.

Well-planned, well-managed forests provide a wide array of major social, economic and environmental benefits. They can provide, often simultaneously:

- a sustainable supply of environmentally friendly building materials and other products such as food;
- a source of renewable energy;
- a way of storing carbon;
- a home for wildlife;
- somewhere to play and exercise;
- a place to work or learn;
- more beautiful town and rural landscapes;
- clean air;

[8] www.scotland.gov.uk/Publications/2005/03/20613/51366
[9] www.sac.ac.uk/mainrep/pdfs/fourpointplan.pdf
[10] www.sac.ac.uk/mainrep/pdfs/farmsoilsplandec.pdf
[11] www.voluntaryinitiative.org.uk

- reduced flood risks;
- screens for noise;
- a focus for community cohesion and development.

One of the main water-related interests is the positive role of forestry in helping to mitigate climate change and helping Scotland adapt to it.

The earlier large-scale programme of upland conifer afforestation caused a number of problems for the water environment, including sediment losses. This led to introduction by the Forestry Commission, after extensive consultation, of a set of *Forests and Water Guidelines* in 1988 to address these issues through improved management practices. Regular revisions have ensured the guidance continues to reflect the most recent research and operational experience.[12]

Forestry is now recognised by many as leading the way in developing best practice in land use planning and management to protect water environments. Today's forest management is changing the emphasis from viewing forestry and woodlands as a threat to providing a range of significant benefits for the water environment. One example is the creation of riparian woodland buffers not only to provide wildlife corridors and other ecological benefits, but also to reduce the transport of diffuse pollutants from agriculture to the water environment. Likewise, the role of forestry in environmental protection, such as natural flood management, is being increasingly recognised and developed.

The Scottish Forestry Strategy[13] sets out the Scottish Executive's framework for taking forestry forward in the 21st century and is underpinned by the requirements of sustainable forest management. Within the context of integrated land management, the strategy includes a vision to expand woodland cover to around 25% of Scotland's land area.

Environmental impacts

Environmental impacts from forestry are generally much lower than those from other land uses such as intensive agriculture or urban development. This is partly a result of much lower levels of fertiliser and pesticide inputs, less intensive cultivation practices and the infrequent and smaller scale nature of management interventions associated with forestry.

In addition, the effective application of codes of good practice has transformed forestry practice over the past 20 years. Implementing the measures described in *Forests and Water Guidelines* is recognised as being effective in controlling the majority of water issues, although some problems may remain within highly sensitive catchments.

It is important that no deterioration is allowed in upland catchments as these are often designated under conservation objectives and as drinking water protected areas.

Better integration of farming and forestry at the landscape or catchment scale could make a significant contribution to:

- achieving good water status;
- ensuring no deterioration;
- the sustainable management of the water resource.

The potential risks to water associated with forestry are:

- phosphate input to highly sensitive upland lochs;
- greater scavenging of atmospheric pollutants, which can be significant in extensive, mature forests in upland areas with acid sensitive catchments;
- sediment delivery due to soil disturbance associated with roading, planting and clear felling made worse during heavy rainfall events;
- potential pollution incidents associated with spillages of fuel or chemicals;
- damage to wetlands following drainage of land for forestry;
- damage to the physical structure of rivers due to historic planting too close to them, or poorly sited roads and drainage systems.

[12]The 4th edition published in 2003 is available at www.forestresearch.gov.uk/PDF/fcgl002.pdf/$FILE/fcgl002.pdf
[13]See www.forestry.gov.uk/sfs; the UK Forestry Standard is available at www.forestry.gov.uk/pdf/fcfc001.pdf/$FILE/fcfc001.pdf and the UK Woodland Assurance Standard at www.ukwas.org.uk

Characterisation data show diffuse pollution from forestry to be a significant issue on lochs (Table 8). These data indicate that over a quarter of the lochs at risk of failing to meet the WFD's environmental objectives by 2015 are affected by forestry related activities. These lochs are upland lochs, which are considered to have high ecological status and are very vulnerable to increased nutrient inputs associated with inappropriate afforestation or felling practices. Typically this type of loch is very rare across Europe and they therefore have considerable biodiversity value. Map 3 shows those water bodies impacted by this significant issue.

Table 8: Extent of the impact of diffuse pollution from forestry in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	652 km	53
Loch	✔	170km^2	21
Transitional	✘	-	-
Coastal	✘	10 km^2	1
Groundwater	✘	-	-

Socio-economic impacts

Clear water upland lochs are one of the components of the Scottish environment which attract tourists and recreational use. Increased nutrient input will result in higher levels of algal growth and algal blooms, reducing both the amenity and biodiversity value of these lochs.

How do we address this issue?

Table 9 lists those measures currently available to address diffuse pollution from forestry and additional measures which could be put in place. The forestry sector has demonstrated that economic incentives and regulatory controls can dramatically reduce the adverse environmental impact associated with forestry activity. However, nutrient losses from forestry to lochs remains a significant issue in some of the more sensitive water ecosystems in Scotland, where small increases in nutrients can have an undesirable impact. Addressing this issue requires spatial planning at a catchment scale so that the establishment of new woodland or changes to the design of existing forests is undertaken such that the impacts on the water environment are not significant. Phasing work so that only a small area is subject to change in any one year will be vital.

There are significant opportunities to integrate forestry with other land uses to help meet the aims of the WFD. Where appropriate, those links have been highlighted in the relevant land use section.

Table 9: Measures to address impacts of diffuse pollution from forestry

What are we already doing about this?	
Regulation	• Effective controls over felling through felling licensing or forest plans • Where appropriate, consideration through the Environmental Impact Assessment (Forestry) (Scotland) Regulations 1999
Economics	• Compliance with the UK Forestry Standard and its associated suite of forestry guidelines as a mandatory requirement of forestry incentives and felling controls
Advice	• Forests and Water Guidelines

What additional measures could we put in place?	
Regulation	• National General Binding Rules • Targeted rules
Economics	• Ensuring that compliance with the UK Forestry Standard (and hence the Forests and Water Guidelines) becomes a cross-compliance requirement within Rural Development Contracts • Use of Rural Development Contracts to support forest planting to protect water quality e.g. riparian woodland and shelter belts
Advice	• Phasing of land use change in the catchment of sensitive lochs
What additional measures do you think should be developed? What can you do to help?	

7.3 Diffuse pollution: urban development

The majority of Scotland's old towns and cities are served by combined sewerage systems designed to convey both wastewater and surface water run-off within the same pipes. These systems were designed to allow excess flows caused by heavy rainfall to be discharged through combined sewer overflows (CSOs). At the time it was thought that the rainfall would dilute the wastewater enough not to cause significant pollution to the receiving waters. It is now understood that combined sewers can cause significant pollution (see section 8.1). Therefore new urban developments are now served by separate systems, one conveying wastewater to be treated before discharge and another conveying surface water run-off to receiving waters.

Many studies have shown that pollution entering the surface water system comes from different sources including roads, pavements, roofs and yards. As a result of rainfall, pollutants are scoured from urban surfaces and flushed through the surface water sewers. Although these sources may be individually minor, they are collectively significant. This form of diffuse source pollution has been identified as a major adverse impact in urban streams and rivers.

Much of the contamination of urban surfaces comes from road run-off and is associated with cars and other road vehicles. Although cleaner technology is being developed for cars and other vehicles, the volume of traffic on the roads continues to rise, undoing any benefits. Pollution does not simply arise from contaminated run-off as rainfall washes pollutants from the air and scours deposited material off impervious surfaces.

Many people are unaware of the type of drainage system serving their homes or work places. Pollution can occur when chemicals or waste oil or other polluting materials are illegally disposed of 'down the drain' directly into watercourses (albeit often without an intent to cause pollution) on a site with separate sewerage systems.

Keeping surface water run-off separate from wastewater through use of two different drainage systems is essential to limit the amount of polluted effluent discharged untreated from CSOs during heavy rain. However, urban run-off is polluting and needs to be treated before being discharged.

Environmental impacts

Diffuse pollution from urban areas includes the following.

- The main pollutants are toxic metals, oil and other hydrocarbons such as polyaromatic hydrocarbons (PAHs) which are associated with hydrocarbon spills and especially with the combustion of hydrocarbons. These coat river beds with a toxic film which kills invertebrates and fish.
- Herbicides used to control weeds along roadsides and pavements, and spillages of domestic pesticides kill plants in rivers.
- Pollution can also occur when foul drainage is mistakenly and/or illegally connected to the surface water drainage pipe instead of the foul drain, and therefore is conveyed directly to the nearest watercourse without treatment. This is compounded by waste washed from the streets. The result is bacterial contamination and low oxygen levels caused by the breakdown of organic matter.

The impacts of urban run-off on groundwater are not well understood as there are no groundwater monitoring sites under urban areas. It is currently thought that most pollutants from urban areas adhere rapidly to particles and will therefore be held within the soil.

Diffuse pollution from urban development has been identified as a significant issue on rivers and coastal water bodies (Table 10). Map 4 shows those water bodies impacted by this significant issue.

Table 10: Extent of the impact of urban diffuse pollution in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✔	1,044 km	88
Loch	✘	1 km^2	2
Transitional	✘	77 km^2	4
Coastal	✔	98 km^2	2
Groundwater	✘	-	-

There are other impacts of urban run-off which are not associated with pollution. These result from the rapid run-off of rain straight into drains and to rivers. When rain falls on an area with permeable surfaces such as fields, water can soak into the ground and percolate through it gradually allowing rivers to rise slowly. It is only after persistent and heavy rain when the ground is saturated that water flows directly over the surface into rivers. In cities, where water cannot infiltrate because of the extent of impermeable surfaces such as roads and paved areas, the rapid overland run-off causes rivers to rise quickly increasing the risk of flooding. This is a major problem in low-lying urban areas. The speed of the run-off may also have a physical impact on rivers. River gravels, which could be used for fish spawning, are washed away and river banks eroded.

Socio-economic impacts

The vast majority of Scotland's population lives in urban areas where rivers have high amenity potential and can form the focus of urban regeneration. However, pollution from urban run-off can have a major impact on these watercourses. In some areas, particularly those subject to social deprivation, pollution of watercourses contributes an impression of decay and neglect. The rapid run-off from urban areas also contributes to the flooding of properties.

How do we address this issue?

The expansion of urban areas over the past 20 years has increased the impacts of urban run-off. Substantial progress has been made recently to halt the pollution from urban areas and to start the process of addressing existing problems.

Sustainable urban drainage systems (SUDS) are a vital tool that can be used to address the issue of both the quantity and quality of run-off while providing amenity value. SUDS aim to 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.

New developments

Developers are increasingly accepting the use of SUDS to control run-off. SUDS are promoted in Planning Advice Notes[14] (increasingly required as part of local authority development plans) and since 1 April 2006 have been required for all new developments under the Controlled Activities Regulations. For SUDS draining two or more properties, historic problems of securing long-term maintenance have been addressed by providing for Scottish Water to adopt public SUDS under the provisions of the Water Environment and Water Services (Scotland) Act 2003.

SUDS are most effective when dealing with pollution at source before the pollution enters the water environment.

[14]See www.scotland.gov.uk/library/pan/pan-cover.asp

This is particularly so when addressing sometimes highly polluted road run-off. The roads authorities are responsible for road drainage until this is connected to the public sewerage system and SUDS (e.g. swales or filter trenches) should be used to reduce the pollutant load ultimately conveyed by the public drainage system.

Existing developments

The historical pollution from urban drainage will take many decades to address. The strategy for improving watercourses already impacted by urban drainage is to:

- find economic options to retrofitting SUDS into existing urban areas;
- improve awareness of drainage systems generally to help change behaviour in relation to the disposal of wastes.

Scottish Water has agreed to build new SUDS to address the worst cases of surface water pollution (mainly from industrial estates).

Retrofitting of SUDS to large surface water drains offers one mechanism to address the problem. However this approach has some constraints, particularly the area of land required to provide effective treatment. The introduction of source control (management of a pollutant at or near its source) is the most effective means of addressing existing and future pollution and flooding problems. The approach of reducing pollution and run-off at source is also critical if the volumes of surface water flowing to sewer causing premature operation of sewer overflows are to be reduced to a more sustainable level (see section 8.1).

For these reasons, it is important to take a holistic approach to the management of surface water drainage through the development and implementation of integrated and sustainable surface water management plans. These should consider how best to address the issues surrounding the conveyance of surface water including pollution, flooding, amenity, health, ecological and physical impacts.

Surface water management plans are an important tool in the planning of new developments and the redevelopment of existing urban areas. Surface water management plans are also important in urban planning and redevelopment. This involves:

- the use of permeable surfaces in areas not subject to heavy traffic;
- the use of swales and filter trenches to treat road run-off;
- the use of open spaces to store flood water during heavy rain to hold back pollution and minimise flood risk.

Table 11 summarises those measures currently available to address diffuse pollution from urban development and additional measures that could be put in place.

Table 11: Measures to address the impact of diffuse pollution from urban development

What are we already doing about this?	
Regulation	• Local authority development plans require SUDS • Local authority development control enforces the requirements for SUDS • General Binding Rule under Controlled Activities Regulations (CAR) requires all new surface water discharges to be treated by SUDS
Economics	• Scottish Executive is to develop a scheme of drainage charges based on the amount of impermeable area draining to sewer • Scottish Water is provided with funds under Quality and Standards to retrofit SUDS to surface water systems in industrial estates
Advice	• Scottish Water's technical manual specifies design requirements for SUDS
What additional measures could we put in place?	
Regulation	• Promote source control of polluted road drainage before its discharge into the public drainage system
Advice	• Promote the development of integrated surface water management planning in major urban areas • Pollution-reducing campaigns involving the National Advisory Group and Area Advisory groups
What additional measures do you think should be developed? What can you do to help?	

7.4 Diffuse pollution: sea and coastal water transport

Operations and traffic in Scottish coastal waters are diverse and associated with:

- ferries;
- container, bulk goods and general cargo transport;
- oil and coal;
- leisure and fishing.

Much of the cargo entering and leaving Scotland's ports is in the form of raw materials such as oil, chemicals, petroleum, ores, grains and foodstuffs. Finished goods include vehicles, fresh foods, steel, timber, building materials, machinery and manufactured goods.

Ship traffic makes a contribution to solving national transport problems by decreasing road congestion and the environmental damage caused by land-based transport.

The two largest ports in Scotland in terms of the amount of freight traffic are those in the Forth and at Sullom Voe. Other major Scottish ports are those in the Clyde and Cromarty Firth and at Orkney, Glensanda and Aberdeen. Ports are often at the heart of their local community. They are major providers of employment within their areas. Many also contribute to local economies through leisure activities such as yachting, sightseeing, angling and diving.

Environmental impacts

Like many forms of transport, shipping traffic can cause diffuse pollution of our waters. Diffuse pressures arise from anti-foulants used to prevent fouling of hulls by marine organisms, accidental releases of oil when ballast water is discharged or bilges are cleaned and from ship wrecks. The impacts from dredging and dredge spoil disposal are considered elsewhere.

The main impacts caused by shipping are as follows:

- Chemical contamination resulting from the release of antifouling compounds can be toxic or have sub-lethal effects on marine invertebrates. Tributyl tin (TBT) is the main anti-foulant of concern. It is a powerful endocrine disrupter and has been shown to make dog whelks infertile at concentrations below the analytical limit of detection and affect oyster flesh production.
- Oil released from ships can have a toxic or smothering effect on marine invertebrates and plants. Larger vessels such as a container ships or oil tankers take on ballast water when unloading cargo. The process involves pumping seawater into compartments in the hull to maintain the ship's stability. Before the vessels are loaded they discharge the seawater from these compartments. Problems can arise where the ballast water being discharged contains invasive alien species, oils or other chemical contaminants.
- Oil pollution can result from accidents such as the grounding of vessels and from historic ship wrecks.
- Litter from vessels makes a significant contribution to the debris washed on our shores.

These pressures can have widespread impacts, but may not always affect coastal water bodies as a whole.

Characterisation data indicate that approximately a third of transitional and coastal water bodies at risk of failing to meet the environmental objectives of the WFD are affected by diffuse pollution from sea and coastal water transport (Table 12). Map 5 shows those water bodies impacted by this significant issue. This assessment does not include the impact of litter.

Table 12: Extent of the impact of diffuse pollution from sea and coastal water transport in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	-	-
Loch	✘	-	-
Transitional	✔	129 km^2	7
Coastal	✔	1,031 km^2	17
Groundwater	✘	-	-

Socio-economic impacts

Adverse impacts are largely associated with recreation and tourism. Oil spills affect recreational sports such as sailing and surfing, while litter problems affect the enjoyment of beaches and impose clean-up costs on local authorities.

How do we address this issue?

Tributyl tin (TBT)

The ban by the International Maritime Organisation (IMO) on the use of TBT anti-foulants on vessels <25 m came into effect in 1989. This has led to considerable environmental improvements along parts of the Scottish coastline as measured by imposex levels in dog whelks. There are still some downgraded areas (based on monitored imposex levels), but these are now near major ports where larger ships operate. It is hoped that the later ban for ships >25m in 2003 will result in an improvement with time in these downgraded areas. The IMO ban means that, from 1 January 2008, any ship painted with TBT will be refused entry into Scottish and other European ports (even if the vessel is flagged in the European Union).

Oil and other contaminants

The introduction of Port Waste Management Plans in 1998 and the Merchant Shipping and Fishing Vessels (Port Waste Reception Facilities) Regulations 2003 has led to significant improvements in the quantity of oils and other contaminants being released to coastal waters from vessels. The continued enforcement of these regulations and further education of boat users will seek to continue this improvement. The implementation of the IMO's International Convention for the Control and Management of Ships' Ballast Water and Sediments will be supported as an effective means of controlling pollution from ballast water discharges.

SEPA considers that marine litter is an important environmental issue although it does not fall within the scope of the WFD. The basin planning process may provide a suitable forum to address this issue.

Table 13 lists those measures currently available to address diffuse pollution from sea and coastal water transport and additional measures that could be put in place.

Table 13: Measures to address the impacts of diffuse source pollution from sea and coastal water transport

What are we already doing about this?	
Regulation	• IMO ban on use of TBT on vessels <25 m (1989) • IMO ban on use of TBT on vessels >25 m (2003) • IMO complete ban on TBT treated vessels in European ports (2008) • The Merchant Shipping and Fishing Vessels (Port Waste Reception Facilities) Regulations 2003
Advice	• Ballast Water Management Plan for NW Europe: guidelines for vessels entering the OSPAR region (2007)
What additional measures could we put in place?	
Regulation	• IMO's 'International Convention for the Control and Management of Ships' Ballast Water and Sediments' made into legislation
Advice	• Promote better use of port waste reception facilities through greater understanding among mariners of effects of discharging oily wastes at sea
What additional measures do you think should be developed? What can you do to help?	

8 Point source pollution

This section describes five types of point source pollution identified as significant water management issues. Table 14 lists the lengths or areas of water bodies affected by each issue. The number of water bodies is given in brackets.

Table 14: Significant point source pollution issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Point source pollution	Collection and treatment of sewage	3,015 km (230)	88 km^2 (15)	369 km^2 (14)	2,417 km^2 (34)	-
	Aquaculture	145 km (15)	134 km^2 (23)	-	37 km^2 (3)	-
	Manufacturing	342 km (32)	14 km^2 (1)	190 km^2 (8)	1,279 km^2 (14)	2,460 km^2 (7)
	Refuse disposal	147 km (16)	-	123 km^2 (3)	230 km^2 (2)	4,510km^2 (14)
	Mining and quarrying	363 km (36)	-	-	-	6,428km^2 (14)
	Total	**3,488 km (287)**	**196 km^2 (34)**	**421 km^2 (16)**	**2,250 km^2 (42)**	**9,697 km^2 (29)**

8.1 Point source pollution: collection and treatment of sewage

Sewage is a mixture of water from domestic sources (baths, sinks and washing machines), water and human waste from toilets, industrial effluents and, in many catchments with older infrastructure, rainwater run-off from roofs, roads and other surfaced areas. In most areas, sewers are constructed to collect wastewater and convey it to sewage treatment works (STWs).

There are two main types of sewerage systems.

- Surface water sewers take rain run-off from roads, yards and roofs. They often discharge this without treatment to the water environment (see section 7.3 on urban diffuse pollution).
- Combined sewers convey domestic sewage, trade effluent and some rain run-off to STWs. The volume of sewage in combined sewers increases considerably during wet weather; if they become full during heavy rain, they are designed to overflow diluted screened, settled or untreated sewage in order to protect homes, properties and STWs from flooding.

Sewage disposal is a long-standing source of pollution which has progressively improved over the past hundred years. The most serious problems are now associated with the sewers, which often date back to Victorian times. During heavy rain these sewers overflow into rivers causing pollution. During prolonged periods of heavy rain, some sewers back up and contribute to flooding of urban areas.

Treatment at STWs is designed to remove pollutants. Some of the pollutants are broken down by bacteria to harmless constituents. However, persistent hazardous substances cannot be broken down and either pass through the STW or are removed from the wastewater into the sludge left after the biological treatment. These contaminants then create problems for the reuse of the sludge.

The public collection and treatment of wastewater is provided by Scottish Water. Public sewage treatment works serve 96.3% of the 4.8 million people in the Scotland river basin district. There are about 1,693 STW and 3,276 combined sewer overflows (CSOs) in the Scotland RBD. The public sewerage system causes most of the impacts associated with wastewater discharge. There are also localised environmental problems in rural areas caused by sewage from scattered houses, small hotels and industry which are typically treated by septic tanks or small treatment works.

Scottish Water's sewerage systems are only part of the drainage network (see section 7.3). Local authorities have drainage systems for roads, which sometimes feed into the sewerage system. Small rivers can be engineered into culverts (particularly in urban areas) and run into the drainage system. In large urban areas, in particular, there is interaction between these elements.

The management of surface water drainage is critical to a successful solution to the problems of both pollution and flooding. All aspects of the drainage network need to be taken into account when considering its development. Solutions to pollution (quality) problems in the sewerage network need to be linked to flooding issues – the two cannot be addressed separately.

Environmental impacts

Untreated wastewater is polluting.

- The organic matter present removes oxygen from the water killing fish and other aquatic wildlife.
- The nutrients present encourage algae to grow to nuisance levels, smothering fish habitats and requiring expensive treatment of water abstracted for industrial or domestic use.
- Toxic substances from industry, household chemicals and road run-off in the sewage do not degrade and accumulate within fish and marine mammals.
- Sewage-related debris can affect the amenity value of rivers and beaches. It can also cause damage at treatment works.
- Bacteria and viruses in the sewage can cause health problems with water contact sports such as swimming, canoeing or fishing.

Pollution caused by inadequately treated sewage is the second most important source of river pollution and the most important for transitional and coastal waters. Of Scotland's river, transitional and coastal water bodies at risk of failing to meet the Water Framework Directive's environmental objectives, over a third are affected by point source pollution from the collection and treatment of sewage activities. Table 15 shows the extent of this issue within the river basin district. Map 6 shows those water bodies impacted by this significant issue.

Table 15: Extent of the impact of point source pollution from collection and treatment of sewage activities in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✔	3,015 km	230
Loch	✘	88 km^2	15
Transitional	✔	369 km^2	14
Coastal	✔	2,417 km^2	34
Groundwater	✘	-	-

Socio-economic impacts

Pollution from sewage and rain run-off tends to be located near urban areas where the water environment can have a high amenity value for many people. Rivers polluted with sewage lose their value as a community asset and, in extreme cases, may represent a health hazard.

More housing means more sewage and new impermeable surfaces resulting in increased run-off. It is important to consider the effects on the existing network and the environment at the planning stage. Limits on the capacity of some sewerage networks or treatment works means it is not always possible to allow new developments to connect to the sewerage system. This constraint can pose a major barrier to development, jeopardising the regeneration of areas. However Scottish Water has received funding since 2006 to provide strategic capacity at water and sewage treatment works. Constraints then transfer to the capacity of the network to accept more wastewater without

causing an increase in flooding. It is the developer's role to pay for the upgrading of the network to accommodate any extra wastewater input due to their building project.

In the absence of a connection to Scottish Water's sewers, developers can request permission to build independent private sewers and treatment works. However, SEPA considers the proliferation of private systems in urban areas to be inappropriate. This is because such systems cannot provide the equivalent level of environmental protection to that offered by an integrated public system.

How do we address this issue?

Investment in Scottish Water's assets

Investment in Scottish Water's sewers and treatment works is the main mechanism to address pollution caused by wastewater. This investment is delivered via a public planning process called Quality and Standards, which determines the investment objectives in the context of ministerial decisions on the scale of charges that can be afforded by customers.

Over the past ten years significant progress has resulted in improved water quality at fisheries, bathing waters and shellfish waters. Current projects to enhance Scottish Water's network will contribute toward the achievement of WFD objectives with improvements to nearly 1,000 km of rivers and coastal waters during the current Quality and Standards period which ends in 2014.

The considerable historical backlog of investment requirement in combined sewerage networks means that only some of the environmental problems can be addressed in any one investment period. For example, solving Glasgow's drainage problems alone (of which the sewerage system is a part) is expected to cost over £1 billion.

The rate at which Scotland can address these issues depends on the charges we are prepared to pay. Household charges were standardised across Scotland following the formation of Scottish Water in 2002; the average household charge increased by approximately 25% up to 2006. During the current regulatory period (2006-2010), charges to household and business customers are expected to increase by less than inflation.

Controlling pollution at source

Source control is the management of a pollutant at or near its source. Reducing pollution at source reduces the costs associated with its treatment and produces environmental benefits. This is especially true for hazardous substances, nutrients and sanitary litter. For example, not using certain substances in domestic products (e.g. removing phosphates from detergents) reduces the need for treatment to remove them from sewage and reduces their concentration in sewage sludge. The '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 STWs.

Reducing flooding and pollution

As well as reducing the amount of pollution entering the sewerage network it is also vital to reduce the amount of rainfall run-off entering it. This will help to reduce the frequency of flooding incidents associated with CSOs and sewers overflowing. The run-off from roads and yards is polluted with oils, hazardous substances and bacteria. Sustainable urban drainage systems (SUDS) (see section 7.3) have been developed which treat this run-off allowing its discharge to rivers or, in some areas, canals.

The development and implementation of integrated and sustainable surface water management plans (see section 7.3) enable a holistic approach to the management of surface water drainage.

In the Netherlands and parts of Germany environmental targets have been set for storm water capacity and reduction in sewer loading through the disconnection of paved and roof areas from combined sewers. Scotland does not currently make much effort to address these issues and SEPA believes targets for reducing run-off to sewers should be developed in problem catchments.

Human health

Removal of pollutants through pollution control has led to improvements in the quality of rivers and coastal waters. However standard treatment methods do not generally remove bacteria and viruses. To meet the standards set by the Bathing Water Directive, SEPA requires the disinfection of wastewater discharging at sites designated as bathing waters (particularly where there are significant levels of human activity).

Providing disinfection at all STWs in Scotland would be extremely expensive and energy-intensive, which in turn would result in higher emissions of carbon dioxide (a major greenhouse gas). The approach taken to disinfection therefore needs to be balanced and targeted at those areas of highest need.

Table 16 summarises those measures currently available to address point source pollution from collection and treatment of sewage activities and additional measures that could be put in place.

Table 16: Measures to address the impacts of point source pollution from collection and treatment of sewage activities

What are we already doing about this?	
Regulation	• SEPA controls on wastewater discharges to rivers, lochs, etc. • Scottish Water controls on trade effluent discharges to sewer • Statutory controls over use of polluting substances in products
Economics	• Scottish Water charging scheme provides incentives for industry to reduce the amount of trade effluent they discharge to sewer
Advice	• Pollution reduction campaigns (Scottish Water) • Environmental best practice campaigns for industry
What additional measures could we put in place?	
Regulation	• Control of domestic products with regard to their impact on the environment (e.g. low phosphorus detergents)
Economics	• Scottish Executive to review scheme of charges to provide incentives to reduce the amount of rainfall run-off passing to sewer
Advice	• Develop integrated surface water management plans for all urban areas • Pollution-reducing campaigns involving the National Advisory Group and Area Advisory Groups
What additional measures do you think should be developed? What can you do to help?	

8.2 Point source pollution: aquaculture

Over the past 20 years commercial aquaculture in Scotland has become a successful and significant economic sector. It is now estimated to contribute over half the value of food exports from Scotland. Scottish salmon represents a high value product which sells at a premium compared with competing products from other nations and trades on the good reputation of Scotland's environment.

The aquaculture industry is an important employer especially in the Western Isles, Shetland Islands and the rural north and west. Although estimates of the numbers of jobs dependent on aquaculture vary, several thousand people are employed directly and indirectly in the industry. These jobs are particularly important in sustaining the economic viability of these regions.

In terms of volumes of production, the most significant component is salmon farming in marine cages. This rose from about 5,000 tonnes of production per year in the 1980s to around 150,000 tonnes/year in 2006. The average size of a marine fish farm also increased in size from about 85 tonnes biomass in 1985 to around 1,000 tonnes biomass in 2006.

The production of eggs and young fish requires freshwater facilities. These consist of hatcheries and cages in freshwater lochs, with the stock being moved to sea cages to complete their growth cycle.

In addition to the production of young salmon, there is a significant freshwater industry in the form of land-based tank farms and cage sites in lochs producing rainbow trout and, in some cases, brown trout for the table and restocking of game fisheries.

There is also a small but growing industry producing marine fish (primarily cod) but also small quantities of other species such as halibut and haddock. Arctic charr have also been grown on a small scale at freshwater sites.

Environmental impacts

Fish farms have a range of environmental impacts which vary depending on:

- whether the farm is sited in coastal or inland waters;
- whether the fish are produced in cages or within hatchery or tank-based premises.

Licensed discharges from hatcheries are generally treated before release to the river, thus reducing their impact. Waste and effluent from cage fish farms are discharged without treatment. However, hatcheries may affect river flows as a result of the abstraction of water from the river into their premises.

The main impacts of the effluent from fish farm premises are as follows.

- Natural processes break down organic material present (waste food and faeces), reducing oxygen concentrations in the water.
- The organic matter deposited on the seabed leads to significant changes in the animal and plant populations in the vicinity of the fish farm.
- Dissolved nutrients from the food and faeces may result in increased aquatic plant and algal growth. As a result, lochs turn green and face greater risk of algal blooms.
- Chemicals used to treat disease and parasites may have a toxic impact on wildlife in the vicinity of fish farms.
- Diseases, parasites and escapes from fish farms could have an adverse impact on native fish populations.
- Litter and redundant equipment from fish farms contribute to the debris found on Scottish beaches.

The most important impacts associated with marine cage farms arise in part from the locations and sites at which the industry initially developed. The marine aquaculture industry was founded at sites in sheltered sea lochs where stresses on the early cage designs caused by wind and waves were reduced. In some cases these farms have progressively expanded to a size where further development is now prevented because the scale of their impact on the seabed or on migratory salmonids has become apparent.

The significant water management issue associated with freshwater aquaculture is the input of nutrients into lochs. One fifth of the area of freshwater loch water bodies at risk of failing to meet the environmental objectives within the Scotland river basin district are impacted by point source pollution from fish farms and fish hatcheries (Table 17). These nutrients may cause changes in loch ecology, for example, increased algal production leading to an increased risk of algal blooms. Algal production and algal blooms can be natural seasonal features of water bodies; the important issue is the degree of primary productivity appropriate for specific water bodies. Many upland lochs are considered to have high ecological status and are very vulnerable to increased nutrient inputs. This type of loch is very rare across Europe and they therefore have considerable biodiversity value.

Map 7 shows those water bodies impacted by this significant issue.

Table 17: Extent of the impact of point source pollution from aquaculture in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	145 km	15
Loch	✔	134 km^2	23
Transitional	✘	-	-
Coastal	✘	37 km^2	3
Groundwater	✘	-	-

*The scale of the effect of fish parasites on migratory salmonids has not been defined and is not included.

Socio-economic impacts

The aquaculture industry provides many direct and indirect jobs. It can also affect the recreation and amenity value of the inland water environment. Game angling for salmon and sea trout is an important component of the Scottish rural economy, but it depends on good water quality and the presence of sustainable flows in the breeding streams. Increased nutrient inputs into freshwater lochs and rivers and escapes of non-native fish may potentially affect such fisheries. The industry may also affect the use of freshwater sites by other leisure sectors (e.g. nutrient discharges increasing the probability of algal blooms).

Marine salmon farms may also affect the recreation and amenity value of the coastal water environment for anglers, divers, yachtsmen and windsurfers through:

- impacts on the seabed;
- the potential to enhance algal blooms;
- the effect of diseases, parasites and escapes on wild fish populations.

In certain cases such farms also compete for space on the coast with yachtsmen and inshore fishermen.

How do we address these issues?

Marine cage fish farms

Considerable advances in technology now allow cage fish farms to be developed in more exposed locations and new large farms now tend to be sited further off-shore in less sheltered locations. This minimises their environmental impacts because the dilution and dispersion of effluents and the residues of any medicines are more effective at such sites. Such sites are also often further from rivers important for migratory salmonids, a move which may reduce the interaction between wild populations and lice from farmed salmon.

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*[15] advises on this and best practice guidance is being prepared on the future location of finfish and shellfish 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. In recent years, however, 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. Impacts have thus been minimised without a cessation of production and the loss of jobs. The mothballing of these 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 formation of the Tripartite Working Group[16] and associated Area Management Groups which have brought together fish farm, wild fishery and public sector interests to negotiate area-based management agreements covering issues such as synchronised sea lice treatments of caged fish and the rotational fallowing of farms or groups of farms.

[15]www.scotland.gov.uk/Publications/2007/03/29102058/0
[16]See www.scotland.gov.uk/Topics/Fisheries/Fish-Shellfish/18677/14220

Freshwater cage fish farms

SEPA uses the results of modelling the likely effects of discharges of nutrients on the loch where the farm is sited to limit the size of the farm and its level of production to ensure its discharges will not lead to deterioration in the nutrient status of the loch. However, some fish farms were licensed before 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 and better feeding systems.

Freshwater lochs have a very limited capacity to accept nutrients. Fish cages discharge effluent without treatment and therefore represent an inefficient use of this capacity. SEPA consequently recommends development of land-based fish farms where pollutants can be removed from the effluent before it is discharged to lochs.

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. 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 fish farms. Similarly, limiting future development of farms to these rivers could significantly constrain development of the industry and its potential economic contribution to rural Scotland. This would result in an increase in fish imports with the probable increased risk of the introduction of disease and parasites (including such threats as *Gyrodactylus salaris*). There is, therefore, a difficult judgement to be made over the extent to which deterioration in some lochs is acceptable.

It is recognised that immediate closure or removal of existing fish farms from lochs is not a sensible way forward. An initiative to conduct strategic development planning along similar lines to the marine sector Location/Relocation programme[17] may offer a sensible way to move forward with this sub-sector. Any consideration of this proposal should include all sectors that input nutrients to the freshwater environment.

Table 18 summarises those measures currently available to address point source pollution from aquaculture and additional measures that could be put in place.

Table 18: Measures to address impacts of point source pollution from aquaculture

What are we already doing about this?	
Regulation	• To protect the local environment, a SEPA licensing regime places limits on the rate or scale of discharges from fish farms • To protect the wider water body, SEPA applies an assimilative capacity approach under Scottish Executive Locational Guidelines[18] following advice from Fisheries Research Services (FRS)
Economics	• Quality assurance schemes run by the industry
Advice	• Area management agreements have been developed leading to loch-wide treatment plans for sea lice • Code of Good Practice for Scottish Finfish Aquaculture[19]
What additional measures could we put in place?	
Regulation	• Local authorities can use new planning controls over the location of new farms to minimise conflicts with other users and deal with landscape issues, etc. • The Aquaculture and Fisheries Act 2007 gives the Fish Health Inspectorate powers to monitor fish farms for adequate sea lice control and prevention of escapes
Economics/ regulatory	• The Tripartite Working Group is to develop environmental risk assessment of sites so that economic support and regulatory action can be directed at relocating a prioritised list of sites • Initiative to conduct strategic development planning for freshwater along similar lines to the marine sector location/relocation programme
What additional measures do you think should be developed? What can you do to help?	

[17]See www.scotland.gov.uk/Topics/Fisheries/Fish-Shellfish/18364/12843
[18]See www.scotland.gov.uk/library2/doc06/mff-00.htm
[19]www.scottishsalmon.co.uk/dlDocs/CoGp.pdf

8.3 Point source pollution: manufacturing

The level of water pollution from manufacturing has decreased dramatically over the past 40 years primarily due to the decline of heavy industry in Scotland and powerful regulatory controls. In addition, industry has progressively taken a proactive approach by developing environmental management systems which can deliver improved environmental performance and often cost benefits.

The remaining impacts caused by direct discharges from manufacturing are associated with the chemicals and food and drink sectors. Environmental impacts are partly a consequence of current operations and partly the result of historical operations which have contaminated sediments.

Environmental impacts

Inadequately treated industrial discharges can result in the following impacts:

- The high levels of organic matter in the discharges consume oxygen as they degrade, reducing the levels of oxygen in the receiving waters.
- The levels of dissolved metals and hazardous organic chemicals present can have a direct toxic effect on animals and plants.
- Metals and hazardous/persistent organic chemicals can accumulate within the food chain and result in high levels of contaminants in top predators.
- Significant levels of metals and hazardous/persistent organic chemicals contaminate the sediment.

Point source pollution from manufacturing is a significant issue on transitional and coastal water bodies but rivers, lochs and groundwater are also impacted (Table 19). Data indicate that approximately 40% of Scotland's transitional and coastal water bodies at risk of failing to meet the environmental objectives of the Water Framework Directive are affected. Map 8 shows those water bodies impacted by this significant issue.

Table 19: Extent of the impact of point source pollution from manufacturing in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	342 km	32
Loch	✘	14 km^2	1
Transitional	✔	190 km^2	8
Coastal	✔	1,279 km^2	14
Groundwater	✘	2,460 km^2	7

Socio-economic impacts

Chemicals that are persistent and bioaccumulative are of particular concern. These chemicals can be transported over long distances and accumulate through the food web. Studies on the effects of high chemical levels in humans suggest that toxic chemicals can lead to reproductive problems, cancer and neurological disorders.

These chemicals cannot be easily removed from the food chain even after their releases have ceased, and may persist in the sediment. They can increase in concentration as they move up the food chain (e.g. from plankton to fish to seals to polar bears), accumulating in the bodies of wildlife species and contributing to serious health impacts.

How do we address this issue?

Efforts now centre on controls on the use and production of potentially hazardous chemicals whose use can harm the environment via domestic and industrial discharges to sewer and as a result of diffuse pollution.

Industrial processes are already subject to an effective regulatory regime which has resulted in substantial environmental benefits. The present aim is to ensure these tools are applied in a proportionate and risk-focused manner which will continue to achieve environmental benefits. Table 20 summarises those measures currently available to address point source pollution from manufacturing and additional measures that could be put in place.

Table 20: Measures to address impacts of point source pollution from manufacturing

What are we already doing about this?	
Regulation	• Pollution Prevention and Control (PPC) regime regulates industrial processes to minimise pollution • Controlled Activities Regulations (CAR) regulate discharges to the water environment • SEPA controls the use of certain dangerous substances through marketing and use regulations • Local authority development control ensures industrial developments are sited in appropriate locations • Local authority contaminated land regime (prioritisation of sites may require review to reflect river basin planning targets)
Advice	• Environmental management systems promoted as means to improve environmental performance • NetRegs (www.netregs.gov.uk) offers advice on best practice • SEPA offers advice on minimising water pollution through www.sepa.org.uk/wastemin • SEPA is a partner in HAZRED which provides guidance to businesses on reducing the use of hazardous raw materials along with case studies (www.hazred.org.uk) • Envirowise provides guidance on minimising use of hazardous raw materials and reducing water pollution (www.envirowise.gov.uk)
What additional measures could we put in place?	
Regulation	• Controls over Priority Substances as required by the Water Framework Directive daughter directive • New European chemicals regulation (REACH) will provide controls over the use of hazardous substances
Advice	• SEPA can work with the Government's Knowledge Transfer Networks[20] to advise on new technologies to improve environmental performance • SEPA is currently strengthening the advice it gives to industry through its Environmental Protection staff as part of routine visits and will ensure advice on reducing water pollution is fully incorporated
What additional measures do you think should be developed? What can you do to help?	

8.4 Point source pollution: refuse disposal

Historically landfill sites were often inadequately engineered and, in some cases, had no lining. Polluted liquid (leachate) generated from the degrading waste was thus able to percolate through soil and rock, entering groundwater and contaminating surface waters. More modern landfill sites are designed in accordance with the Landfill Regulations and operated under Pollution Prevention and Control Regulations. Landfills are required to contain and manage leachates by incorporating a basal liner and leachate collection systems. Leachate levels must be minimised, and waste compacted and capped to minimise rainwater ingress.

[20]An element of the Technology Strategy being implemented by the Technology Strategy Board.

Environmental impacts

The potentially harmful properties of landfill leachates result from the presence of:

- high levels of ammonia and suspended solids;
- dissolved solids;
- toxic compounds;
- immiscible organic chemicals;
- high chemical/biochemical oxygen demand (COD/BOD);
- high levels of nutrients;
- microbiological contaminants.

Some components of leachates are List I or List II substances under the Groundwater Directive on the basis of their toxicity, bioaccumulation and persistence.

Refuse disposal pressures do not affect groundwater bodies as a whole, but can present localised impacts which are significant where they relate to private drinking water supplies and rivers in close proximity to the site.

Point source pollution from refuse disposal activities is identified as a significant issue for transitional and groundwater bodies in the Scotland river basin district. Almost a third of transitional water bodies and just over a fifth of groundwater bodies at risk of failing to meet the environmental objectives of the Water Framework Directive (Table 21) are affected by point source pollution from refuse disposal activities. Map 9 shows the water bodies impacted by this significant issue.

Table 21: Extent of the impact of point source pollution from refuse disposal activities in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	147 km	16
Loch	✘	-	-
Transitional	✔	123 km^2	3
Coastal	✘	230 km^2	2
Groundwater	✔	4,510 km^2	14

How do we address this issue?

Refuse disposal sites identified as impacting transitional and groundwater consist of:

- historic areas of waste disposal devoid of any regulatory control including sites determined as contaminated land under Part IIA of the Environmental Protection Act 1990;
- sites operated under a Waste Management Licence (WML) that are no longer accepting waste;
- PPC sites with old phases of landfilling, where the PPC permit is used as a mechanism to manage and reduce the contaminant footprint of the old phases and associated groundwater contamination.

No new phases of landfilling designed in accordance with the Landfill Regulations and operated under a PPC permit have been identified as a risk to transitional or groundwater status.

Both new and existing refuse disposal sites are regulated under the PPC regulations; the latter often include older, poorly engineered phases. Other sites where waste deposition has now effectively ceased are regulated and controlled through the Waste Management Licensing Regulations.

SEPA uses PPC permit conditions and WML closure procedures to ensure operators manage and reduce the contaminant footprint of older sites/phases and associated groundwater contamination. However there are historic areas of waste disposal that are not subject to regulatory control. Measures to address these pressures would need to be implemented through local authority strategies to tackle contaminated land.

Table 22 summarises those measures currently available to address point source pollution from refuse disposal activities and additional measures that could be put in place.

Table 22: Measures to address the impacts of point source pollution from refuse disposal activities

What are we already doing about this?	
Regulation	• PPC regulations prevent new landfill sites from polluting groundwater • Measures required to address pollution at sites still operating under a Waste Management Licence • Impacts caused by closed landfill sites no longer subject to licensing can be addressed by the contaminated land regime
What additional measures could we put in place?	
Regulation/ advice	• Actions to implement the National Waste Strategy[21] will progressively reduce the volume of waste going to landfill
What additional measures do you think should be developed? What can you do to help?	

8.5 Point source pollution: mining and quarrying

The UK has a long history of mining carried out on an industrial scale since the Roman occupation 2,000 years ago and which peaked in the 18th and 19th centuries following the Industrial Revolution.

Mining activities in Scotland were primarily associated with coal, oil shale, fireclay and ironstone mining but were largely restricted to areas of coal and oil shale extraction. As the mines could be hundreds of metres deep with workings well below the water table, groundwater frequently had to be pumped from the deep mines. As a general rule, Scotland's coal mines generate 4–5 times more groundwater than their counterparts in England per tonne of coal extracted.[22] Once mines are abandoned, groundwater levels recover, dissolving minerals within the workings and causing high metal concentrations in groundwater across large areas. Should these waters reach the surface, polluted mine water discharges into surface waters causing significant changes in the chemistry and ecology of affected water bodies.

There are currently no deep mines working in Scotland. Remaining coal extraction takes place in opencast sites, which are often extensive.

Environmental impacts

Acid mine drainage (AMD) is a consequence of mining where the excavation of minerals (both metal-bearing and coal) below the natural groundwater table exposes sulphur-containing compounds to oxygen and water. As groundwater flows through the mine after its abandonment, sulphate salts dissolve and this acidic metal-containing mixture forms AMD. The generation of acid mine drainage (AMD) and its discharge to the environment can have serious impacts on the water environment.

As mining in Scotland largely comprised coal and oil shale extraction, the main metal of concern is iron from pyrites (ferrous sulphide) within coal seams and mudstones in coal measures.

With the closure of many coal mines from the 1950s to the 1990s, the discharge of ferruginous waters from disused mines became an environmental problem. As deep mines closed, groundwater pumping stopped or was reduced resulting in the rebound of groundwater within the abandoned workings. Eventually, rising water levels lead to discharges of iron-contaminated water from mine entries, outcrop zones and discharge pipes. Once the mine water reaches the surface and comes into contact with air, a chemical reaction causes the formation of an iron pigment more commonly known as ochre.

[21] See www.sepa.org.uk/nws/index.htm

[22] *Groundwater – Our Hidden Asset*, compiled by R A Downing on behalf of the UK Groundwater Forum, 1998 (see www.groundwateruk.org/html/forum/forum_assetbook.htm)

The main impacts associated with mining are listed below.

- Existing groundwater that has been polluted by mining activities can no longer be used for drinking water supply or for most industrial purposes.
- Rising iron-rich groundwater can contaminate overlying or adjacent aquifers preventing their use as a source of drinking water or water for industrial processes.
- Rivers may be polluted by mine water flowing from adits and shafts within abandoned mines and through the migration of iron-containing groundwater to surface water as baseflow. These outbreaks can kill most animal life and turn the river bed red, affecting its amenity and recreational value. Due to the location of abandoned mines, it is often rivers in deprived urban areas which are affected.

Approximately 30% of Scotland's groundwater bodies at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by pollution from mining and quarrying. Point source pollution from mining and quarrying also impacts 363 km of rivers (Table 23). Map 10 shows the water bodies impacted by this significant issue.

Table 23: Extent of the impact of point source pollution from mining and quarrying in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
Rivers	✘	363 km	36
Loch	✘	-	-
Transitional	✘	-	-
Coastal	✘	-	-
Groundwater	✔	6,428 km^2	14

How can we address this issue?

The major problem in addressing this significant issue is that the mine or quarry often closed many years ago and therefore there is no longer anyone directly responsible for controlling this source of pollution.

The Coal Authority was formed in 1994 with a remit to deal with the legacy of pollution from abandoned coal mines. This remit was strengthened when powers to deal with the issue were included in the Water Environment and Water Services (Scotland) Act 2003. In recent years the Coal Authority has put in place a world-leading programme to tackle coal mine discharges.

SEPA and the Coal Authority have developed a priority list of discharges to rivers from abandoned mines which require treatment. The Coal Authority has already provided mine water treatment facilities at 12 Scottish sites but a further 29 are required. Further action in addressing the 363 km of polluted rivers in Scotland depends on continued funding of the Coal Authority. Funding has been limited in recent years with no Scottish schemes being constructed since 2004. There is no guarantee that future funding for this programme will be made available.

Table 24 summarises those measures currently available to address point source pollution from mining and quarrying and additional measures that could be put in place.

Table 24: Measures to address point source pollution pressures from mining and quarrying

What are we already doing about this?	
Regulation	• SEPA and the Coal Authority have a Memorandum of Understanding which provides the basis for the Authority's mine water programme • SEPA can impose controls on mine dewatering and its discharge from existing mines and quarries • SEPA can require the treatment of discharges from mines where a responsible person can be identified • Planning conditions imposed by local authorities minimise wider environmental impacts
What additional measures could we put in place?	
Regulation	• The Scottish Executive is considering the introduction of restoration regulations giving SEPA powers to intervene to treat discharges from non-coal mines
Economics	• Additional funding is required to allow the Coal Authority to treat polluting discharges from coal mines • Funding is required to allow SEPA to initiate work to treat pollution from non-coal mines
What additional measures do you think should be developed? **What can you do to help?**	

9 Abstraction and flow regulation

This section describes three types of water resource pressures which have been identified as significant water management issues. Table 25 lists the lengths or areas of water bodies affected by each issue. The number of water bodies is given in brackets.

Table 25: Significant water resource issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Abstraction and flow regulation	Electricity generation	1,451 km (130)	279 km^2 (45)	48 km^2 (2)**	–	–
	Water supply	1,112 km (89)	192 km^2 (42)		–	–
	Agricultural irrigation	833 km (116)*	2 km^2 (1)*		–	2,068 km^2 (17)
	Total	**3,971 km (359)***	**362 km^2 (85)***	**48 km^2 (2)****	**–**	**2,068 km^2 (17)**

*Data from new licences provide more up-to-date information than Water Framework Directive characterisation data.
**This is cooling water abstraction at coastal power stations which affects transitional waters.

9.1 Abstraction, flow regulation and morphological change: electricity generation

Hydropower stations use the downhill flow of water to generate electricity. The large-scale production of hydropower began in Scotland in the late 19th and early 20th centuries, creating major generation schemes covering hundreds of square kilometres. 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 run by Scottish and Southern Energy (16), Scottish Power (5) and Alcan (2). The catchments supplying these schemes cover over 8,373 km^2 of mainland Scotland.

The Glendoe Hydro Scheme – a 100 MW scheme[23] – is being constructed by Scottish and Southern Energy just to the south of Loch Ness. This is the first scheme of this scale to be constructed for more than a generation. There are few sites left that would permit the construction of large hydropower schemes so Glendoe may be the last major conventional scheme to be constructed in Scotland.

There are 74 small-scale hydropower plants in Scotland owned by a range of private companies and individuals. Typically these are run-of-river schemes which use the hydraulic head in a river to generate energy. These schemes may remove water from a river, pass it through a turbine and return it to the same river.

There is some potential for new small-scale hydropower development in Scotland. The British Hydropower Association[24] estimates that there may be capacity for the production of a further 400–500 MW from small-scale run-of-river schemes. Over the past year SEPA has received around 100 enquiries for new small schemes across Scotland, with around half of these expected to be submitted as applications in due course.

Hydropower generation provides substantial employment in many rural communities across Scotland with over 200 hundred jobs within the industry. The sector contributes over £400 million annually to the Scottish economy.

Environmental impacts

Hydropower has positive impacts on the environment, representing an important source of renewable energy in Scotland generating 4,167 GWh per year. This is equivalent to 8.5% of Scotland's energy generation and 54% of its renewable energy generation. One of the largest hydropower schemes (excluding pumped storage schemes which are not considered renewable energy schemes) is the one built in the Tummel Valley between the 1930s and the 1950s, which has an installed generating capacity of 240 MW.

[23]See www.glendoe.co.uk
[24]See www.british-hydro.org

The great advantage of large hydropower schemes is that they can generate energy on demand and are less susceptible to the weather than energy produced by windfarms or run-of-river hydropower schemes. Additional pump storage hydro capacity may be beneficial in future to match consumer demands with fluctuating supplies from large-scale intermittent sources such as wind and wave power. Without such balancing mechanisms, the proportion of electricity that can be accommodated on the National Grid from intermittent renewable sources will be restricted.

As part of Scotland's contribution to combating climate change, ministers have set targets to increase electricity generation from renewable energy sources to 18% by 2010 and a further 22% by 2020. Part of this additional renewable energy contribution will be delivered by hydropower, although wind power and wave/tidal power are likely to be more important new sources of energy in the future. In theory, a single large windfarm could potentially generate more energy than would be provided by the development of all the remaining small-scale hydropower sites in Scotland. However, wind power is not without its own environmental and planning issues and no windfarm of this scale has yet been approved and built.

The development of a secure renewable energy generating capacity within Scotland is dependent on a mix of types of generation. Hydropower will remain part of our fight against climate change.

The potential negative environmental impacts of hydropower are associated with the abstraction of water and the construction and operation of dams. If these are activities are not controlled and appropriate mitigation measures incorporated, they can result in:

- low flows in rivers, which may be virtually dry except during periods of heavy rain;
- highly variable flows below generating stations, resulting in bare banks and potential stranding of fish;
- highly variable water levels in reservoirs leading to regular drying out of the shoreline, preventing the growth of plants and spawning of fish;
- barriers to fish migration caused by dams and death of fish entering turbines;
- interruption of the flow of sediment downstream of dams, which depletes gravels needed by salmon and trout to spawn;
- compaction of silt and the loss of some habitats in some cases from steady compensation flows.

These impacts affect ecology via the effects of changing river flows and loch levels as well as changes to the morphology of rivers and lochs.

Abstraction and flow regulation from electricity generation is a significant issue on rivers and lochs (Table 26). The abstraction of water for use as cooling water at power stations also impacts transitional water bodies. Approximately 10% of water bodies in Scotland at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by abstraction and flow regulation for public water supplies.

Map 11 shows those water bodies impacted by abstraction, flow regulation and morphological alterations from electricity generation.

Table 26: Extent of the impact of abstraction and flow regulation from electricity generation in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✔	1,451 km	130
Loch	✔	279 km^2	45
Transitional	✘	48 km^2	2
Coastal	✘	-	-
Groundwater	✘	-	-

Morphological impacts from electricity generation are another significant issue on lochs (Table 27).

Table 27: Extent of the impact of morphology from electricity generation in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✔	1,451 km	130
Loch	✔	279 km^2	45
Transitional	✘	48 km^2	2
Coastal	✘	-	-
Groundwater	✘	-	-

Some hydropower reservoirs and rivers affected by hydro schemes can provide conditions that have lead to sites being designated under conservation legislation. For example, some reservoirs are operated to maintain constant reservoir water levels when black throated divers are nesting. In future it may be possible to deliberately create specific types of habitat at new hydropower sites.

Socio-economic impacts

Hydropower generation can affect the recreation and amenity value of the water environment. Angling contributes £113 million to the Scottish economy and it is therefore important to protect this resource. The potential conflict between hydropower and fisheries interests has long been recognised and debated between the sectors.

There are also positive effects. Some naturally inaccessible rivers were opened up to migrating salmon and sea trout as part of the mitigation measures for some hydro schemes and many reservoirs are used for angling (especially for brown trout).

Hydropower developments often occur where there are waterfalls or rapids and so coincide with the type of river used by canoeists and for rafting.

Freshets (periodic large-scale releases of water from dams) are released to guarantee suitable flow conditions, foremost to help maintain fish migration. Another positive benefit is that they can contribute to good conditions for canoeists and rafters. For example, regular freshets below the Clunie dam on the Tummel scheme are used every weekend in the summer for recreational rafting and canoeing, which support several small recreational businesses.

How do we address this issue?

Balancing environmental benefits for existing schemes

The main mechanism for addressing the negative impacts of hydropower schemes on the water environment is through the regulatory controls defined in SEPA licences. The main aim of these controls is to reconcile measures to improve the water environment with the importance of renewable energy generation in combating climate change. SEPA believes tackling climate change is an important priority and therefore operates a presumption in favour of renewable energy.

The river basin management plan will designate heavily modified water bodies where restoration of the water environment to good ecological status cannot be achieved without causing a significant adverse impact on energy generation (see section 12.3).

Within this framework SEPA considers it possible to achieve important improvements in the water environment by moving existing schemes towards modern standards of good practice. The following four approaches could provide improvements in the water environment without significantly affecting energy generation:

- Redistribute water to maximise the environmental benefits without affecting energy generation.
- Identify changes that are not related to the volume of water released (e.g. improvements to fish migration and protection provisions, and improvements to the physical quality of river and loch habitats.

- Identify situations where a large environmental improvement can be delivered for a small loss of generating capacity.
- Apply best practice design to old major schemes and upgrade the turbines to compensate for any loss of energy generation.

Supporting new hydropower schemes

Scotland needs to promote new hydropower schemes but these must not compromise important environmental sites or third party interests. We need to find a way to reconcile these potentially conflicting interests.

The most likely interests to be affected by hydropower are nature conservation, fishing and canoeing.

- **Nature conservation.** Should we focus on protecting Special Areas of Conservation (SACs), designated species, Sites of Special Scientific Interest (SSSIs) and Biodiversity Action Plan (BAP) sites?
- **Fisheries.** Sensitive siting and the application of good design for new small hydropower schemes can avoid significant impacts on fisheries, although the cumulative impact of such schemes on fish migration remains a concern. Are there other criteria that should be used to identify areas which are particularly important for fisheries?
- **Canoeing.** New hydropower schemes tend to reduce the potential for canoeing by introducing obstacles (weirs) or by reducing river flows so much that the period available for canoeing is seriously constrained. It is possible through sensitive siting and the introduction of appropriate mitigation measures to reduce these impacts. However, SEPA believes it is important to retain some high quality sites which are easily accessible for this expanding sport.

To give confidence to the hydropower industry it is necessary to identify sites important for these other uses. This will ensure that hydropower development is directed towards sites where environmental and other concerns can best be mitigated, minimised or are less significant.

Table 28 summarises those measures currently available to address abstraction and flow regulation from electricity generation and additional measures that could be put in place.

Table 28: Measures available to address the impacts of abstraction and flow regulation from electricity generation

What are we already doing about this?	
Regulation	• SEPA imposes controls on licensed hydropower schemes • Fisheries (Electricity) Committee provides advice on measures to protect fisheries imposed via SEPA licences • Local authority development planning and control
Advice	• Voluntary agreements between hydropower companies and interest groups such as anglers
What additional measures could we put in place?	
Economics	• Encourage generation from existing large schemes with the potential to exceed 20 MW* • Make environmental best practice a criterion for eligibility for Renewable Obligation Certificates* (ROCs)
Advice	• Map showing potential constraints on hydropower development to facilitate the targeting of development
What additional measures do you think should be developed? What can you do to help?	

*Responsibility of Department for Business, Enterprise & Regulatory Reform/Ofgem

9.2 Abstraction and flow regulation: public water supplies

Public water supplies are extracted from rivers, lochs, reservoirs and groundwater. Water supplies have been developed over a number of years and some have faced a progressive increase in the volume of water used for domestic purposes. In addition, communities have expanded in many areas resulting in increased demand for drinking water. This long-term trend places increasing demands on water resources and consequently on the environment. This trend is mitigated to some extent by the reduction in water consumption by industry over the past 50 years particularly in the central belt areas of Scotland where the demand from heavy and manufacturing industry has declined.

Scottish Water provides drinking water to 97% of the 4.8 million people living in the Scotland river basin district.

The majority of Scotland's drinking water sources are local to the population served. However the major population centres are provided with drinking water supplies from centrally located treatment plants. Many of these supplies and their distribution systems were initially created during the late 19th and early 20th centuries and have been progressively expanded and developed over the years.

Groundwater is also an important source of public water supply. The movement of groundwater through the aquifer has the effect of removing many impurities (as they filter through the rock) so that groundwater is generally much cleaner than surface water. As such, groundwater often requires less treatment than surface water making it a more viable source of water for public supply. In Scotland, abstractions from boreholes and springs are used both for the regional water supply and to augment the supply from surface water sources in some areas.

Environmental impacts

The potential for environmental impact from water supply arises from abstraction of water and the storage of water in reservoirs to support abstractions. However, the creation of reservoirs over the years has in many cases provided an opportunity for the development of new diverse ecosystems, which also provide social and recreational benefits.

Changes in water levels are natural as the amount of water in rivers and lochs varies according to the season and between years. Environmental impacts result when the changes in water levels and flow exceed the levels of change to which ecology can adapt. In the most extreme cases, rivers may be dry during certain times of the year – a feature that can be further exacerbated by abstraction activities.

The environmental impacts associated with water supply include:

- exacerbation of low levels of water in rivers (particularly during the summer) by direct abstractions with the potential to damage the ecology of rivers and their associated wetlands;
- low groundwater levels caused by abstraction leading to the drying out of small tributaries and wetlands, and the reduction in river baseflows during periods of low rainfall;
- variation in water levels in lochs and reservoirs leading to regular drying out of the shoreline, preventing the growth of plants and spawning of fish;
- barriers to fish migration caused by dams;
- interruption of flow of sediment downstream of dams depletes gravel needed by salmon and trout to spawn;
- reduction in the groundwater resource, resulting in a reduction in baseflow to surface water and wetlands.

These impacts affect ecology via the effects of changing river flows and loch levels as well as changing the morphology of rivers and lochs.

Approximately 10% of water bodies in Scotland at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by abstraction and flow regulation for public water supplies. The extent of the impact of abstraction for public water supply is given in Table 29. Map 12 shows those water bodies impacted by this significant issue.

Table 29: Extent of the impact of abstraction for public water supply in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	1,112 km	89
Loch	✔	192 km^2	42
Transitional	✘	-	-
Coastal	✘	-	-
Groundwater	✘	-	-

Socio-economic impacts

Drinking water abstractions from rivers and lochs tend to occur in upland catchments where there are few or no conflicting uses of the water environment. Fisheries are consequently the other key water user affected, with dams and limited compensation flows restricting fish migration and recruitment. Conversely there are huge benefits to society in the provision of a wholesome, reliable supply of treated water with respect to public health, amenity value and industrial/commercial development.

How do we address this issue?

Over the past ten years there has been substantial investment in the water supply infrastructure in Scotland. This concentrated on improving drinking water quality, which is now of a very high standard when measured against European drinking water standards.

Scottish Water is preparing a Water Resources Plan which will identify the future supply and demand requirements on water resources for the next 25 years.

The three approaches to reducing the impact of water supplies on the water environment are outlined below.

Development of new resources

Although the potential for developing new sources of drinking water supply is limited, there are still opportunities for developing resources and using this to reduce the impact in the areas subject to water stress. Overall there may be a reduction in the environmental impact. This option is very expensive and it can substitute one environmental problem with another.

Development of existing infrastructure

Water lost by leakage within the supply network represents a waste of high quality drinking water which causes unnecessary abstraction from the environment. On average, leakage within many of the public water supply systems is estimated to be about 50%.

Eliminating leakage represents the most attractive means of reducing abstraction but it is challenging to deliver significant leakage reductions in many areas. There is a balance between the costs involved in finding and repairing leaks, and the benefits which result. The economic level of leakage varies across the country.

In terms of barriers to fish passage, investment can also provide benefits by installing fish ladders on reservoirs to support fish migration and providing additional compensation flows for downstream rivers.

Managing demand

The progressive increase in the demand for water is unsustainable, making demand management an important priority. Improving water efficiency standards for domestic appliances such as washing machines and dishwashers and moving to dual flush toilets is crucial. The application of building standards to promote grey water use and the collection of rain water for gardens is also important.

Table 30 summarises those measures currently available to address abstraction for public water supply and additional measures that could be put in place.

Table 30: Measures to address the impact from water supply activities

What are we already doing about this?	
Regulation	• SEPA controls on levels of abstraction, management of dams and efficient use of water
Economics	• Charging incentives encourage efficient use of water by industry
Advice	• Publicity campaigns promoting efficient water use by domestic customers
What additional measures could we put in place?	
Regulation	• Building standards to require rainwater capture and recycling for garden use and toilet flushing • Water efficiency included for eco housing as well as energy efficiency
Advice	• Improve water efficiency standards for domestic appliances and provide water efficiency as well as energy efficiency information for customers
What additional measures do you think should be developed? What can you do to help?	

9.3 Abstraction and flow regulation: agriculture

Abstraction of water for agriculture serves many purposes depending on the type of farming, e.g. water for crop irrigation, drinking water for livestock and washing down for dairy farms. The largest agricultural use of water is for irrigation and occurs primarily in the east coast of Scotland supporting the production of fruits, vegetables and root crops such as potatoes. The most important crop is potatoes, where irrigation is required in most years to ensure a quality product.

Recent additional data available through the CAR licensing system allowed SEPA to realise the importance of abstraction of water by agriculture as a significant issue. Although abstraction for farming may not be widespread across Scotland, it is a localised issue in different parts of the country. More importantly it is an issue that is extremely difficult to address. To successfully manage the problem farmers would be required to work at a catchment scale to identify appropriate quantities and timings of abstraction. There is an important economic balance to be addressed with this approach, particularly where there are multiple users within a catchment.

Environmental impacts

Irrigation is typically required during dry weather when rivers are low. As a consequence, abstraction for irrigation exacerbates naturally occurring low flows. In addition, the distribution of crops means that farmers frequently have to rely on groundwater or on small burns and tributaries. During periods of low flows these may not have sufficient flow to support the abstraction without causing an environmental impact.

A typical irrigation pump can extract 1,200 m^3 of water over a period of 24 hours. This is equivalent to the average water used by approximately 6,000 people. Across Scotland, SEPA has issued 796 licences for irrigation, including a number for multiple abstractions. Assuming each represents the daily use of only one pump, then irrigation could abstract in total the equivalent of the daily water use of 4.8 million people (i.e. the population of the Scotland river basin district).

Irrigation typically occurs between May and August. It has the following environmental impacts.

- Reduced summer flows occasionally lead to stranding of fish and drying out of wetlands.
- It increases the vulnerability of fish and other freshwater life to high temperatures in pools isolated by low flows.
- It exacerbates the effects of pollution with very limited dilution for discharges, resulting in low oxygen conditions.
- Small dams across rivers are sometimes constructed to assist in the abstraction of water and can, if poorly constructed, impede the migration of fish.
- The effects of agricultural abstraction often combine with the effects of diffuse pollution to seriously damage the ecology of small burns along the east coast.

- In productive fissured aquifers, the effects of groundwater abstraction can affect receptors very quickly. In these areas, irrigation abstraction from groundwater can further reduce summer low flows in rivers.
- Groundwater abstraction can impact on wetlands and can damage aquifers by inducing the inland intrusion of seawater.

Approximately 10% of water bodies that are at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by abstraction and flow regulation for agriculture. Table 31 shows the area/length of water bodies impacted by abstraction for irrigation in the river basin district. Map 13 shows those water bodies impacted by this significant issue. More up to date information is available but this is not shown on the map.

Table 31: Extent of the impact of abstraction for irrigation in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	833 km*	116
Loch	✘	2 km^{2}*	1
Transitional	✘	-	-
Coastal	✘	-	-
Groundwater	✘	2,068 km^{2}	17

*Data from new SEPA licences provides more up-to-date information than WFD characterisation data.

Socio-economic impacts

Abstraction for agriculture primarily affects the population of juvenile fish, particularly in small burns used for spawning. This in turn reduces recruitment for fisheries, which are already under pressure from a wide range of sources both in freshwater and at sea.

How do we address the problem?

The scale of irrigation has increased over the past 20 years, particularly in the east of Scotland. This trend, together with climate change projections for drier summers along the east coast, suggests the environment will be at greater risk of harm and the water resources available to farmers more vulnerable and less predictable or secure.

SEPA is determined to apply its new regulatory powers in a proportionate and risk-based manner so that its resources are focused on those catchments where there is a risk of environmental harm. There are three mechanisms that can be used to minimise the risks to the environment while ensuring that farmers have access to sufficient water. These are described below.

Environmental best practice

SEPA is developing best practice guidance to help minimise the amount of water required to support crops. Active management will be required to avoid over-irrigation of parts of fields.

Management agreements

Whether an environmental impact is caused by irrigation generally depends on how farmers time their abstractions. In a catchment subject to over-abstraction, the river is likely to dry up or be subject to damaging abstraction levels if all the pumps in the area are operated at the same time. If an agreement can be reached between farmers to operate their pumps at different times then:

- the environment is protected;
- downstream farmers have sufficient water;
- all parties can utilise the available resource.

Such management agreements will be a key tool to allow and support farmers to manage water resources efficiently. SEPA can require compliance with a management agreement via its licensing regime.

Investment in storage

Where water is in short supply, farmers would benefit from abstracting during high river flows where there is no shortage of water and storing this water in farm ponds until irrigation is required. The use of irrigation ponds is widespread and SEPA intends to encourage their expanded use in the future.

Table 32 summarises those measures currently available to address abstraction for irrigation and additional measures that could be put in place.

Table 32: Measures to address impacts of abstraction for agricultural irrigation

What are we already doing about this?	
Regulation	• SEPA imposes controls on volume of water that can be abstracted and the time over which it can be abstracted, through Controlled Activities Regulation (CAR) • Require efficient use of water
Economics	• SEPA's charging scheme provides incentive to abstract water in the winter and provide storage
What additional measures could we put in place?	
Regulation	• Require compliance with management agreements between farmers over timing of irrigation
Economics	• Develop SEPA's charging scheme to provide additional incentives to abstract when flows are high • Part funding for irrigation ponds under Rural Development Contracts Tier 3
Advice	• Publicity campaigns promoting efficient water use by farmers • Organise workshops for farmers on water efficiency • Promote management agreements between farmers
What additional measures do you think should be developed? What can you do to help?	

10 Impacts on morphology

This section describes five types of morphological impacts which have been identified as significant water management issues. Table 33 provides the lengths/areas of water bodies affected by each issue. The number of water bodies is given in brackets.

Table 33: Significant morphology issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Morphology	Historical engineering	2,182 km (185)	49 km^2 (17)	123 km^2 (7)	404 km^2 (5)	–
	Urban development	644 km (60)	–	0.2 km^2 (1)	–	–
	Agriculture	1,851 km (162)	1 km^2 (1)	–	–	–
	Electricity generation*	904 km (86)	298 km^2 (53)	–	–	–
	Land claim	–	–	204 km^2 (12)	229 km^2 (5)	–
	Total	**5,063 km (462)**	**339 km^2 (65)**	**213 km^2 (14)**	**525 km^2 (8)**	**–**

*See section 9.1.

10.1 Impact on morphology: historical engineering and urban development

Many of Scotland's freshwaters display a history of engineering interventions. Examples include:

- diverting and canalising rivers to utilise floodplains;
- culverting to improve drainage or enable development;
- building embankments to prevent flooding;
- bridging waterways for transportation.

Much of this work has been vital to Scotland's social and economic development.

Although engineering has an important and ongoing role in river management, it is now recognised that some engineering interventions can significantly alter a river's natural character leading to habitat damage, a requirement for costly river maintenance programmes and, in some instances, increased flood risk.

Rivers are naturally dynamic; they flood adjacent lands, erode their banks and bed, and move sediment around. These natural processes help create a healthy river or loch environment that will support a range of important flora and fauna.

Morphology describes the size, form and character of a river or loch. Under natural conditions, rivers will 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 can affect this natural balance and result in morphological damage. This can lead to a loss of important habitats, changes to rates of erosion or sediment deposition and, potentially, an increased risk of flooding elsewhere in the catchment.

Environmental impacts

Urban development and historical engineering activities can result in:

- the loss of floodplain wetlands and associated biodiversity from the construction of embankments;
- the loss of in-channel habitats due to increased erosion during floods affecting fish, invertebrates and aquatic plants.

- the loss of bankside vegetation, often with increased risk of bank erosion downstream and resultant loss of in-channel habitat supporting fish, invertebrates and aquatic plants;
- structures (associated with culverts, dams and small weirs) that impede the migration of fish and other organisms and which may also affect erosion and deposition rates, and result in a loss of sediment supply downstream;
- loss of in-channel habitats and significant changes to erosion and sediment deposition in the surrounding channel as a result of channel straightening;
- loss of habitat for fish spawning, invertebrates and aquatic plants due to gravel removal;
- increased inputs of fine sediments, increased risk of bank erosion, loss of bankside habitats and elevated water temperatures as a result of removal of bankside vegetation;
- potential increase in the risk of flooding due to the construction of embankments, culverts and other engineering activities.

The permanency of engineering structures means that many of these impacts are likely to be cumulative and long lasting.

More than 30% of river water bodies that are at risk of failing to meet the environmental objectives of the Water Framework Directive are impacted by morphological change from urban development or historical engineering. The extent of the morphological impacts caused by historical engineering and urban development is given in Tables 34 and 35 respectively. Map 14 shows those water bodies impacted by historical engineering and urban development.

Table 34: Extent of morphological impacts caused by historical engineering in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✔	2,182 km	185
Loch	✘	49 km^2	17
Transitional	✔	123 km^2	7
Coastal	✘	404 km^2	5
Groundwater	✘	-	-

Table 35: Extent of morphological impacts caused by urban development in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✔	644 km	60
Loch	✘	-	-
Transitional	✘	0.2km^2	1
Coastal	✘	-	-
Groundwater	✘	-	-

Socio-economic impacts

The adverse economic and social impacts of poorly designed or ineffective engineering include:

- **Erosion.** Hard engineering structures (particularly those that are misaligned) tend to deflect flow, potentially increasing the risk of erosion elsewhere. The costs of rectifying these problems are often incurred by downstream land owners.
- **Flooding.** Poorly planned or designed engineering structures can exacerbate flood risk. Culverts and channel realignments can reduce the storage capacity of the river channel and increase the risk of flooding of adjacent and upstream land. Deepening rivers, draining floodplains and creating flood embankments can isolate rivers from their natural floodplain, increasing the risk of flooding in downstream reaches. Flooding impacts on communities, the economy, the environment and Scotland's cultural heritage. The annual cost to society of flooding is estimated to be around £31 million. These costs are predicted to rise steadily through the 21st century – partly in response to climate change. In those areas experiencing increased flood risk, the need to develop more sustainable approaches to flood management will become increasingly important.
- **Barriers to fish migration.** Fisheries are dependent on good fish recruitment. Artificial barriers, including culverts and weirs, can prevent access to spawning sites or impede migrations to sea. This reduces fishery income and imposes costs on fishery managers attempting to mitigate these impacts. There are over 2,500 weirs and impoundments, and 5,000 culverts on Scottish rivers. SEPA plans to identify where these barriers could impede fish passage.
- **Amenity value.** An unintended consequence of river engineering has been a reduction in the amenity and recreational value of some rivers, particularly in urban settings. Engineering can restrict access to rivers and their corridors. It can also remove opportunities to develop parkland or urban reserves.
- **Urban development of floodplains.** This can place pressure on existing flood management measures. Policies are in place to ensure that new developments do not increase flood risk, but continued development on floodplains could increase the costs of maintaining existing levels of flood protection. In addition, reductions in available floodplain space could reduce future opportunities to develop more sustainable approaches to flood management.

How do we address this issue?

Regulatory mechanisms exist that can reduce the direct impact of engineering activities. SEPA will use the Controlled Activities Regulations to protect the environment and to ensure that third party interests are not compromised. This regime applies to proposals for new engineering in rivers and lochs. Although such regimes help to minimise impacts to the environment, cumulative impacts will continue to increase unless redundant or poorly designed structures are removed to compensate for new developments (see below).

Removing historic structures

Engineering pressures on Scotland's freshwaters are largely in areas of urban and agricultural development. In some urban areas, rivers have been altered to such a degree that attempting to return a river to a natural condition would now be economically or technically infeasible.

Despite these constraints, there are opportunities to restore rivers to a more natural condition and thus achieve substantial environmental, social and economic benefits. This type of restoration work is widespread across Europe and the USA. SEPA will identify sites where catchment-focused restoration of rivers should be considered.

Instruments to deliver river (or loch shoreline) restoration are limited in Scotland. SEPA can require:

- remedial works where structures are part of an existing water management scheme (water supply or hydropower);
- improvements as part of river maintenance work (e.g. reviewing sediment management for drainage or flood defence).

At present there are no similar mechanisms to remove abandoned structures that no longer serve a purpose. The Scottish Executive is considering the introduction of restoration regulations, which would address this gap.

Sustainable flood risk management

A common driver for river engineering, particularly in urban areas, has been flood protection. Engineering schemes to alleviate flooding are common on many Scottish rivers and, in many areas, this work has significantly reduced the risk of flooding for local communities. However, climate change and the loss of natural floodplains mean these schemes are likely to become more expensive and technically challenging.

Flood management schemes are the responsibility of local authorities. Historically this meant that flooding was managed locally and with limited consideration of other factors influencing flooding within the catchment. It is now recognised that flood prevention measures benefit from catchment level planning. This includes addressing man-made factors within the catchment that may be exacerbating flooding such as the loss of floodplains. Flood liaison and advisory groups have been set up by local authorities to improve co-ordination of flood management measures within catchments.

The Scottish Executive is working to define principles and objectives to underpin sustainable flood management. This includes:

- improved catchment level planning of flood management measures;
- recognition of the benefits of 'natural' flood management measures including utilising floodplains and wetlands as natural flood storage areas;
- integration of rural land use and flood management policies and funding.

Implementation of the new EU Directive on the Assessment and Management of Flood Risks[25] will require application of these principles and the development of catchment flood management plans.

Urban development

National and local planning policy frameworks for flooding are in place. These frameworks recognise that a new development should not take place if it would significantly increase the risk of flooding. Enhanced co-ordination of flood management is achieved by requiring new developments to align their flood management schemes with existing strategic flood management plans.

Table 36 summarises those measures currently available to address morphological impacts from historical engineering and urban development and additional measures that could be put in place.

Table 36: Measures to address morphological impacts from historical engineering and urban development

What are we already doing about this?	
Regulation	• Controlled Activities Regulations (CAR) prevent new damage to the water environment from engineering works on rivers (including from maintenance regimes) • Planning and development control used to identify restrictions on urban development and opportunities for restoration
Advice	• Planning Advice Notes warn against development on flood plains • Scottish Executive efforts to promote sustainable flood management
What additional measures could we put in place?	
Regulation	• The Scottish Executive is considering the introduction of river restoration and remediation regulations • Stronger planning constraints to prevent progressive loss of flood plains • Development of flood risk management plans under the new Floods Directive
Economics	• New funding framework to enable much more restoration work
What additional measures do you think should be developed? What can you do to help?	

[25]See http://ec.europa.eu/environment/water/flood_risk/index.htm

10.2 Impact on morphology: agriculture

As described in section 7.1, agriculture has a major role in the protection and improvement of the environment while contributing significantly to the Scottish economy.

Some of Scotland's most productive agricultural land is alongside rivers. However there are difficulties in farming land in the vicinity of rivers (e.g. rivers move eroding into fields, floods can threaten livestock and damage crops). This has led farmers to straighten and deepen rivers, reinforce banks and construct flood defences.

Agricultural practices, and the associated engineering, can affect the natural balance between local conditions and conditions within the catchment, resulting in impacts to morphology. Alterations typically occur in areas where constraining or altering a river will bring economic benefits (e.g. maximising the area available for agricultural production).

Environmental impacts

Some common pressures associated with agriculture that can affect river morphology include:

- loss of natural bankside vegetation due to ploughing up to the edge of rivers or allowing grazing of river banks;
- construction of flood embankments reducing the area of the floodplain;
- construction of hard bank protection to control bank erosion;
- straightening and realignment of rivers to create straight boundaries to allow farm machinery to operate close to the river, or to lower water levels to drain land;
- increased inputs of fine sediments due to farm run-off or loss of bankside vegetation;
- land drains and culverts.

These pressures can have a variety of direct or indirect impacts on river morphology and ecological health. Channel straightening, dredging, erosion control and flood embankments can lead to a loss of natural morphological features. This can lead to channel destabilisation (erosion or aggradation) and loss of important habitats on which animals and plants depend. The loss of natural bankside vegetation can remove an important natural buffer between agricultural land and the river. This can exacerbate the impacts from other pressures, including engineering and diffuse pollution. In extreme situations, the result is a ditch-like river with limited biodiversity values and which has lost its resilience to pollution and flooding.

Approximately 20% of river water bodies at risk of failing to meet the environmental objectives of the Water Framework Directive are affected by morphological changes resulting from agricultural activities. Morphological impacts caused by agriculture mainly affect river water bodies although one loch is recorded to be affected (Table 37). Map 15 shows those at risk water bodies impacted by this significant issue.

Table 37: Extent of morphological impacts caused by agriculture in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✔	1,851 km	162
Loch	✘	1 km^2	1
Transitional	✘	-	-
Coastal	✘	-	-
Groundwater	✘	-	-

Socio-economic impacts

Engineering and land management continues to have a vital role in flood management. But in some areas of the country, land drainage and river engineering have contributed to increased flood risk. These impacts are typically restricted to areas where works are undertaken in an ad-hoc manner without full consideration of flooding processes and other works within the catchment.

Examples of how agriculture can influence flooding include:

- drainage networks increasing rates of run-off, potentially resulting in changes to the timing of floods and increased flood peaks;
- loss of natural floodplain flood storage areas through channel deepening and creation of embankments (while important for protecting the land adjacent to a river, these works can lead to increased flood risk downstream);
- erosion control and sediment management leading to sediment accumulation in downstream reaches.

River engineering in agricultural areas can have direct economic consequences for other land owners. Where engineering has substantially altered the natural character of a river, there may be unplanned impacts that must be addressed by upstream or downstream land owners. In severe cases, these impacts can result in a requirement for continued and costly maintenance works, including sediment management and erosion control. However, this work is often the result of landowners protecting land to make production more viable.

How do we address this issue?

Agricultural land alongside rivers has often been cultivated through centuries of investment to protect it from flooding and to improve drainage. Compromising important areas of agricultural production could have serious impacts on rural economies and food production. But constraining the space available to a river can harm the environment, create problems for downstream landowners and increase flood risk in urban areas. It will therefore be important to achieve the correct balance.

Agriculture will continue to have an important role in protecting the environment. The Scottish Rural Development Plan[26] and single farm payment schemes provide an opportunity to deliver benefits to farmers and the environment. The Controlled Activities Regulations, which provide controls over engineering works on river and lochs, will help prevent unnecessary damage to the water environment. Similarly, the proposed national General Binding Rules (see section 7.1) will help address environmental impacts resulting from some agricultural practices.

There is a close relationship between measures to protect rivers from diffuse pollution and measures to restore river morphology or improve natural resilience to flooding. For instance, the creation of buffer strips alongside rivers to reduce pollution also provides rivers with space to recover habitat diversity. Riparian woodlands reduce diffuse pollution and contribute to lower rates of bank erosion. Floodplain vegetation can also help store flows on floodplains, thereby alleviating downstream flood risks. These actions, which can deliver benefits to farmers and the environment, will be promoted through single farm payments and the proposed General Binding Rules.

In those catchments where there is a high risk of flooding, targeted re-establishment and restoration of floodplains will contribute to a sustainable approach to managing flood risk. Restoration of floodplains will require capital investment (e.g. to remove embankments). This could affect agricultural income, depending on the type of agricultural land and the frequency of floods. This is an area where the balance between public and private liability needs to be debated. It is likely that some level of public financial support will be required.

Table 38 summarises those measures currently available to address morphological impacts from agriculture and additional measures that could be put in place.

[26]See www.scotland.gov.uk/Topics/Rural/RDR

Table 38: Measures to address morphological impacts caused by agricultural engineering activities

What are we already doing about this?	
Regulation	• Controlled Activities Regulations (CAR) prevent new damage to the water environment from engineering works on rivers
Economics	• Single farm payments promote good agricultural practice • Forestry Committee's woodland grant schemes promote riparian woodland
Advice	• Best practice advice from NGOs/SEPA/SNH/Forestry Commission on river management • Habitat enhancement schemes led by local voluntary initiatives
What additional measures could we put in place?	
Regulation	• General Binding Rules to protect buffer strips alongside rivers • New restoration regulations would allow investment to remove abandoned structures such as old embankments
Economics	• Sustainable and catchment-orientated framework for addressing flood risk
What additional measures do you think should be developed? What can you do to help?	

10.3 Impact on morphology: land claim

Land claim is the enclosure of intertidal or sub-tidal areas within impermeable banks followed by infilling for use by agriculture, housing, port or industry. Initial phases of land claim in Scotland were undertaken to enclose salt marshes and mudflats with earthen banks for agricultural purposes. More recently land claim of intertidal areas for ports and marina, industrial, energy generation and urban development has resulted in additional losses of intertidal areas within Scotland's transitional waters.

In the Scotland river basin district, the majority of land claim works are concentrated on the major estuaries and firths, although there are also some areas of land claim on the coast.

Environmental impacts

Land claim involves the direct removal of ecosystem elements resulting in significant losses to intertidal habitats particularly mudflats and salt marsh. Land claim can result in significant reductions in intertidal area and the biological integrity of the associated ecological elements, thus reducing the capacity of some systems to support many benthic, bird and fish populations.

Physical impacts associated with land claim can include:

- changes in the nature and extent of coastal features, e.g. salt marsh and sand spits;
- substratum loss (removal/direct damage to substrate) and changes to the natural size of sediment;
- increased deposition/smothering due to changes in suspended sediment concentrations – potential short-term effects are during 'infill' operations though, in the longer term, the effects depend on estuary-wide morphological change such as increased erosion;
- changes in longitudinal and lateral sediment transport pathways – land claim development rules out natural erosion of the coastline and can interrupt sediment transport pathways;
- changes in currents – effects are site-specific but impacts can extend beyond the immediate vicinity of the development footprint;
- changes in flushing, stratification and mixing characteristics – land claim results in changes to the planform and cross-section of an estuary affecting the tidal prism;
- changes in wave exposure.

These changes to the hydromorphology can affect the ecology which it supports. Changes in intertidal habitat extent and species composition can have an indirect consequence on food availability for birds and fish, and the composition, density and abundance of phytoplankton leading to reduced overall ecological productivity.

Transitional waters are important nursery and over-wintering habitats for many fish species. The intertidal area is also a source of food for a range of higher trophic levels leading ultimately to birds, seals and dolphins. At low tide, bird populations benefit from the abundant food supply whereas fish feed on the intertidal area at high tide. Fish and birds in particular are therefore susceptible to the loss of intertidal habitat.

The loss of habitat reduces the refuge zones and habitat patches necessary for ecosystem functioning. In the Forth Estuary land claim has removed 24% of the natural fish habitats, which equates to a 40% reduction in their food supply.

In the Scotland river basin district just over half of all at risk transitional water bodies are impacted by land claim (Table 39). Map 16 shows those water bodies impacted by this significant issue.

Table 39: Extent of morphological impacts from land claim in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	-	-
Loch	✘	-	-
Transitional	✔	204 km^2	12
Coastal	✘	229 km^2	5
Groundwater	✘	-	-

Socio- economic impacts

Intertidal areas that have undergone land claim provide the foundation for ports and harbours, marinas, industry, energy generation, housing and increased agricultural productivity. This in turn provides many direct and indirect jobs, and forms an important component of the Scottish economy. Some areas of reclaimed land (e.g. parts of the Musselburgh ash lagoons) are nature conservation areas such as RAMSAR sites, SPAs, SACs or local nature reserves. These areas now have an amenity value associated with them.

The loss of intertidal areas as a result of land claim increases the vulnerability to sea level rise, with flood defence costs becoming unsustainable in some areas.

How do we address this issue?

SEPA has duties under the Nature Conservation Scotland Act 2004 to ensure that land claim is not going to affect biodiversity adversely.

The main mechanisms for addressing the negative impacts from land claim developments in transitional waters are through:

- Coast Protection Act 1949;
- Environmental Impact Assessment Regulations 1999 (EIA);
- Food and Environment Protection Act 1985 (FEPA).

SEPA is a statutory consultee under the EIA Regulations and provides advice to the planning authorities. Advice is provided in line with National Planning Policy Guideline 13 *Coastal Planning* (NPPG13),[27] Scottish Planning Policy 7 *Planning and Flooding* (SPP7)[28] and UK Biodiversity Action Plan (UK BAP)[29] guidance.

[27]See www.scotland.gov.uk/Publications/1997/08/nppg13-coastal
[28]See www.scotland.gov.uk/Publications/2004/02/18880/32952
[29]See www.ukbap.org.uk

There are no statutory consultees under FEPA. But as part of the FEPA licence determination process, the Fisheries Research Service Marine Laboratory has adopted a policy of active consultation on all FEPA licence applications and has a group of consultees which includes SEPA and Scottish Natural Heritage (SNH). SEPA provides any further advice, often in discussion with SNH, to the Fisheries Research Service during this consultation process.

The UK BAP requires agencies in Scotland to maintain at least the present extent and regional distribution of Scottish mudflats. This target will require compensating for losses to development by the restoration of mudflats where this is possible. This can be achieved by:

- modifying the design of the land claim development (e.g. removing obsolete structures, open-piled structures, incorporating environmentally friendly design and materials);
- providing on-site or off-site habitat creation and enhancement.

Managed realignment is the deliberate process of altering flood defences to allow the flooding of a presently defended area. How this is done depends on the site and the reasons for doing it. The two principal methods are breach alignment and bank realignment. Other techniques include lowering a section of existing tidal defence to provide a spillway, or installing sluices or pipes in an existing defence to permit periodic exchange of the tide.

Restoring the hydromorphology and habitat extent within some estuarine systems through managed realignment offers the potential to meet the requirements of the WFD for some water bodies. Re-establishing the ecological integrity of intertidal habitats for biodiversity gain will also be an important driver for managed realignment to mitigate the negative effects of previous land claim developments.

The benefits of managed realignment include:

- the potential to restore intertidal habitats and ecosystem functioning;
- the enhancement of areas for recreational value and access (e.g. bird watching and walking);
- nursery areas for fisheries;
- improved water quality (i.e. valuable pollution sink);
- managing the effects of sea level rise by moving defences landward and providing additional capacity for estuaries and coasts to respond and adapt to higher sea levels;
- sustainable and cost-effective coastal defences and flood and storm buffering capacity.

Table 40 summarises those measures currently available to address the morphological impacts of land claim and additional measures that could be put in place.

Table 40: Measures to address the morphological impacts of land claim

What are we already doing about this?	
Regulation	• Local authority development controls on new areas of land claim • Use of the Environmental Impact Assessment Regulations by local authorities • Fisheries Research Service imposes controls on development below mean low water
Advice	• Coastal planning guidance, e.g. National Planning Policy Guideline 13 and Scottish Planning Policy 7 • UK Biodiversity Action Plans • Restoration demonstration projects by Scottish Natural Heritage and NGOs
What additional measures could we put in place?	
Economics	• Develop funding mechanisms to promote managed realignment/retreat (as part of flood risk management plans)
Advice	• Develop a strategic approach to managed realignment projects
What additional measures do you think should be developed? What can you do to help?	

11 Invasive alien species

This section describes the effect of invasive alien species which have been identified as significant water management issues. Table 41 lists the lengths or areas of water bodies affected by these issues. The number of water bodies is given in brackets.

Table 41: Significant invasive alien species issues in the Scotland river basin district

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Invasive alien species	All sectors	315 km (7)	21 km^2 (4)	136 km^2 (4)	46 km^2 (1)	–

Invasive alien species are non-native organisms that successfully establish themselves in our aquatic ecosystems, resulting in damage to our natural biodiversity and creating potentially significant economic impacts.

Numerous alien species have been introduced deliberately into Scotland through, for example, agriculture, forestry, horticulture and fisheries. Many other species have, however, been introduced accidentally to Scotland through these and other sectors.

Scottish Natural Heritage has identified almost 1,000 alien species present in the wild in Scotland. Most of these are not presently strongly invasive or harmful to native biodiversity. But given the appropriate environmental conditions, a minority of alien species behave invasively and, becoming established, can cause declines in native biodiversity and the transformation of ecosystems. The inter-connectedness of our water environments also assists the dispersal of invasive aquatic species.

Work is underway through the UK Technical Advisory Group on the Water Framework Directive (UKTAG) to produce additional guidance on the inclusion of translocated native species to cover species native to the UK that could be potential threats when introduced into other parts of the country where they were previously absent. For example, the fish species ruffe (*Gymnocephalus cernuus*) was unknown in Scotland until it was discovered in Loch Lomond in 1982. Since then, the population has increased dramatically and caused a fundamental shift in many aspects of the ecology of the loch. This UKTAG guidance should be available for the next round of characterisation of pressures and impacts.

Environmental impacts

Alien species have been divided by the UKTAG into three categories of impact – high, low and unknown. To make the task of assessing risk to the water environment manageable, characterisation work has concentrated on ten key high impact species:[30]

- Australian swamp stonecrop (*Crassula helmsii*);
- Chinese mitten crab (*Eriocheir sinensis*).
- common cord-grass (*Spartina anglica*);
- floating pennywort (*Hydrocotyle ranunculoides*);
- Japanese weed (*Sargassum muticum*);
- North American signal crayfish (*Pacifastacus leniusculus*);
- parrot's feather (*Myriophyllum aquaticum*);
- slipper limpet (*Crepidula fornicata*);
- water fern (*Azolla filiculoides*);
- zebra mussel (*Dreissena polymorpha*);

[30]UKTAG guidance on the assessment of alien species pressures, January 2004.
Available at: www.wfduk.org/tag_guidance/Article_05/Folder.2004-02-16.5332/TAG%202004%20%28PR1-16-03-04%29/view

These species were selected because:

- their impact is known to be severe;
- information on them is usually available for the water bodies in which they occur.

Scottish Natural Heritage identified records of known locations of these alien species. Their presence indicates a risk that the water body will not achieve the WFD's environmental objective of good ecological status. The analysis was not a comprehensive assessment of all alien species but indicates the potential extent of the problem in the Scotland river basin district.

No detailed assessment of ecological impact was made for any of the risk assessments of water bodies. For the purpose of the 2004 characterisation exercise,[31] the recorded presence of one or more of the species on the SNH list was considered sufficient to place the water body at risk of failing to meet its environmental objectives under the WFD.

The following four important invasive alien species identified by the UKTAG as posing a risk to water ecosystems were present in the Scotland river basin district at the time of assessment in 2004.

- The North American signal crayfish, *Pacifastacus leniusculus*, is present in several catchments in the Scotland river basin district. It has an impact on fish abundance and age structure, as one of its main food sources is fish eggs and larvae. It also burrows into banks, releasing silt and causing possible slumping of banks.
- The common cord-grass, *Spartina anglica*, is found in a number of transitional and coastal water bodies in the river basin district where it grows on mudflats and adjacent salt marshes. It has the potential to change the habitats to a monoculture, reducing the area of open mud and potentially altering the pattern of accretion of silt.
- The Australian swamp stonecrop, *Crassula helmsii*, is a highly invasive water plant which can form dense mats, completely out-competing native water plants and creating a poorer habitat for native invertebrates and fish. It is also extremely difficult to eradicate once established.
- The water fern, *Azolla filiculoides*, is a small floating water plant that can completely cover the surface of freshwater bodies (typically pond and lochs), leading to the shading out of light and loss of submerged water plants. This can lead to an impoverishment in the fauna dependent on the native water plants.

The historic record for parrot's feather (*Myriophyllum aquaticum*) was not accurate enough to be ascribed to a specific water body. Subsequent to the risk assessment, Japanese weed *Sargassum muticum* was recorded in Loch Ryan in southwest Scotland (Solway Tweed RBD) and has continued to spread further north along the Scottish west coast, reaching Loch Fyne in the Scotland RBD by August 2006 and the Firth of Lorne by May 2007. Assessment of the spread and impacts of this newly arrived invasive alien marine species requires further work and water bodies affected by it are not included in the totals below.

More than 20% of Scotland's transitional water bodies are at risk of failing to meet the environmental objectives as a result of alien species. A number of rivers, lochs and coastal waters are also affected. Further work is required for all water body categories to establish the extent and severity of the problem. Table 42 shows the area/length and number of water bodies impacted by invasive alien species. Map 17 shows those water bodies impacted by this significant issue.

Table 42: Extent of the impact of key aquatic invasive alien species in the Scotland river basin district

Category	Impacts more than 15% length/ 20% area of 'at risk' water bodies	Length/area impacted	Number of water bodies
River	✘	80 km	23
Loch	✘	-	1
Transitional	✔	91 km^2	4
Coastal	✘	46 km^2	1
Groundwater	✘	-	-

[31]Leading to publication of the Article 5 characterisation report in March 20005.

Socio-economic impacts

Many invasive aquatic and riparian invasive species can have significant social and economic consequences. For example, the combined annual cost of controlling three non-native aquatic plant species in Great Britain (floating pennywort, parrot's feather and Australian swamp stonecrop) has been estimated at over £3 million per year.[32]

A number of invasive alien species also cause considerable interference with the amenity and recreational uses of water environments, e.g. interference with access for angling by giant hogweed, Japanese knotweed and Himalayan balsam. Giant hogweed also poses a risk to health, as contact with its sap can cause significant skin blistering. There are also potential economic impacts from North American signal crayfish on fisheries and through increased bank instability due to burrowing. Chinese mitten crabs have also caused damage to river banks elsewhere in the UK, with the potential for burrows to undermine and increase the instability of river banks.

How do we address this issue?

Addressing alien species problems that prevent the achievement of good ecological status will require action within specific water bodies and consideration of potential sources of re-infestation in the surrounding area.

Experience in controlling alien species has shown that:

- complete eradication is costly and difficult (and may even be impossible in practice);
- preventing introduction in the first place is easily most cost-effective outcome.

If a strategic approach is not adopted there is also a risk of re-infestation from neighbouring sites or, for example, upstream river sections. Co-ordinated control programmes involving a wide range of partners and stakeholders have a much greater chance of success in the long term. Several pilot projects have adopted such an approach.

A three-level hierarchical approach adopted by the Convention on Biological Diversity (CBD) identifies prevention, detection/surveillance and control/eradication as the three main ways of dealing with invasive species. The approach is to:

- develop and instigate a programme of work to tackle existing aquatic alien species problems;
- prevent the further spread of invasive alien species already present;
- prevent new introductions of invasive alien species.

This approach is being adopted by the developing GB Framework Strategy for Invasive Non-native species,[33] the implementation of which in Scotland is being overseen and informed by the work of the Scottish Working Group on Invasive Non-Native Species lead by the Scottish Executive.

This approach is proposed for the Scotland river basin management plan in combination with other relevant activities. Each Area Advisory Group (AAG) will need to identify and prioritise:

- aquatic invasive alien species in their area for monitoring;
- preventative measures to restrict spread;
- measures for control and possible eradication (where appropriate).

Through the AAGs and the RBMP, SEPA will seek to engage with and involve partners. By focussing and prioritising effort, this approach can garner and spend limited resources in the most effective way to address the impacts of priority invasive alien species on the water environment.

Alien species may also be a priority for further research, monitoring and investigation in the first round of RBMP so that we can, subject to available funding, address the gaps and justify measures in future rounds of river basin management planning.

Table 43 summarises those measures currently available to address the impacts from invasive alien species and additional measures that could be put in place.

[32]The Invasive Non-Native Species Framework Strategy for Great Britain [draft], 2007. Available at: www.nonnativespecies.org/documents/Draft_StrategyV6.4.pdf

[33]See www.nonnativespecies.org/07_Public_Consultations.cfm

Table 43: Measures available to address impacts from invasive alien species

What are we already doing about this?	
Regulation	• Control of Pesticides Regulations (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
Advice	• Species Action Framework (Scottish Executive and Scottish Natural Heritage) • NetRegs (www.netregs.gov.uk) advice on best practice for control of certain alien plant species • Local authority and local voluntary projects to address problem species
What additional measures could we put in place?	
Regulation	• Ban on introduction of a wider range of problem species through proposed amendments to Schedule 9 of the Wildlife and Countryside Act 1981 • Ban on sale of problem species through proposed amendments to Schedule 9 of the Wildlife and Countryside Act 1981 and proposed use of Order 14A • Review legislative barriers and link to available legislation
Advice	• Publicity to raise awareness about introduction, spread and need to control/eradicate problem species • Development of a detection/surveillance/control strategy for problem species • Partnerships to support research into control and eradication • Implementation of GB Framework Strategy and Implementation Plan when available
What additional measures do you think should be developed? **What can you do to help?**	

12 Next Steps

12.1 Production of the draft river basin management plan

Over the next 18 months, SEPA will work with the National Advisory Group and Area Advisory Groups to produce the draft river basin management plan for the Scotland river basin district. The WFD requires the draft plan to be published in December 2008 to allow for a period of six months public consultation before publication of the final plan in December 2009.

As required by the WFD, the river basin management plan will include the following information:

- identification of responsible authorities;
- characterisation of the river basin district;
- monitoring networks;
- environmental objectives;
- a programme of measures for the river basin district;
- designation of heavily modified and artificial water bodies;
- a register of protected areas;
- a summary of consultative and participative activities undertaken to support the river basin management plan production and the outcome of these exercises.

The identification and review of significant water management issues in the Scotland river basin district has enabled SEPA to identify those issues it may be able to address through new or additional measures. There are three principal methods by which we may be able to implement these measures:

- changing licence conditions through our planned review of licences under the Controlled Activities Regulations;
- development of new measures such as national policy and guidance (e.g. implementation of a strategy for diffuse pollution);
- actions agreed in partnership by AAG members.

Based on its knowledge of measures that are in place or which might easily be implemented, SEPA has identified those water bodies not expected at this stage to meet good status by 2015.

12.2 Water bodies that may not achieve good status by 2015

SEPA will work with the advisory groups to identify measures that can be taken to address problems affecting those water bodies which we do not expect to reach good status. Everyone will also need to consider whether new approaches can be developed to contribute to the improvement of these water bodies.

Our current assessment indicates that almost one third of all water bodies in the Scotland river basin district will to fail to meet good status by 2015 (Table 44). Map 18 shows the locations of these water bodies and a list is provided in Annex D. According to this provisional assessment, by 2015 the number of water bodies failing to achieve good status may have fallen from 39% (Table 2) to 27% (Table 44).

Table 44: Number and length/area of water bodies which may not achieve good status by 2015 in the Scotland river basin district

Water category	Length/area not meeting good status by 2015 (% of total)	Total length/area of all water bodies	Number of water bodies not meeting good status by 2015 (% of total)	Total number of water bodies
River	6,468 km (31%)	20,819 km	592 (29%)	2,008
Loch	313 km^2 (33%)	961 km^2	84 (27%)	309
Transitional	354 km^2 (59%)	605 km^2	17 (43%)	40
Coastal	1,545 km^2 (3%)	45,796 km^2	23 (5%)	449
Groundwater	17,632 km^2 (26%)	66,567 km^2	123 (45%)	275
Total	**–**	**–**	**839 (27%)**	**3,081**

By working in partnership with stakeholders and through the advisory groups, it is hoped that:

- greater improvements can be made;
- the proportion of water bodies achieving good status can be increased.

Not every water body will be able to meet good status and, for these water bodies, the WFD provides the option of implementing alternative environmental objectives (see section 12.3).

12.3 Objective setting

Objective setting is an improvement planning process which, through the appropriate use of the alternative objectives, will allow us to phase improvements over several river basin planning cycles without undermining the sustainable use of our water resources. Further information on objective setting can be found on the Scottish Executive website.[34]

The WFD's objective setting provisions are designed to allow the development of an appropriate balance between protecting and improving the water environment, and ensuring sustainable uses can continue and flourish. The WFD requires us to aim to achieve good status when and where it is technically feasible and proportionate to do so.

SEPA has reviewed the provisional list of artificial and heavily modified water bodies from 2004 and is interested to hear your views.

Artificial and heavily modified water bodies

The environmental objective for artificial and heavily modified water bodies is good ecological potential by 2015 rather than good ecological status. We have identified artificial water bodies in the Scotland river basin district but work is ongoing regarding the identification of heavily modified water bodies. The work undertaken to date and how we intend to proceed is outlined below.

Artificial water bodies

Artificial water bodies (AWBs) are bodies of surface water created by human activity (e.g. canals). A separate classification scheme is being developed for AWBs which need to attain good ecological potential as opposed to good ecological status. Provisional AWBs were identified in the characterisation for the Scotland river basin district carried out in 2004.

[34]See http://www.scotland.gov.uk/Topics/Environment/Water/15561/14925

In the district, 29 river (canal), 1 loch, 1 transitional and 8 coastal water bodies have been provisionally identified as artificial. Their location is shown on Map 19.

Heavily modified water bodies

In certain circumstances it is not possible for a water body to achieve good status due to substantial physical alterations made for specified purposes such as navigation, water storage, flood defence and land drainage. The WFD recognises that the benefits of such uses need to be retained and allows these water bodies to be designated as heavily modified.

To designate a water body as heavily modified, both of the following criteria must be met:

- The hydromorphological improvements necessary to achieve good ecological status would have a significant adverse effect on the wider environment or on a specified water use.
- Technical feasibility or disproportionate cost mean there is no significantly better environmental option by which the benefits served by the modifications could reasonably be achieved.

In the characterisation report for the Scotland river basin district[35] published in March 2005, provisional heavily modified water bodies were identified on the basis of maps and local knowledge. There have been minor amendments to the number of provisional HMWBs since then due to additional information obtained through the 1b risk assessment review (see section 4.2).

UKTAG has developed a screening tool[36] for use in determining which of these provisional heavily modified water bodies clearly meets the requirements above and should therefore be designated heavily modified without the need to collect additional information.

The uses associated with the modifications to the hydromorphological characteristics covered by the screening tool are:

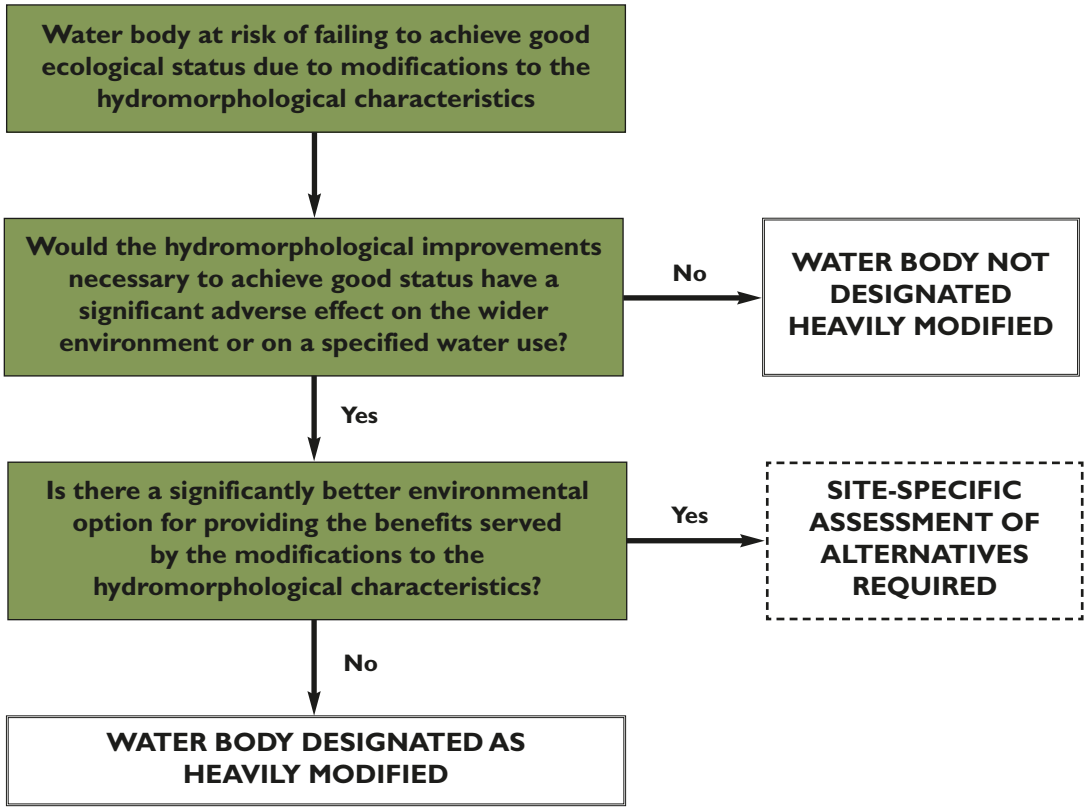
- wider environment (impacts on national and international conservation objectives);
- drinking water supply;
- hydropower generation;
- ports and harbours;
- urban, residential and commercial land use.

This list of uses is not exhaustive. If the use associated with the modifications to the hydromorphological characteristics is not covered by the tool, a site-specific assessment has to be undertaken to collate the necessary information required to determine whether the water body should be designated heavily modified or not.

The tests applied by the screening tool are summarised in Figure 4.

[35]See www.sepa.org.uk/publications/wfd/index.htm
[36]See http://www.wfduk.org/tag_guidance/article_4/

Figure 4: HMWB designation tests as defined by Article 4.3 of the WFD



The screening methodology does not deal with situations where there is a significantly better option for providing the benefits served by the modifications. For example if an impoundment has been built at a loch outflow to provide a drinking water supply, a site-specific assessment may be required to determine whether the water supply could be provided by an alternative source. In situations where there is such an option, a site-specific assessment will be undertaken to decide if the option is technically infeasible or disproportionately expensive in the particular circumstances. Only then will designation be considered. All site-specific assessments will be completed before publication of the draft river basin management plan.

During the autumn of 2006, SEPA applied this screening tool to all 317 water bodies (identified in the characterisation report as provisionally heavily modified) in the Scotland river basin district and identified 226 water bodies that meet the criteria for designation as heavily modified (Table 45).

Information regarding proposed designation is summarised in Table 46. Further more detailed site-specific work is required to assess whether 62 water bodies should be designated as HMWBs. Map 19 shows the location of:

- those water bodies that meet the criteria for designation as heavily modified;
- those water bodies for which site-specific assessments will be undertaken.

Table 45: Results of applying heavily modified water bodies screening tool

	River	Loch	Transitional	Coastal	Total
Total number of water bodies assessed	231	76	8	2	**317**
Results					
Heavily modified	147	71	6	2	**226**
Not heavily modified	27	2	-	–	**29**
Site-specific assessment required	57	3	2	–	**62**
Consult Scottish Natural Heritage/local authorities	2	–	–	–	**2**

Table 46: Reasons for water bodies being designated heavily modified

Use	Number of water bodies*
Hydropower generation	113
Drinking water supply	59
Urban residential and commercial land use	49
Wider environment	35
Ports and harbours	7

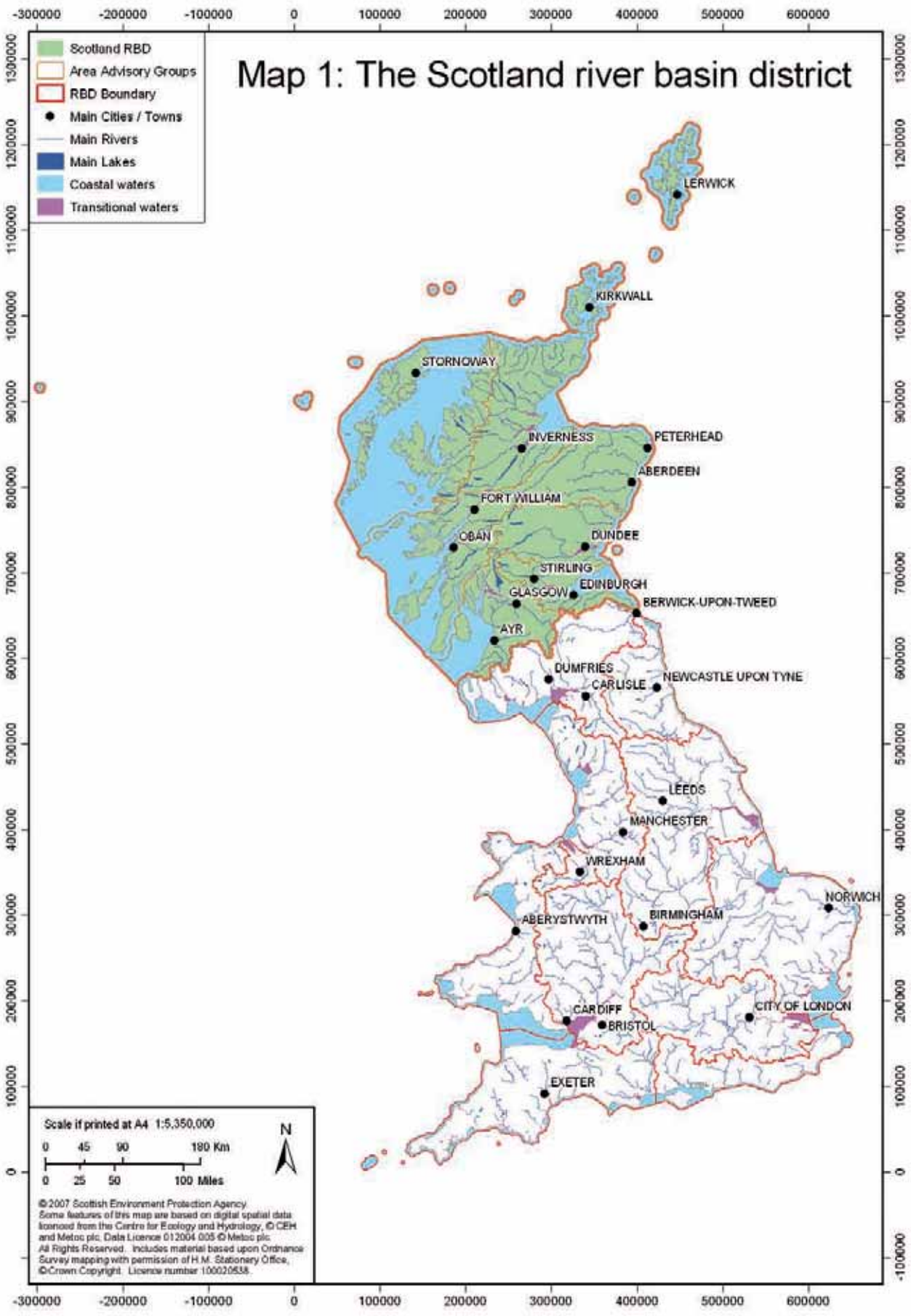
*The total number of water bodies is greater that which comply with the designation tests in Table 45 because a heavily modified water body may be affected by more than one use.

Site-specific assessments will be undertaken through one of the following two processes.

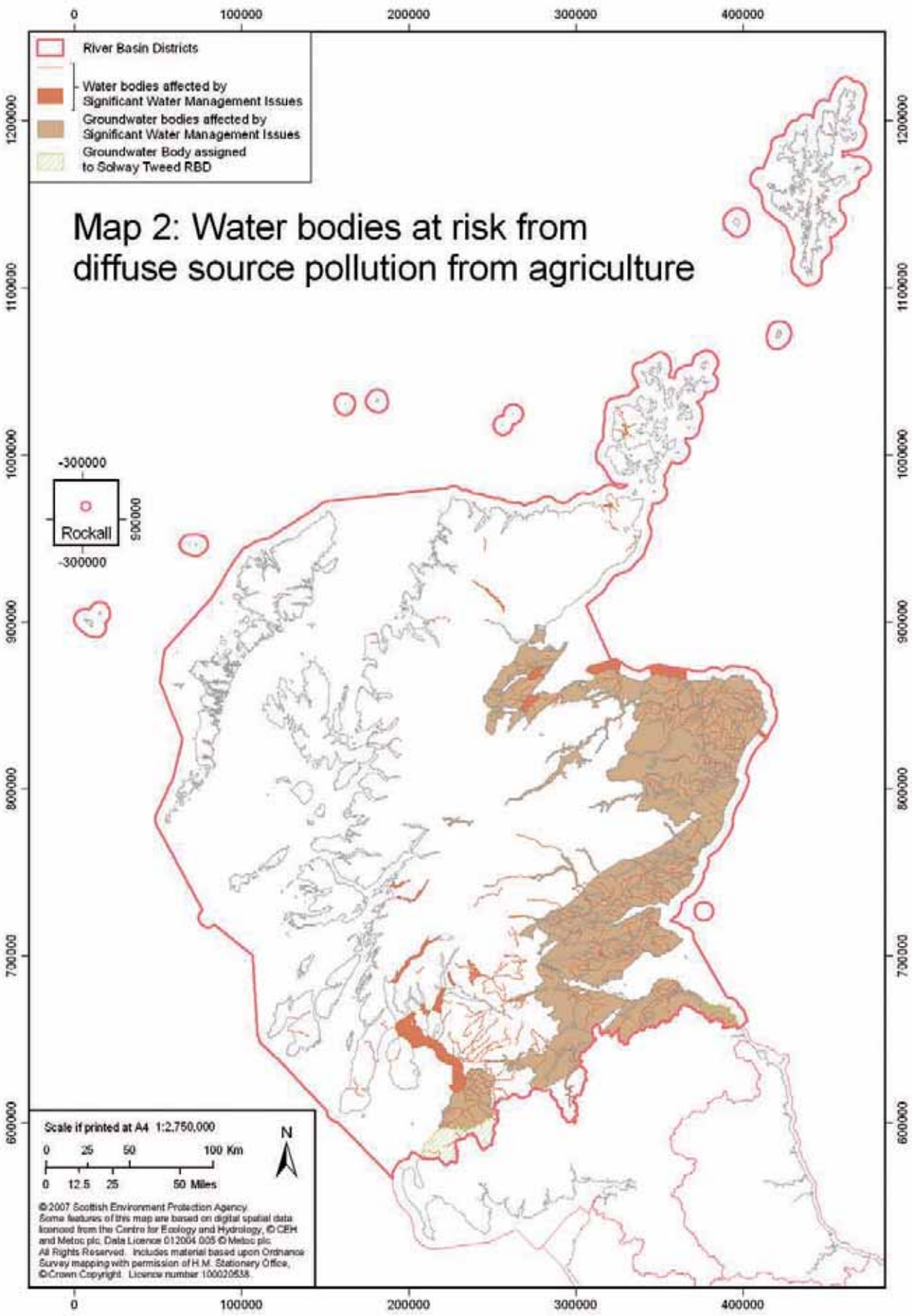
- For those provisional heavily modified water bodies where the activity responsible for their physical modifications is a controlled activity under the Controlled Activities Regulations (e.g. impounding works; maintenance engineering works), SEPA will use its licence review process to identify whether the criteria given above for designation as heavily modified are met.
- For any provisional heavily modified water bodies still remaining, SEPA will use the advisory group networks and external partners to help gather the necessary information needed to determine whether the designation criteria are met.

The final consultation on which bodies should be designated as heavily modified water bodies will be undertaken as part of the draft river basin management plan.

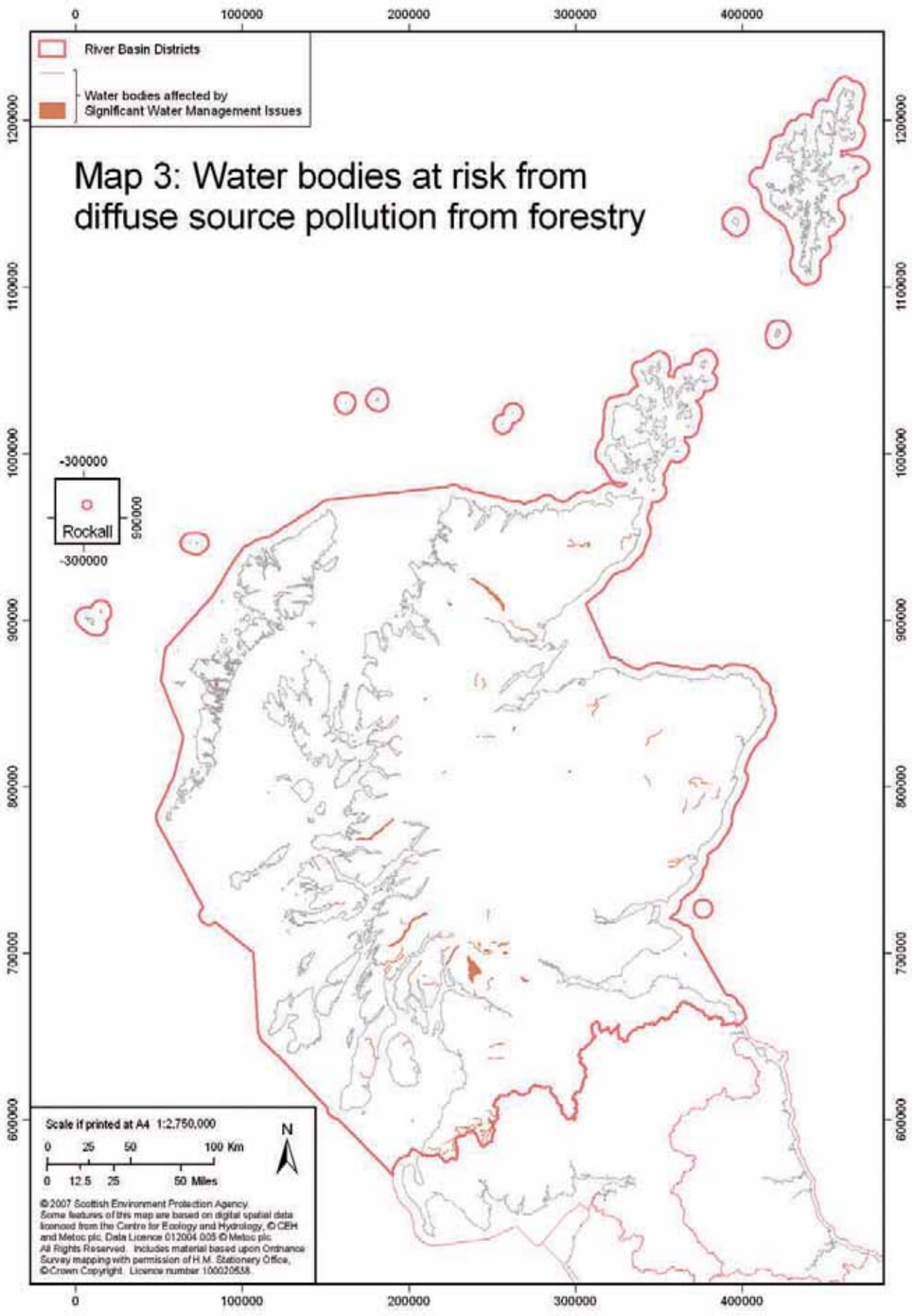
Map 1: The Scotland river basin district



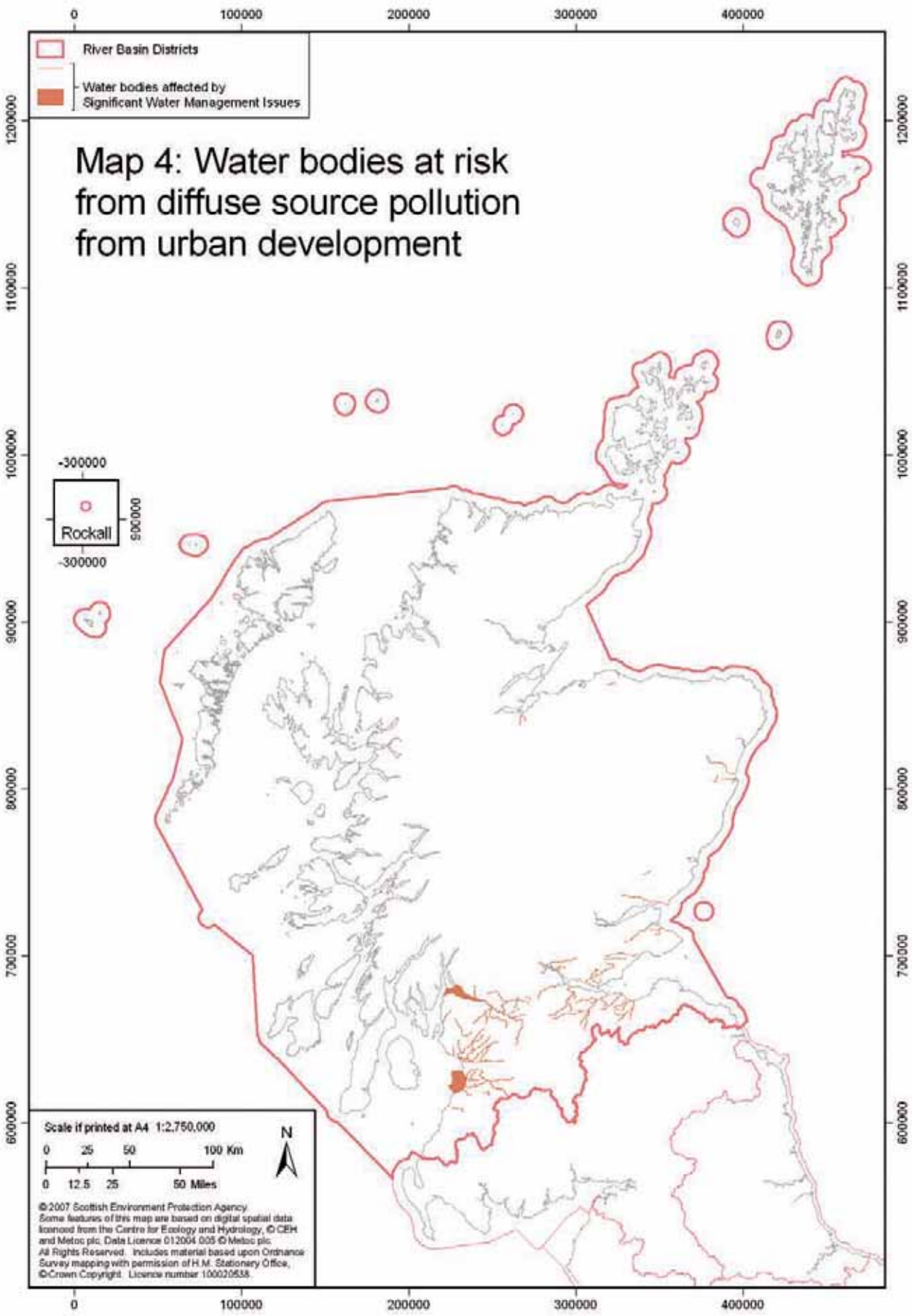
Map 2: Water bodies at risk from diffuse source pollution from agriculture



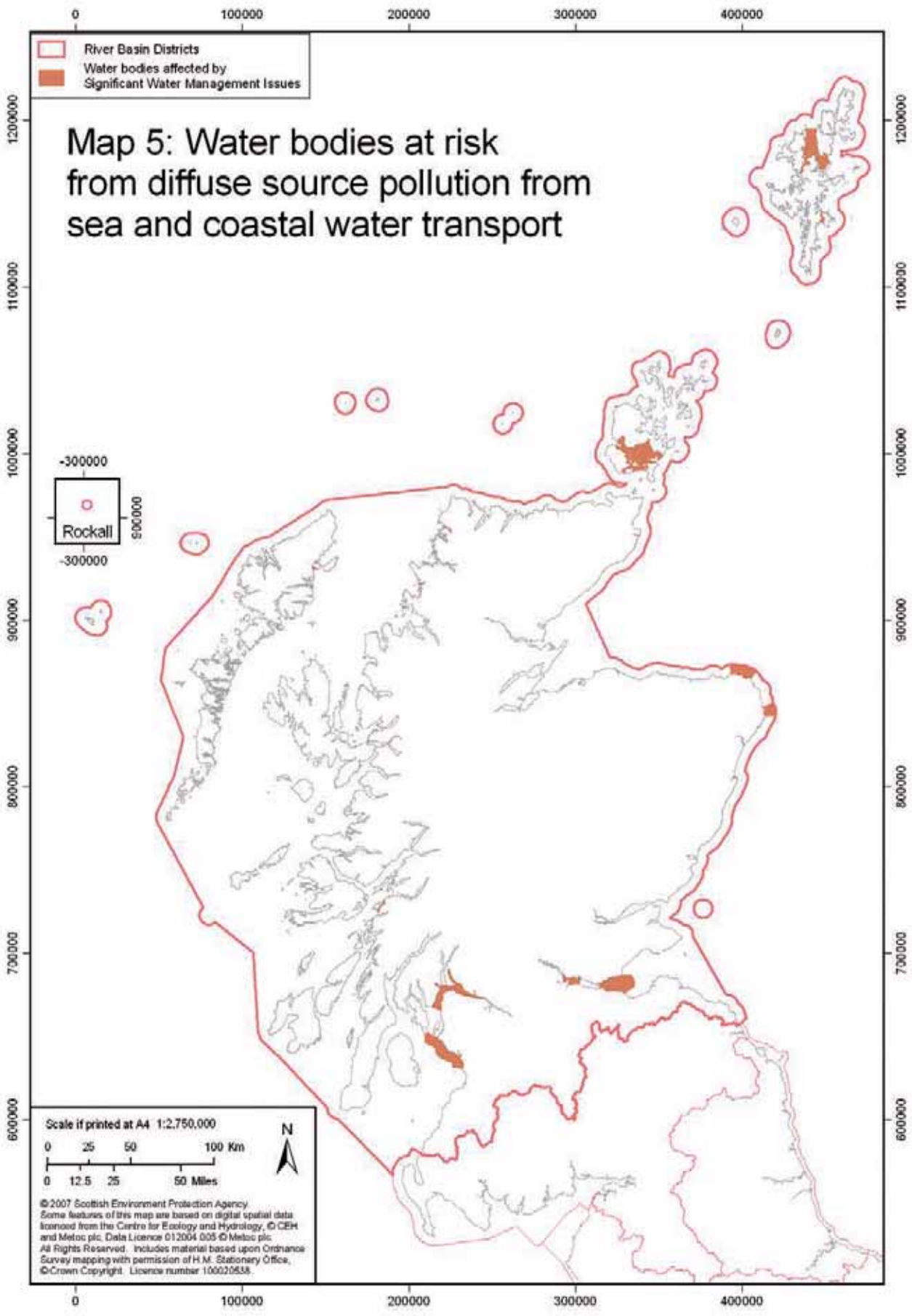
Map 3: Water bodies at risk from diffuse source pollution from forestry



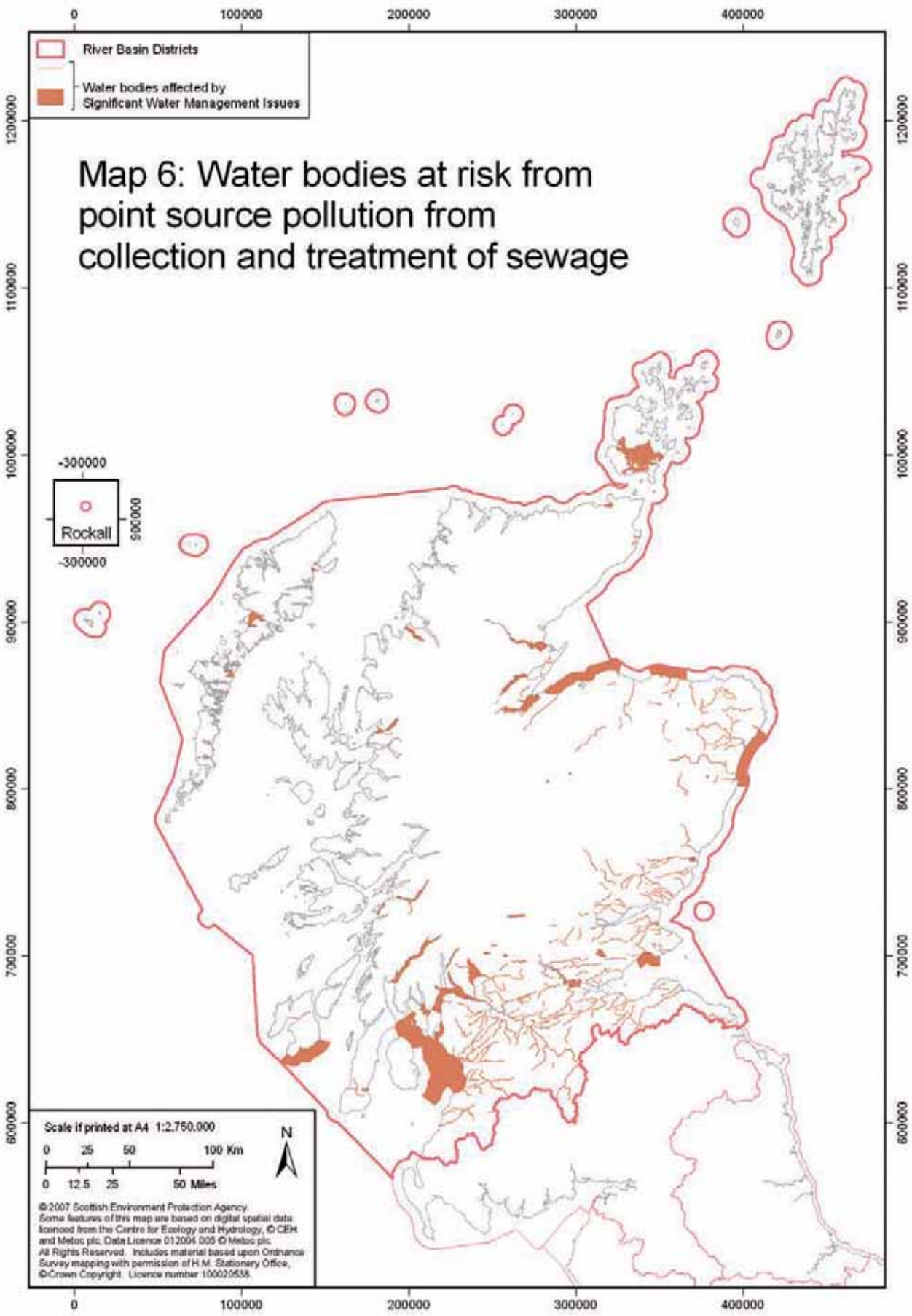
Map 4: Water bodies at risk from diffuse source pollution from urban development



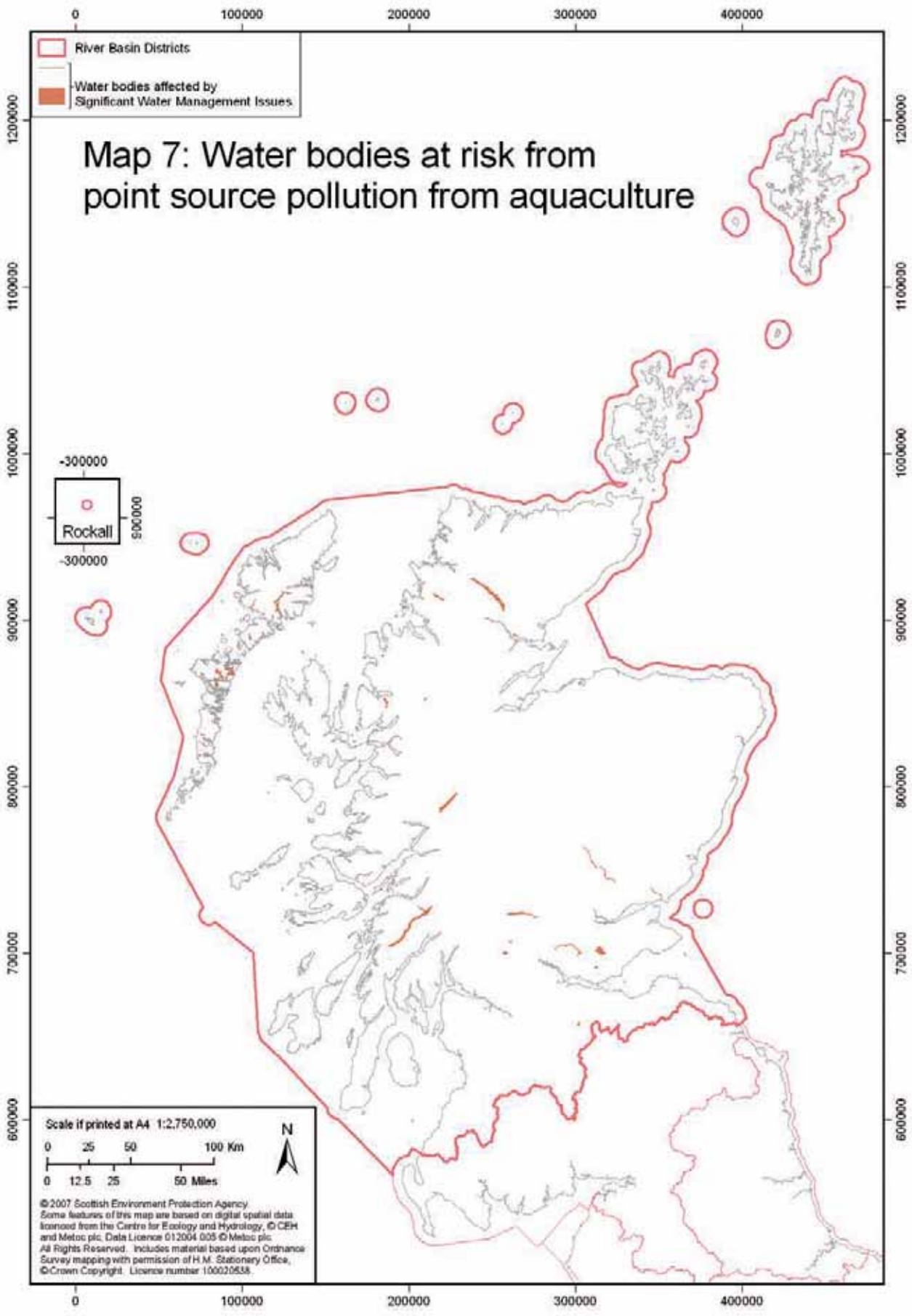
Map 5: Water bodies at risk from diffuse source pollution from sea and coastal water transport



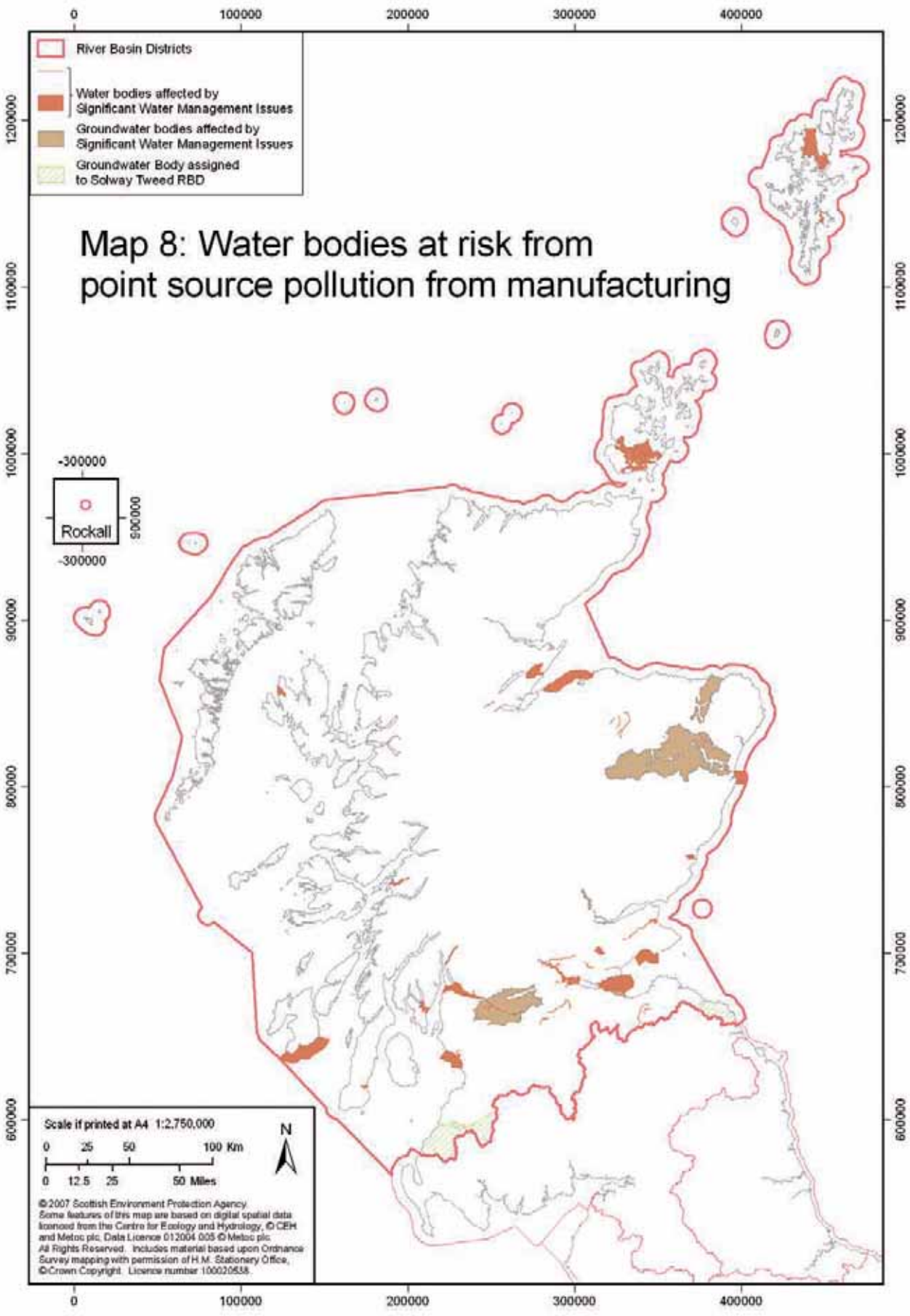
Map 6: Water bodies at risk from point source pollution from collection and treatment of sewage



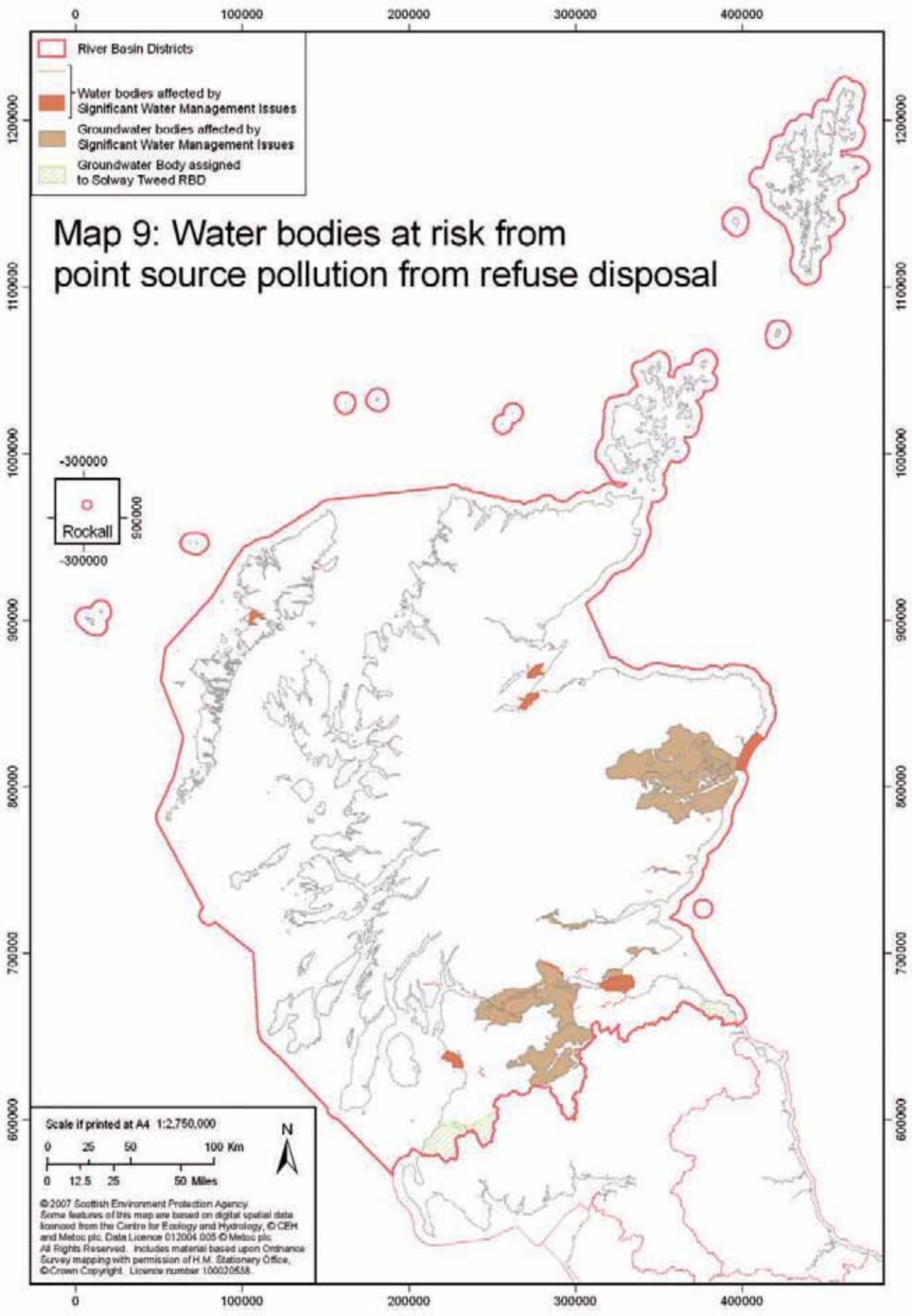
Map 7: Water bodies at risk from point source pollution from aquaculture



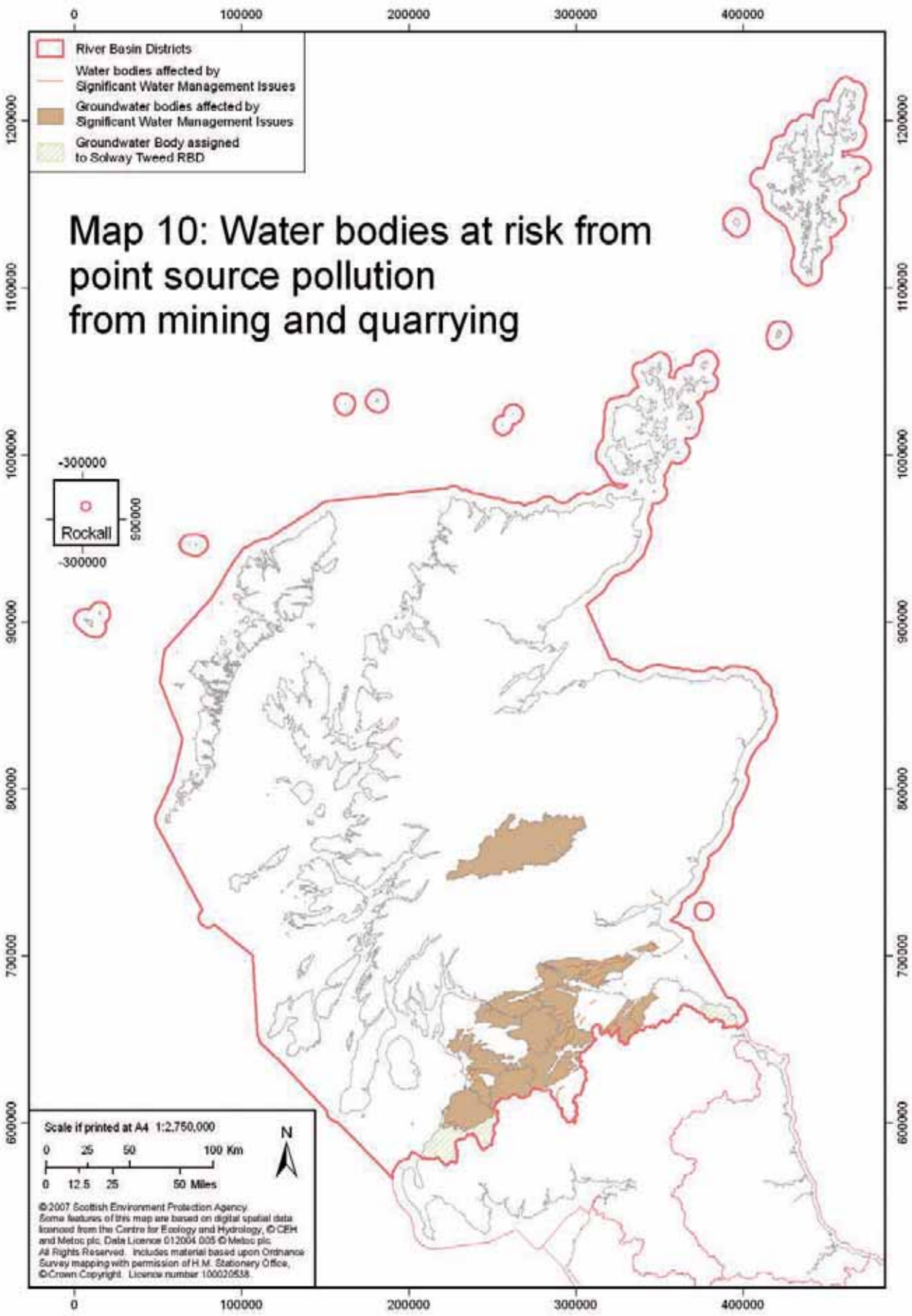
Map 8: Water bodies at risk from point source pollution from manufacturing



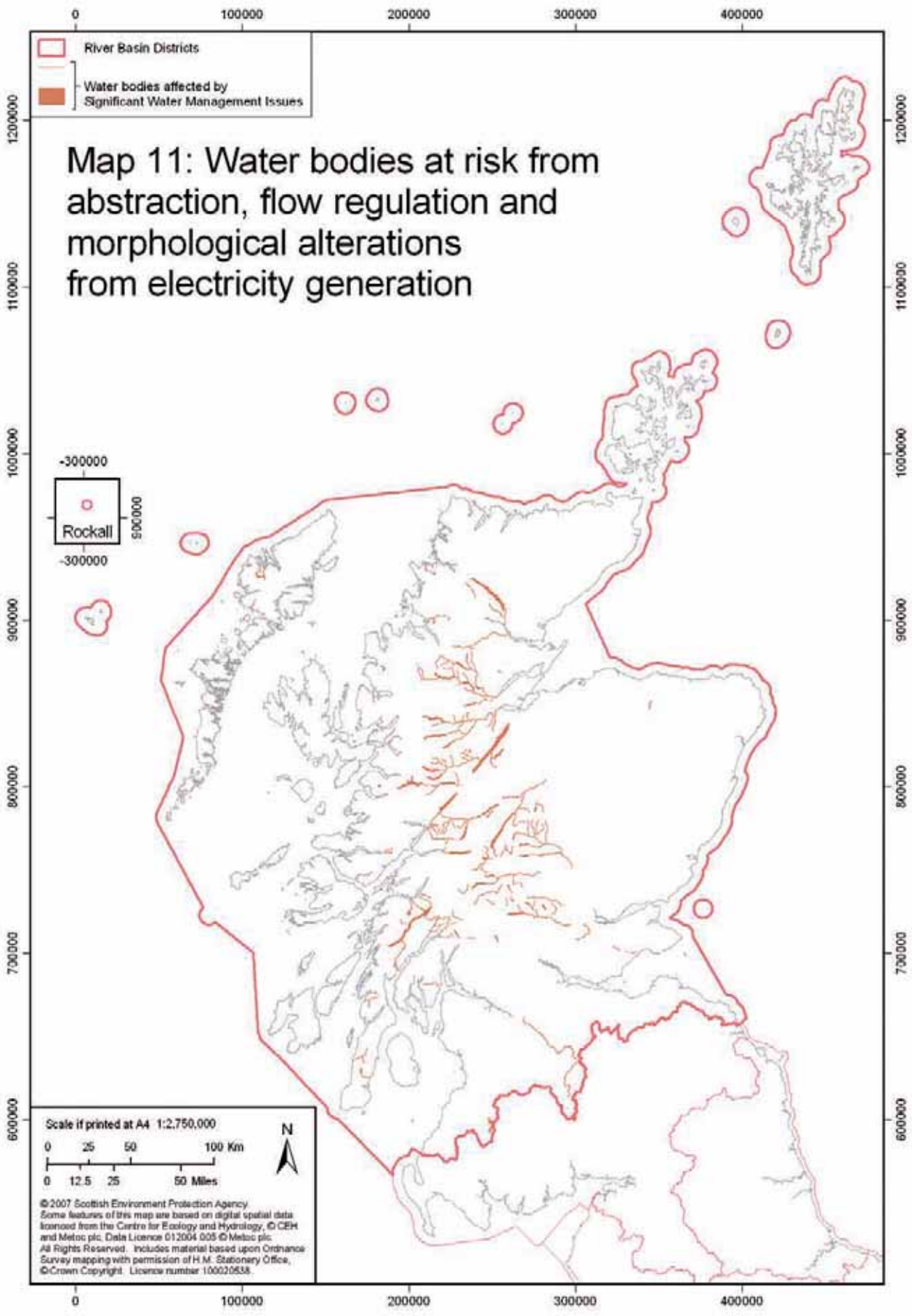
Map 9: Water bodies at risk from point source pollution from refuse disposal



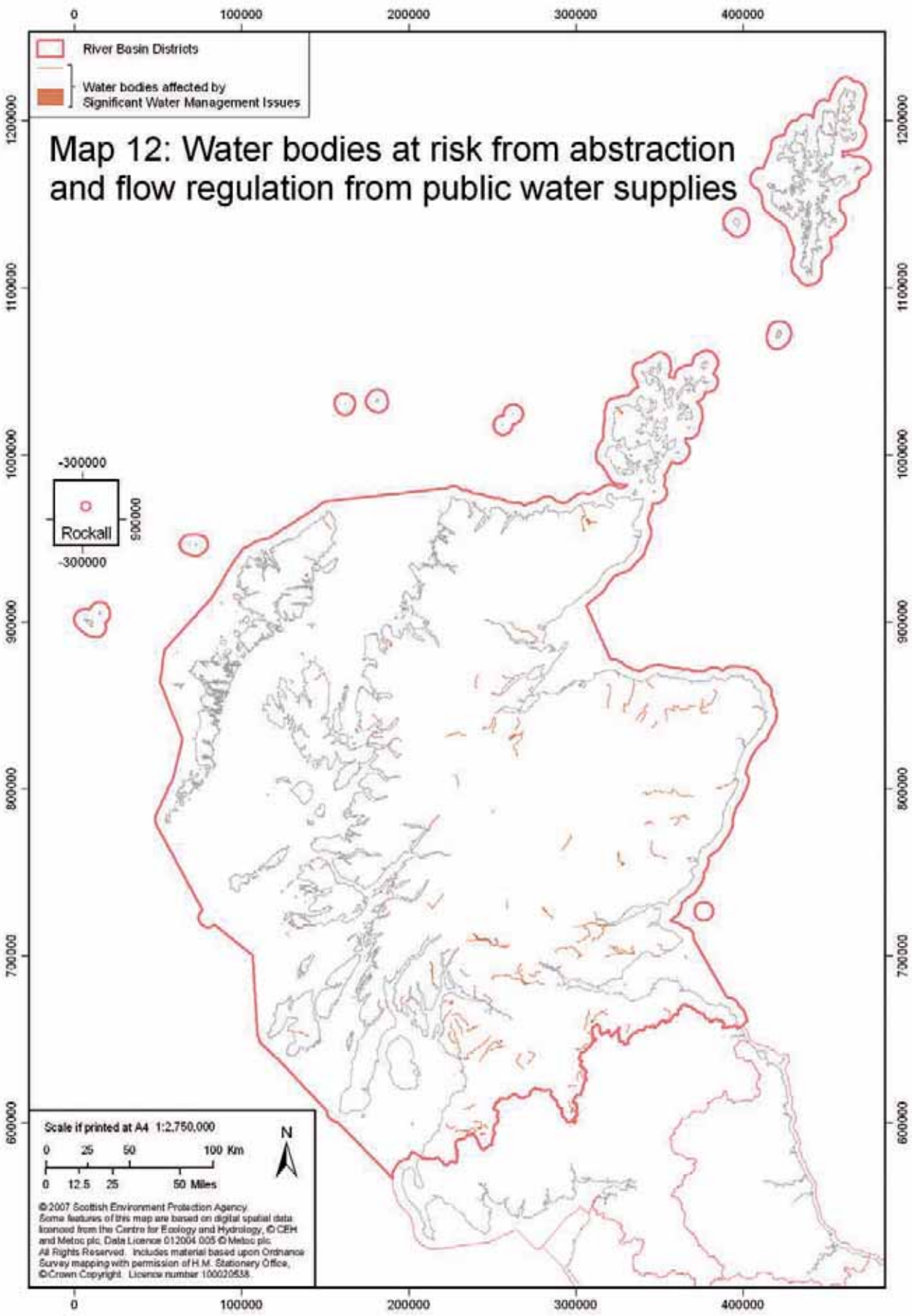
Map 10: Water bodies at risk from point source pollution from mining and quarrying



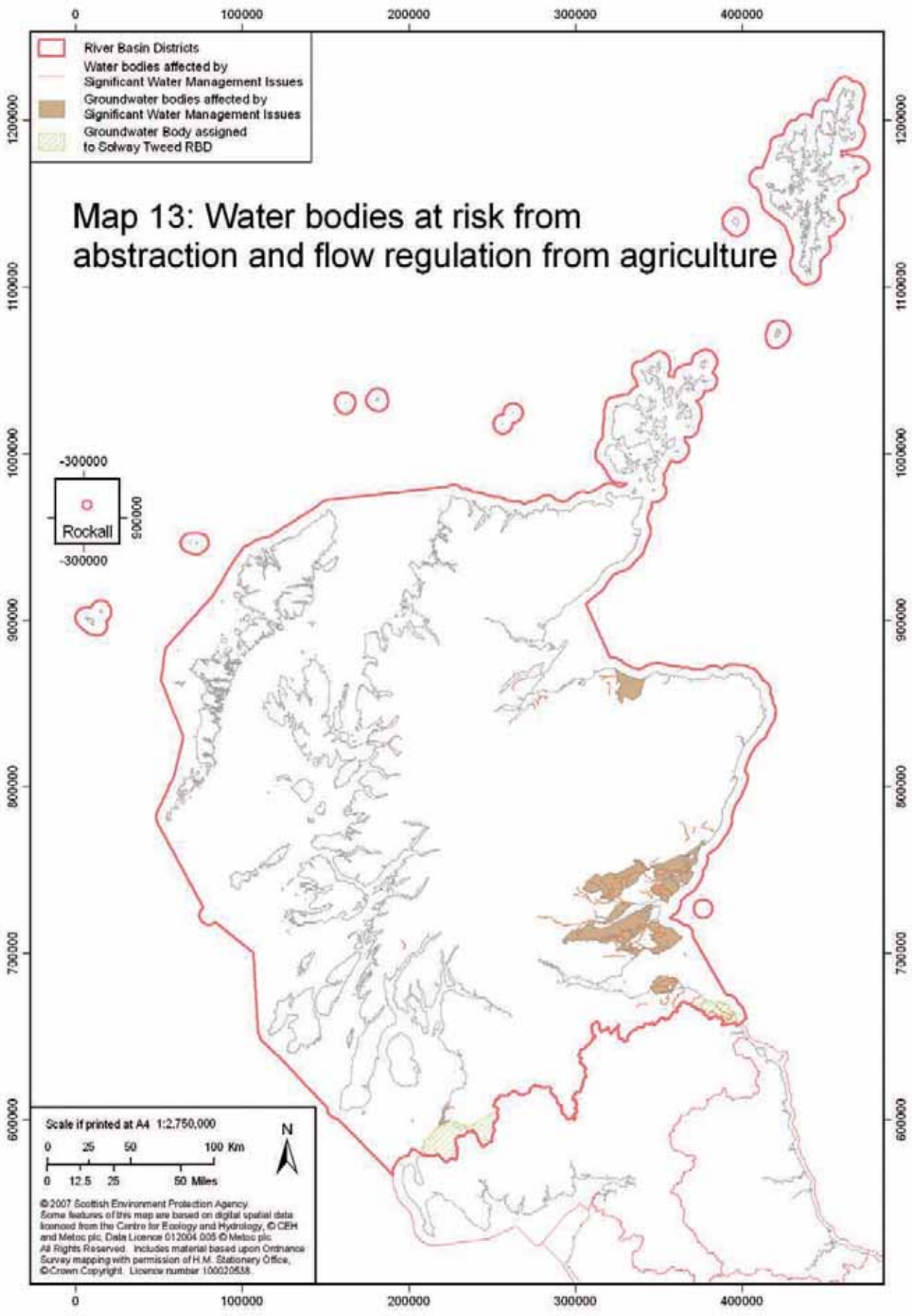
Map 11: Water bodies at risk from abstraction, flow regulation and morphological alterations from electricity generation



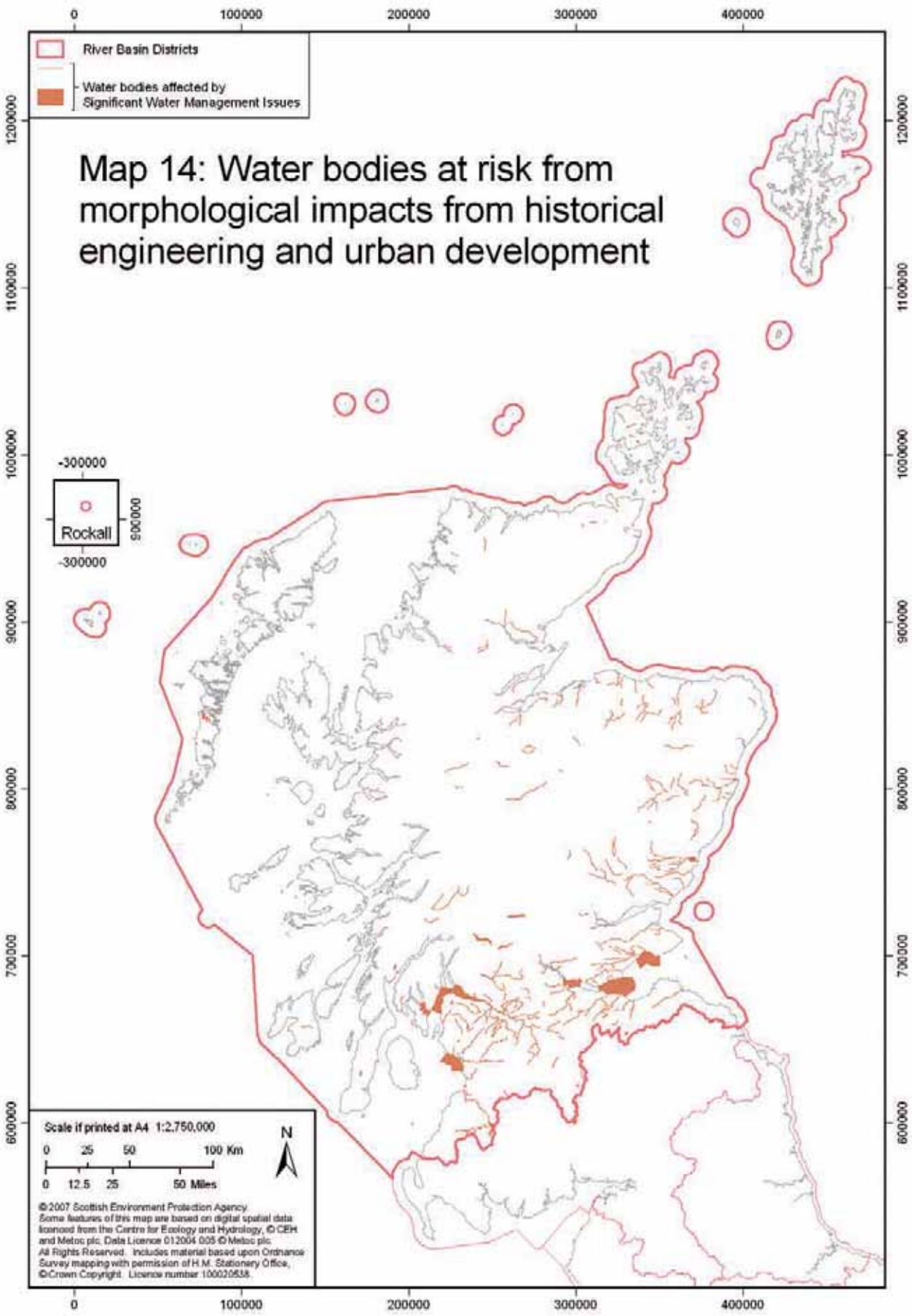
Map 12: Water bodies at risk from abstraction and flow regulation from public water supplies



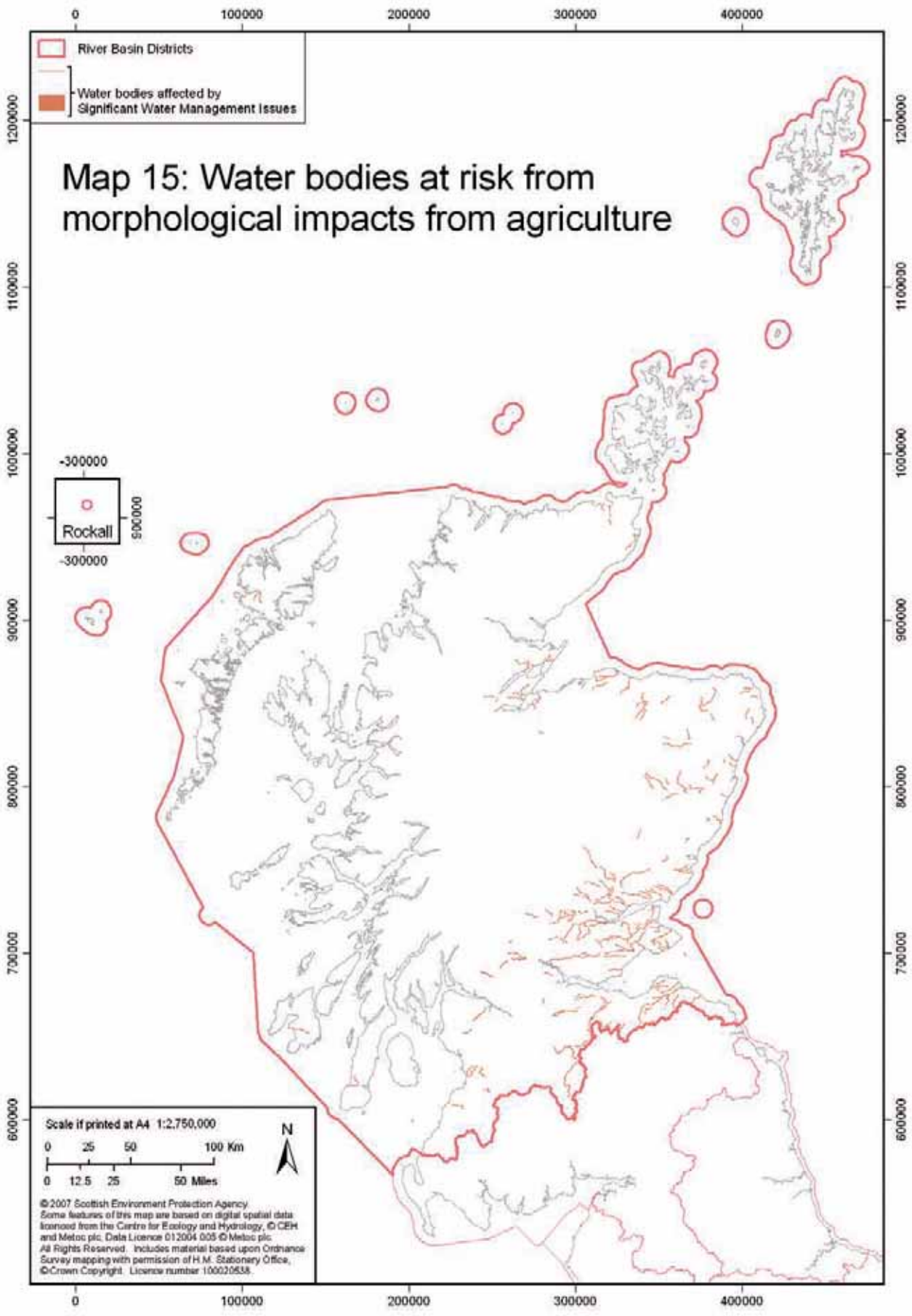
Map 13: Water bodies at risk from abstraction and flow regulation from agriculture



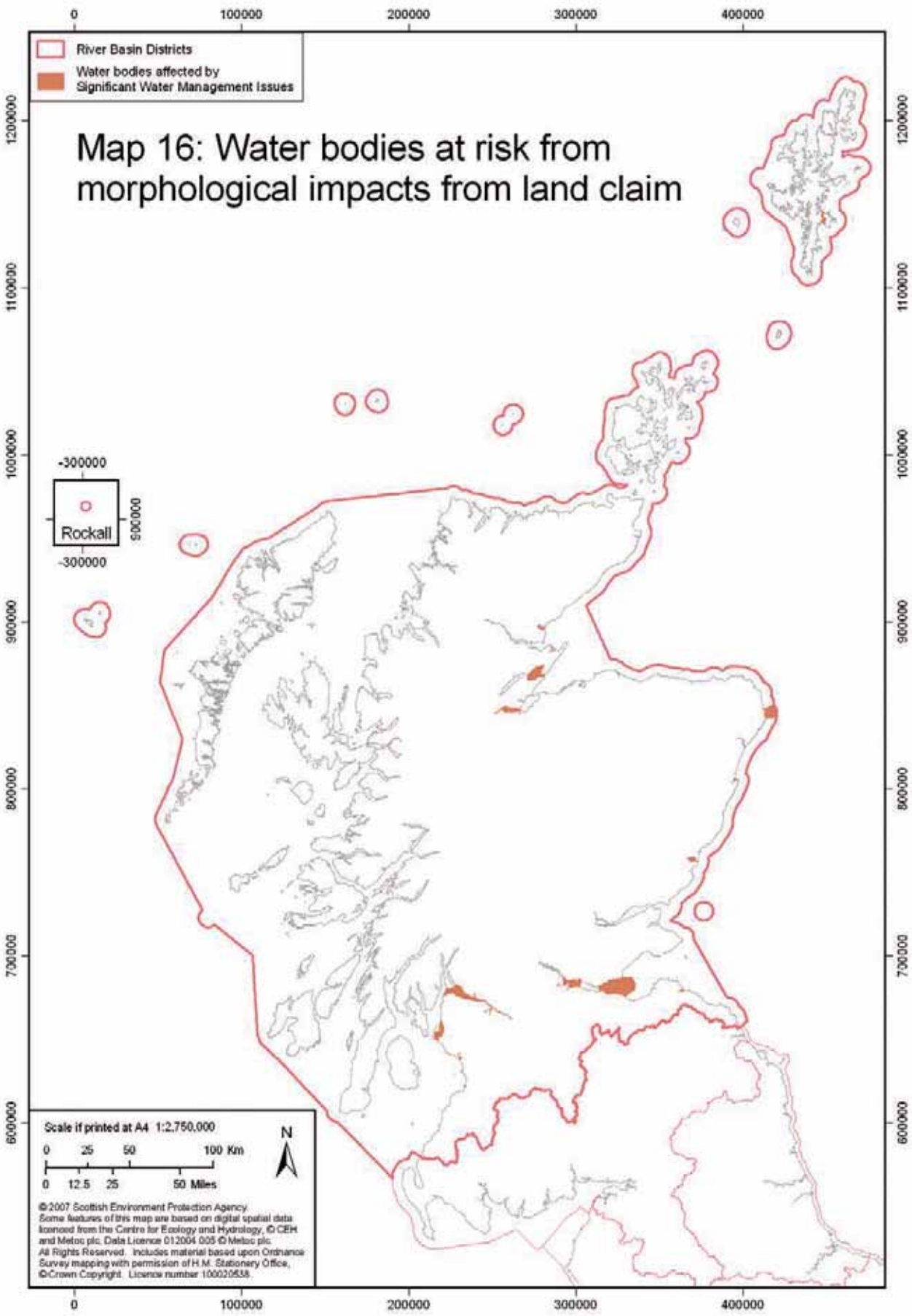
Map 14: Water bodies at risk from morphological impacts from historical engineering and urban development



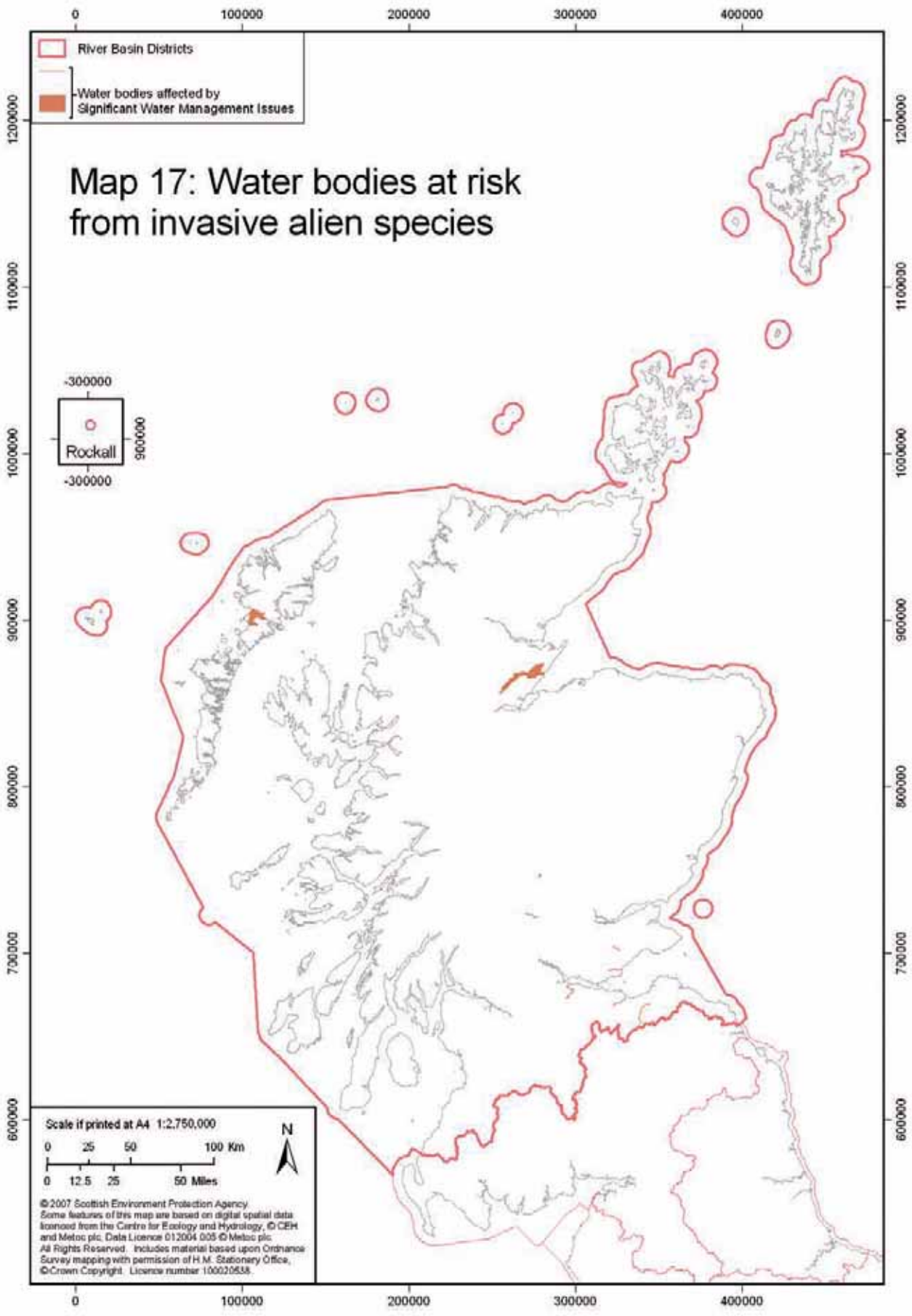
Map 15: Water bodies at risk from morphological impacts from agriculture



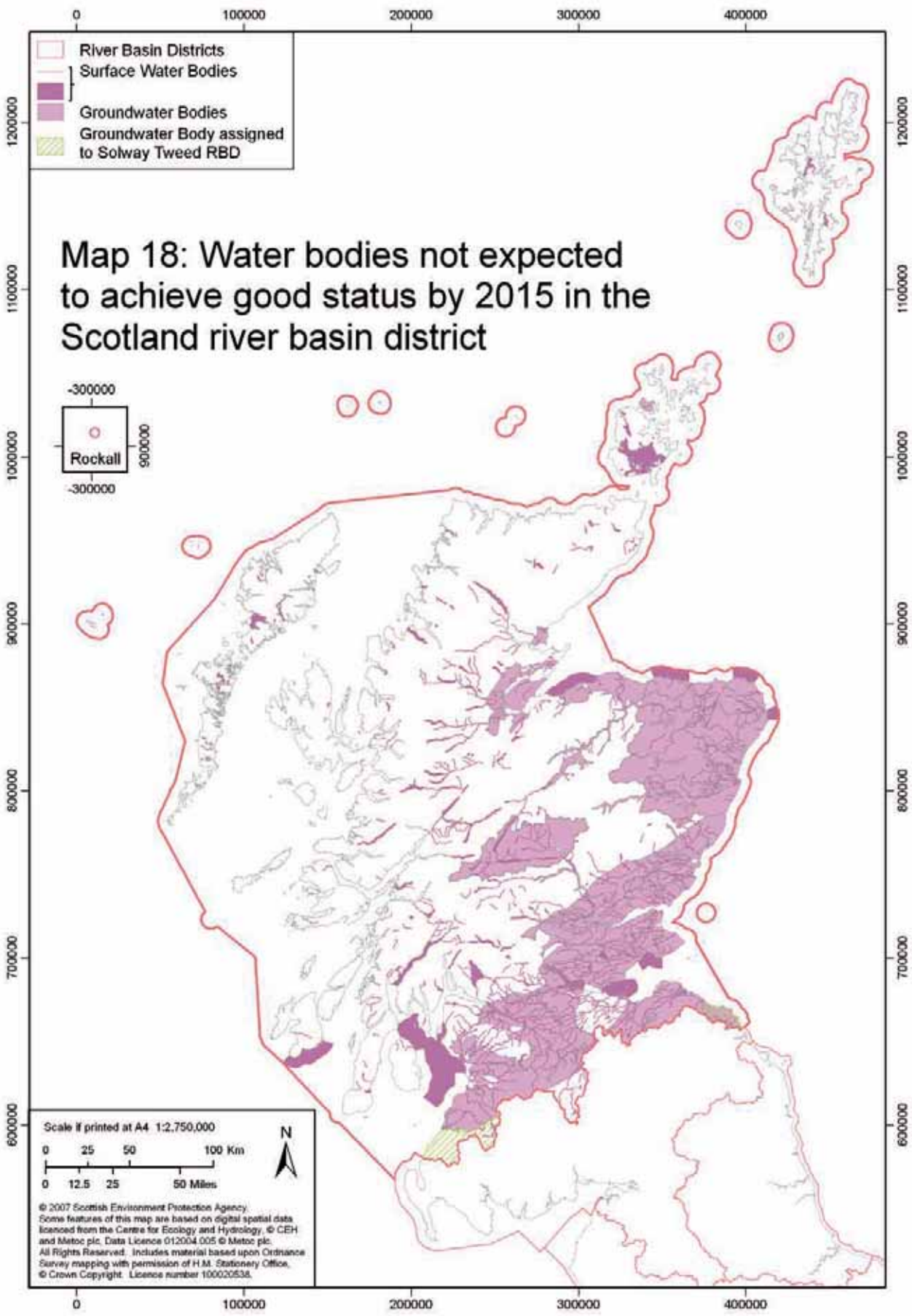
Map 16: Water bodies at risk from morphological impacts from land claim



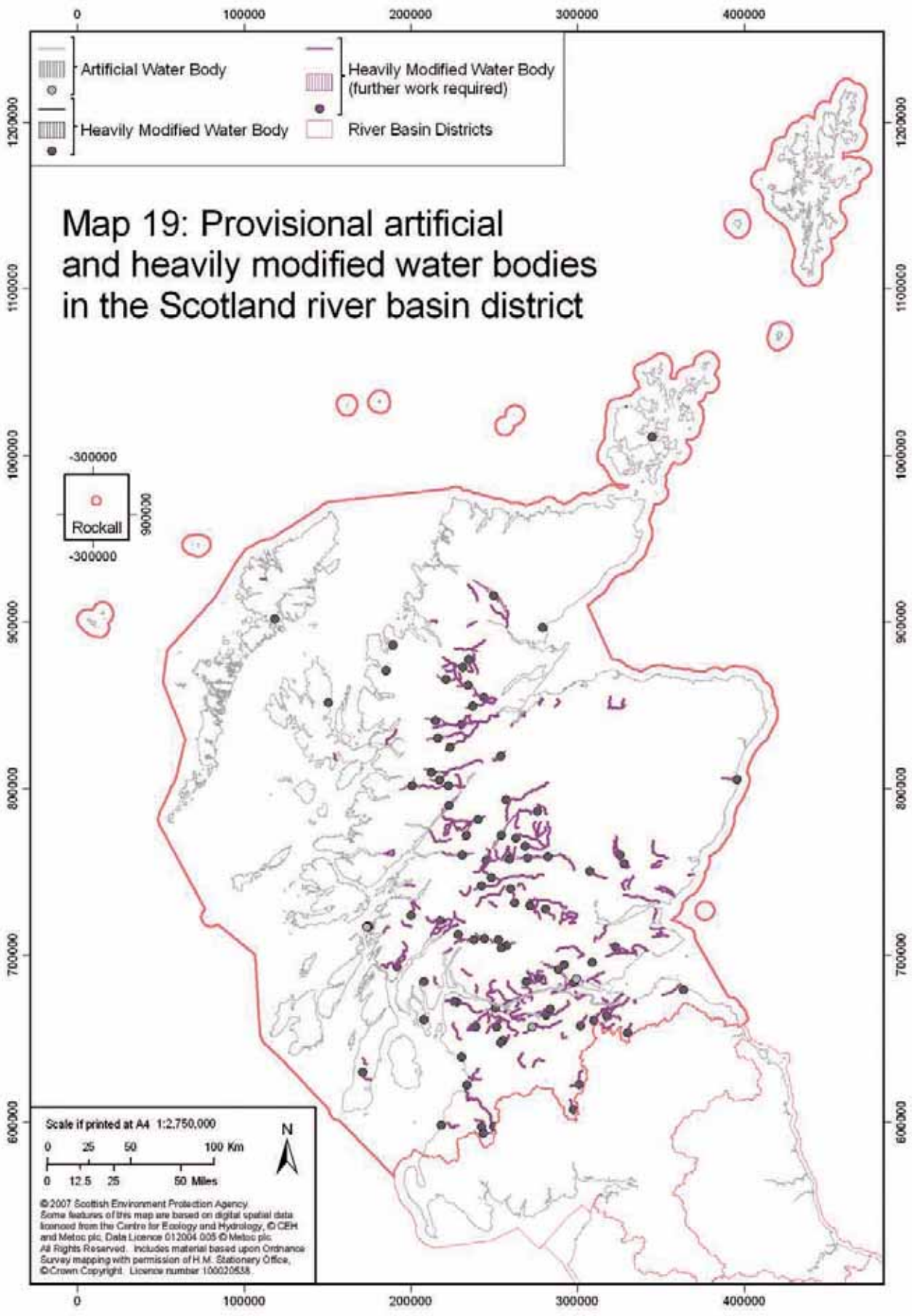
Map 17: Water bodies at risk from invasive alien species



Map 18: Water bodies not expected to achieve good status by 2015 in the Scotland river basin district



Map 19: Provisional artificial and heavily modified water bodies in the Scotland river basin district



Annex A: Further characterisation undertaken by SEPA in the Scotland river basin district

A1 Introduction

Before the implementation of the Water Framework Directive (WFD), environmental assessments focused on pollution pressures, in particular point source pollution, and were supported by extensive chemical and biological monitoring information. The Water Framework Directive requires us to consider pressures that have not previously been taken into consideration when assessing the quality of the aquatic environment – notably abstractions, impoundments and morphological/engineering works.

Since the publication of the characterisation report in 2005, our understanding of the pressures and resulting impacts in the Scotland river basin district has improved mainly as a result of monitoring and the introduction of the Water Environment (Controlled Activities) (Scotland) Regulations 2005.[37] Furthermore, standards and classification schemes for some quality elements (e.g. nutrients) have been developed which have given us a clearer idea of those water bodies currently failing to achieve good status. This has enabled us to refine our assessment of which water bodies are at risk and be more confident in the results.

The focus of further characterisation has been on those water bodies identified as being 'probably at significant risk' (1b) in the characterisation report. A greater degree of certainty regarding the status of these water bodies was required to determine whether additional measures are necessary and if so, what these would be.

Numbers referred to throughout the text are for analyses carried out for all of Scotland, i.e. the Scotland river basin district and the Scottish part of the Solway Tweed river basin district.

A2 Further characterisation methodologies

A2.1 Point source pollution

Since publication of the Article 5 report in 2005, environmental standards (UKTAG Environmental Standards[38]) have been developed at the UK level. Some of the physico-chemical and ecological standards are slightly different to the thresholds used in the initial characterisation. For example, diatom data have been reviewed against new nutrient standards for the assessment of 1b water bodies.

Where appropriate, any additional monitoring undertaken for WFD purposes such as intercalibration and the development of classification tools has been included. This was not available for all water body categories but, where appropriate, information has been used.

SEPA's water quality monitoring network has provided further results since 2004 which have also been used to reassess the risk category of the 1b water bodies. In addition a small number of 1b lochs have been reviewed using the acid neutralising capacity methodology and standing waters classification as indicators of water quality (both diffuse and point source).

The number of changes resulting from the review of water quality data has been minimal but has led to more certainty on the number of water bodies at risk.

A2.2 Diffuse source pollution

The diffuse pollution screening tool used in the initial characterisation has been further developed and now includes a wider range of potential diffuse pollutants. The tool allows the risk from all potential diffuse pollution pressures to be assessed based on pollutant inputs to the land surface and landscape factors which affect their transport. The tool has been applied to all 1b river water bodies and has resulted in only a few changes to the overall number.

[37]The Controlled Activities Regulations were approved by the Scottish Parliament in June 2005 and can be found at www.opsi.gov.uk/legislation/scotland/ssi2005/20050348.htm

[38]See www.wfduk.org/UK_Environmental_Standards/

A2.3 Water resources

For water resources, additional work has been carried out on validating the pressures as well as implementing an improved methodology for assessing their impacts (UKTAG Environmental Standards and Conditions). The new standards were used as the basis for making quantitative assessments of the water resource impacts of known pressures. This marks a significant development from the methodology adopted during the initial characterisation phase whereby assessments were largely based on the presence or absence of pressures.

The introduction of the Controlled Activities Regulations (CAR) enabled the inclusion of authorised agricultural pressures, which were the main omissions from the previous assessment.

In total for all of Scotland, 2,356 river water bodies were assessed of which there are now 195 classed as 1a (definitely at significant risk)and 159 as 1b due to abstraction and flow regulation pressures compared with 208 and 345 as identified in 2005.

In total, 334 loch water bodies (surface area greater than 0.5 km^2) were assessed of which there are now 85 classed as 1a and seven as 1b due to abstraction and flow regulation pressures compared with 100 and 27 as identified in 2005.

A2.4 Morphology

The morphology review primarily used two methods to re-asses the 1b river water bodies. One method is expert judgement on-site using a set of standardised criteria and the second is the application of river habitat surveys and MImAS[39] survey results. Both methods were used in combination with map assessments, aerial photography and old maps where available. Resource constraints meant it was not possible, even using these methods, to reassess all 507 water bodies. A total of 98 river water bodies were re-assessed.

The expert judgement assessments focused on the presence/absence/extent of conifer planting to the banksides. The River Habitat Survey/MImAS surveys focused on sites at risk from straightening/channelisation (agriculture pressures). Of the 98 river water bodies assessed, 30 remain 1b, 15 are 1a and 53 are now 2a (probably not at significant risk).

Surveying of the 1b lochs with a morphological pressure is being carried out as part of the Loch Habitat Survey trial work. Standards against which to apply the survey data are still under development, so results were not available for this report.

The river morphology standards have also been revised since 2004, but SEPA still holds insufficient information to be able to apply the standards to all water bodies. Longer term there is a rolling programme of monitoring targeting 'at risk' water bodies using the MImAS field survey. In addition, a database of morphology pressures (available summer 2007) will allow SEPA to undertake a preliminary classification for morphology of rivers and lochs. Monitoring will then be used to increase confidence in classification. These developments will inform classification for morphology and also the next round of characterisation work.

A2.5 Transitional and coastal water bodies

A review of 1b water bodies has been undertaken for transitional and coastal waters in Scotland as part of the ongoing WFD characterisation process. The purpose of this review was to reallocate as many 1b water bodies as appropriate to the 1a, 2a or 2b (definitely not at significant risk) categories.

The original characterisation process was completed during 2003. The review updated the information by making use of new data including:

- coastal classification results for 2004 (using SEPA's existing water quality classification scheme, not the WFD classification);
- shellfish growing waters results for 2004;
- bathing waters results for 2004.

[39]Morphological Impact Assessment System – tool developed to help characterise physical condition of rivers.

Changes to the transitional and coastal waters risk assessment process were made as follows:

- Class C and D downgrades associated solely with microbiology results at recreational waters (i.e. non-identified bathing waters) with a peak daily user count of <150 were changed to a 2a risk rating. It is considered unlikely that the discharges associated with these downgrades will affect the achievement of good status according to the quality elements defined in the WFD.
- Class C and D downgrades associated solely with microbiology results at shoreline waters were changed to a 2a risk rating. It is considered unlikely that the discharges associated with these downgrades will affect the achievement of good status according to the quality elements defined in the WFD.
- Class C and D downgrades associated with microbiology results at recreational waters (i.e. non-identified bathing waters) with a peak daily user count of >150 were changed to a 1a risk rating. It is considered likely that these waters will be re-designated as identified bathing waters in the near future.
- Class C and D downgrades associated solely with aesthetics were changed to a 2a risk rating. Poor aesthetic quality is unlikely to affect the achievement of good status according to the quality elements defined in the WFD.
- Failure of the EC Shellfish Directive's mandatory and guideline pH and salinity standards were discounted as they are associated with natural conditions such as high freshwater flows, and not with environmental deterioration. These downgrades will be changed from 1a to 2b.
- The OSPAR[40]/WFD imposex classification system has been adopted instead of SEPA's historical classification method which was applied previously. Water bodies are now identified as 1a if they have VDSI[41] scores ≥ 4, as 2a if VDSI scores are 2 to <4 and as 2b if VDSI <2.
- Water bodies (excluding lagoons) were identified as 1a for eutrophication if they are currently identified as a problem area under OSPAR or a sensitive area under the UWWTD.

The further assessments carried out on the 1a water bodies has led to 13 changing from 1a to 2a, and four changing from 1a to 2b. Additional assessments were also carried out for the 1b water bodies; more than 50 changed from 1b to 2a, six changed from 1b to 1a, and two from 1b to 2b.

A2.6 Groundwater bodies

Initial characterisation was completed in 2005 on 124 groundwater bodies; 46% (by area) of groundwater bodies were identified as being at risk of failing the requirement of good status. Each body was, on average, approximately 600 km^2 in size.

The area at risk was considered to be an over-estimate, largely as a function of the considerable size of the groundwater bodies. The size of the groundwater bodies was, in turn, a consequence of:

- limited data on aquifers in Scotland;
- uncertainties as to the link between monitoring requirements and groundwater bodies.

A key strategy underpinning further characterisation in Scotland has been the subdivision of certain groundwater bodies where there was a wide variation in pressures or in geological conditions pertinent to the natural attenuation of pressures. This is necessary in order to provide:

- more focussed assessment of areas at risk;
- a more suitable basis on which to design monitoring networks.

The process of subdivision was made possible by:

- data collected on pressures and geological characteristics during initial characterisation;
- finalisation of UKTAG monitoring guidance.

The UKTAG guidance allowed for grouping of groundwater bodies by similar pressures and geological characteristics, even in at risk situations. This, in turn, meant that monitoring points were not required in all groundwater bodies.

[40]Oslo and Paris Convention
[41]Vas Deferens Sequence Index

Subdivision focussed mainly on those groundwater bodies at risk. In accordance with UKTAG guidance, flow or geological boundaries formed the basis of the new bodies. Appropriate boundaries were selected using a standard set of national geological and hydrological datasets in order to ensure consistency of application. This meant that a small number of 'not at risk' groundwater bodies were also split. Of the original 124 groundwater bodies, 54 were subdivided to create a total of 343 bodies.

The latest round of further characterisation was completed in 2006. Its results were as follows:

- 33% (by area) of groundwater bodies were identified as being at risk of failing the requirements of good status;
- each body was, on average, approximately 230 km^2 in size.

The process of subdivision has allowed a much clearer indication of problem areas. This will allow better targeting of remedial action and will provide a much more transparent basis for the design of monitoring networks.

A2.7 Invasive alien species

No specific work has been undertaken in relation to alien species pressures but updated information received from Scottish Natural Heritage has been incorporated into the risk assessment.

A3 Outcomes of further characterisation

The main reasons for the changes in water body risk assessments are listed in Table A1. In addition, changes in the magnitude or nature of pressures impacting on water bodies, the cessation of existing pressures or the awareness of new pressures may have resulted in changes to the water body category. These changes were made as and when necessary in order to maintain an up-to-date dataset.

Table A1: Main reasons for changes in water body risk assessments

Pressure	Reasons for change
Point source pollution	• Application of new UKTAG physico-chemical and ecological standards • River water quality classification results • Results of monitoring undertaken as part of the intercalibration exercise and classification tool development
Diffuse source pollution	• Further development of diffuse pollution screening tool to include a wider range of potential diffuse pollutants
Water resources	• Application of new UKTAG standards and thresholds • Information on agricultural abstractions obtained through CAR licence application process
Morphology	• New standards have been applied to some water bodies • Further assessment of some water bodies in relation to conifer planting to banksides and agricultural straightening/channelisation
Invasive alien species	• Updated information from Scottish Natural Heritage
Transitional and coastal waters	• Use of new data including the 2004 coastal classification results, shellfish growing waters results and bathing waters results • Changes to criteria related to microbiology, aesthetics, pH and salinity
Groundwater	• Subdivision of certain groundwater bodies

A1.2 Results of further characterisation for the Scotland river basin district

Note: Numbers in Tables A2 to A6 are for the Scotland river basin district only.

Table A2: River water bodies

	Reporting category	Number of water bodies		% of number		Length (km)		% of length	
		2005	2007	2005	2007	2005	2007	2005	2007
Rivers	1a	343	548	17.1	27.3	3,453	5,939	16.6	28.5
	1b	570	278	28.4	13.8	6,523	3,144	31.3	15.1
	2a	291	293	14.5	14.6	3,288	3,286	15.8	15.8
	2b	801	889	40.0	44.3	7,559	8,450	36.3	40.6
Total		2,005	2,008	100	100	20,822	20,819	100	100
Total at risk	**1a+1b**	**913**	**828**	**45.5**	**41.1**	**9,976**	**9,083**	**47.9**	**43.6**

Table A3: Loch water bodies

	Reporting category	Number of water bodies		% of number		Area (km^2)		% of area	
		2005	2007	2005	2007	2005	2007	2005	2007
Lochs	1a	113	138	36.6	44.7	404	520	42.1	54.2
	1b	54	24	17.5	7.8	182	112	19.0	11.7
	2a	37	41	12.0	13.3	103	55	10.8	5.7
	2b	105	106	34.0	34.3	271	273	28.2	28.4
Total		309	309	100	100	961	961	100	100
Total at risk	**1a+1b**	**167**	**162**	**54.1**	**52.4**	**587**	**633**	**61.1**	**65.9**

Table A4: Transitional water bodies

	Reporting category	Number of water bodies		% of number		Area (km^2)		% of area	
		2005	2007	2005	2007	2005	2007	2005	2007
Transitional	1a	17	16	42.5	40.0	357	319	59.1	52.7
	1b	6	5	15.0	12.5	150	106	24.8	17.6
	2a	5	7	12.5	17.5	60	142	9.9	23.5
	2b	12	12	30.0	30.0	38	38	6.3	6.3
Total		40	40	100	100	605	605	100	100
Total at risk	**1a+1b**	**23**	**21**	**57.5**	**52.5**	**507**	**425**	**83.8**	**70.3**

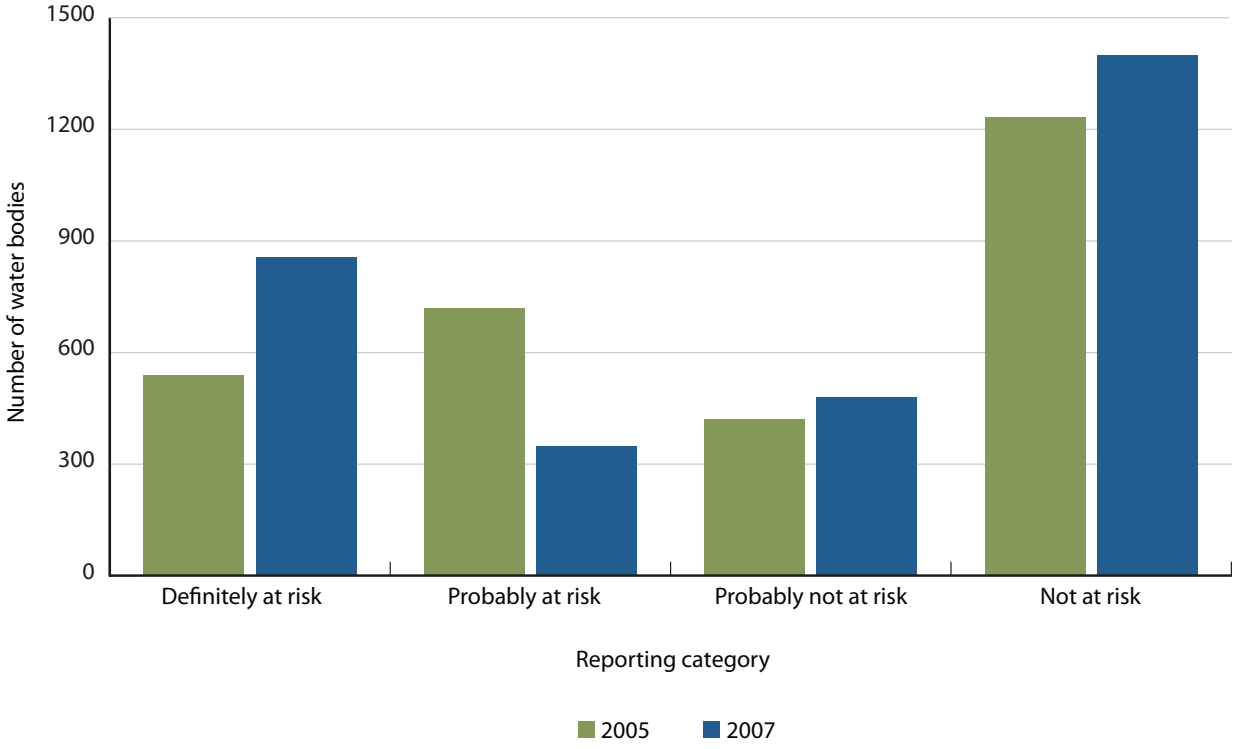
Table A5: Coastal water bodies

	Reporting category	Number of water bodies		% of number		Area (km²)		% of area	
		2005	2007	2005	2007	2005	2007	2005	2007
Coastal	1a	46	30	10.2	6.7	2,650	2,217	5.8	4.8
	1b	82	23	18.3	5.1	5,071	809	11.1	1.8
	2a	53	80	11.8	17.8	21,493	7,101	46.9	15.5
	2b	268	316	59.7	70.4	16,582	35,670	36.2	77.9
Total		449	449	100	100	45,796	45,796	100	100
Total at risk	**1a+1b**	**128**	**53**	**28.5**	**11.8**	**7,720**	**3,025**	**16.9**	**6.6**

Table A6: Groundwater bodies

	Reporting category	Number of water bodies		% of number		Area (km²)		% of area	
		2005	2007	2005	2007	2005	2007	2005	2007
Groundwater	1a	19	123	17.9	44.7	21,072	18,021	31.8	27.1
	1b	6	19	5.7	6.9	6,413	2,784	9.7	4.2
	2a	34	58	32.1	21.1	29,084	9,666	43.9	14.5
	2b	47	75	44.3	27.3	9,682	36,097	14.6	54.2
Total		106	275	100	100	66,250	66,567	100	100
Total at risk	**1a+1b**	**25**	**142**	**23.6**	**51.6**	**27,484**	**20,805**	**41.5**	**31.3**

Figure A1: Comparison of number of water bodies per reporting category in 2005 (characterisation report) and 2007 (SWMI report)



A4 Future characterisation work

Characterisation is an ongoing process and a characterisation and impacts analysis of the river basin district must be undertaken every river basin planning cycle. Characterisation for the second cycle, which is due to be reported in 2013, will look at which water bodies are expected to be at risk of meeting good status by 2021. It will be possible in this second cycle to assess the outcomes of measures and to use information obtained from the new Water Framework Directive monitoring network.

Annex B: Supporting evidence for identification of the significant water management issues in the Scotland river basin district

Figure B1: Significant water management issues affecting 1a and 1b river water bodies in the Scotland river basin district

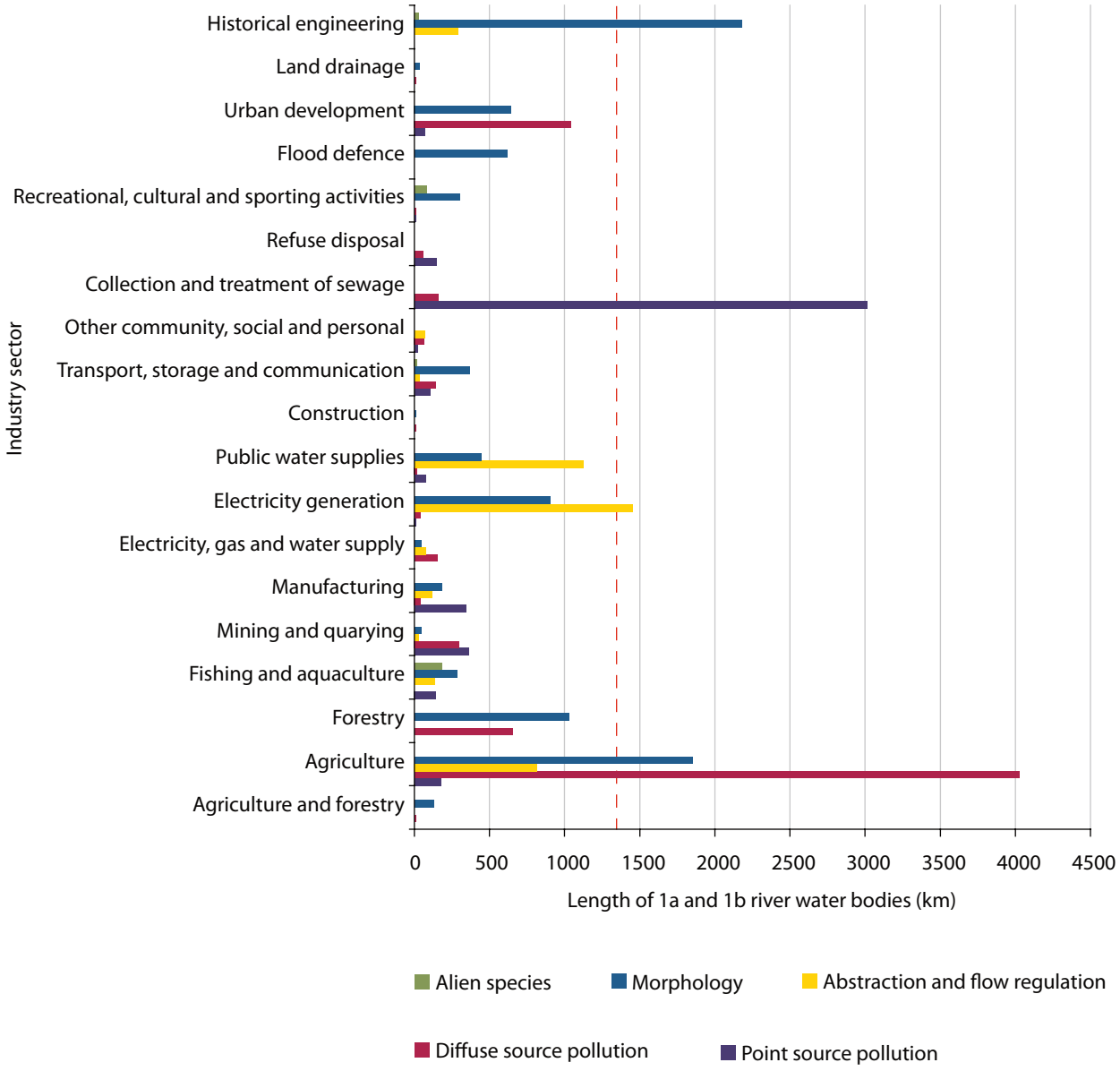


Figure B2: Significant water management issues affecting 1a and 1b loch water bodies in the Scotland river basin district

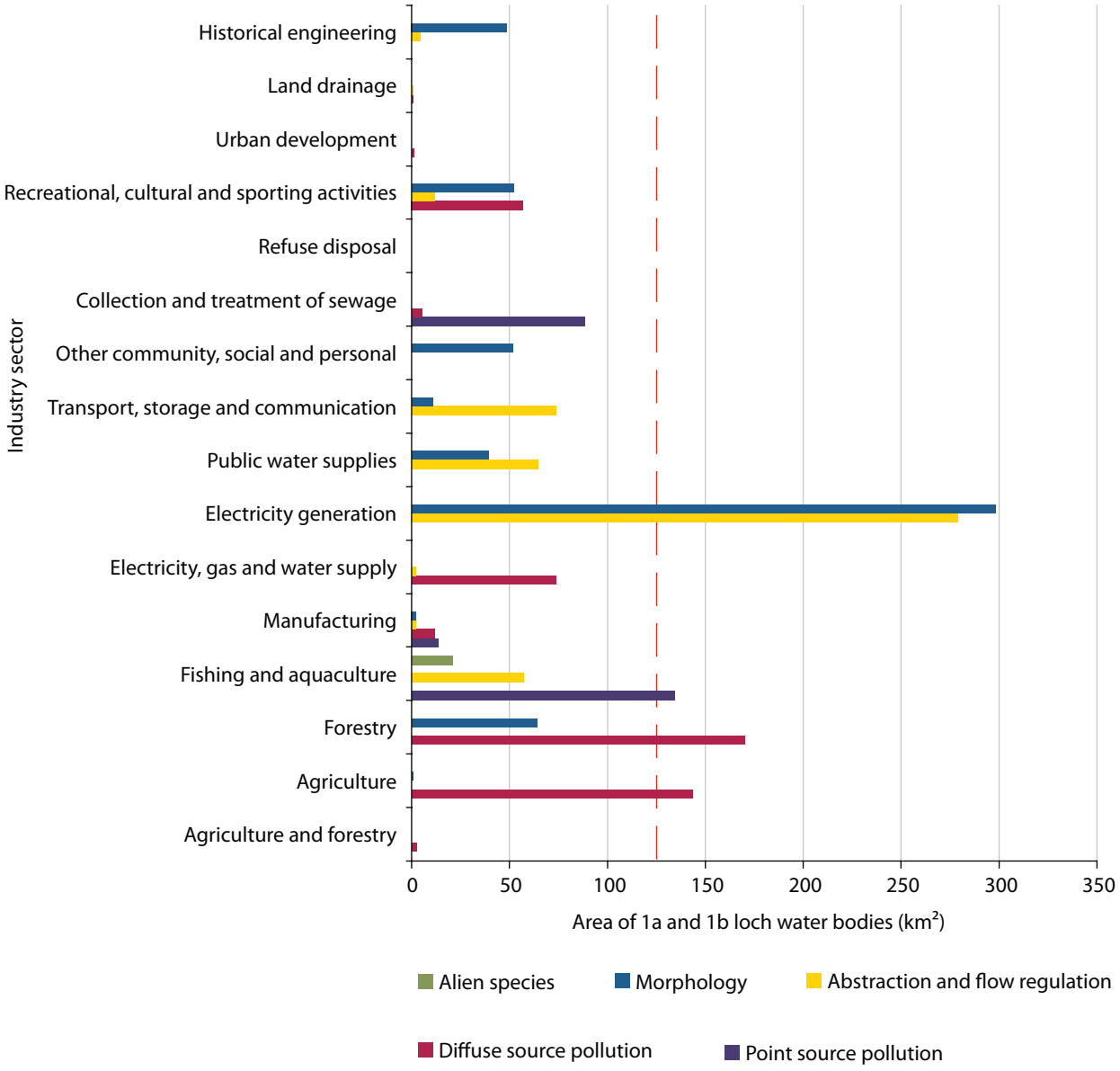


Figure B3: Significant water management issues affecting 1a and 1b transitional water bodies in the Scotland river basin district

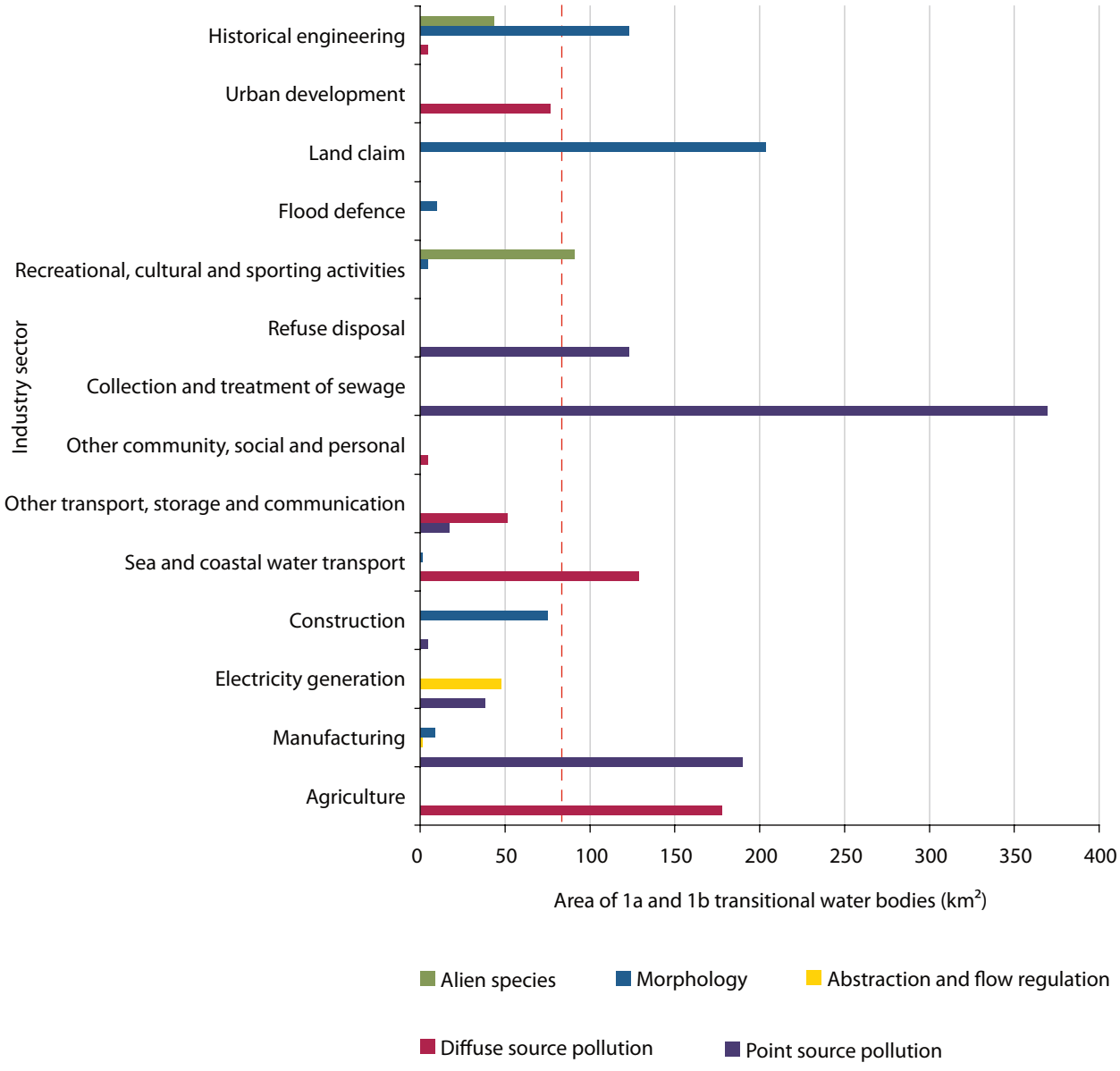


Figure B4: Significant water management issues affecting 1a and 1b coastal water bodies in the Scotland river basin district

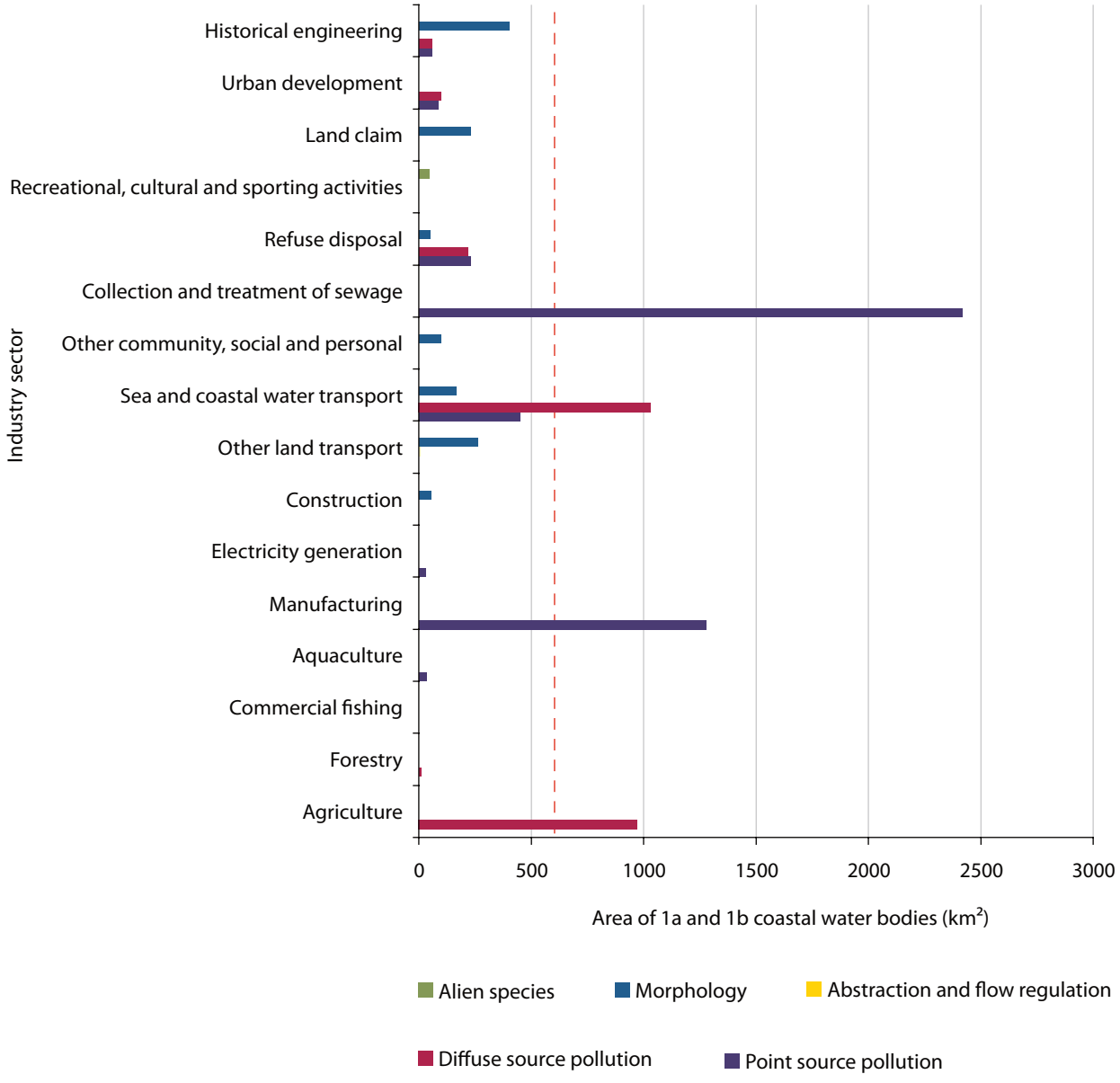
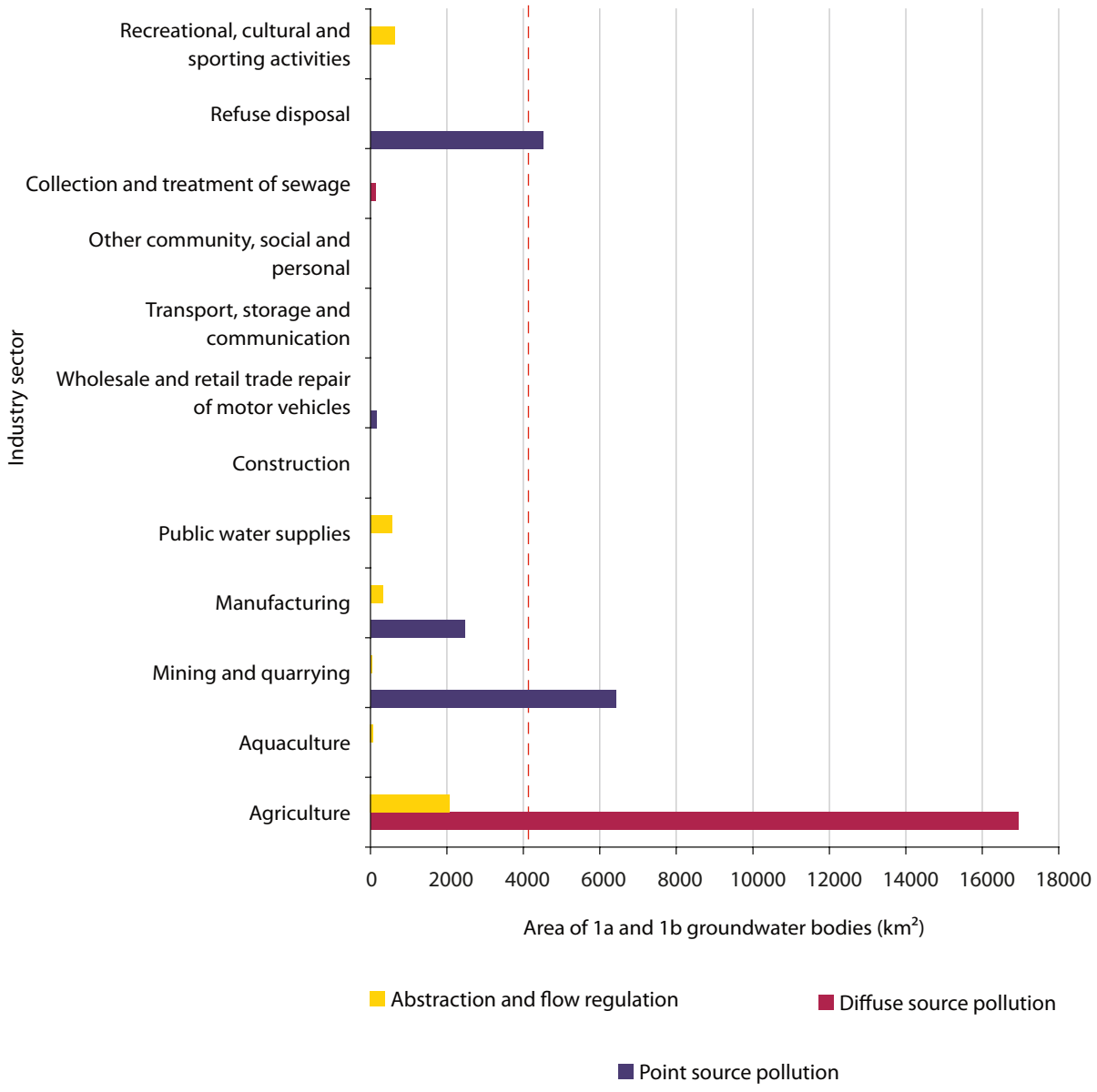


Figure B5: Significant water management issues affecting 1a and 1b groundwater bodies in the Scotland river basin district



Annex C: Sub-basin significant issues

Those issues that are not significant at the Scotland river basin district level are shown in red.
Those issues that were added by the relevant AAG are shown in blue.
Numbers of water bodies are shown in brackets.

Table C: Significant issues within the Argyll sub-basin

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	91 km (7)	–	29 km^2 (1)	98 km^2 (4)	28 km^2 (1)
	Forestry	134 km (11)	50 km^2 (2)	–	–	–
	Electricity, gas and water supply	27 km (3)	25 km^2 (3)	–	–	–
Point source pollution	Collection and treatment of sewage	42 km (4)	–	29 km^2 (1)	297 km^2 (6)	–
	Manufacturing	–	–	–	222 km^2 (3)	–
	Aquaculture	9 km (1)	55 km^2 (3)	–	–	–
Abstraction and flow regulation	Electricity generation	360 km (38)	42 km^2 (10)		–	–
	Public water supplies	96 km (12)	0.5 km^2 (1)	–	–	–
Morphology	Historical engineering	127 km (12)	3 km^2 (2)	–	–	–
	Electricity generation	76 km (8)	87 km^2 (10)	–	–	–
	Forestry	253 km (29)	24 km^2 (5)	–	–	–

Table C2: Significant issues within the Clyde sub-basin

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	1,116 km (73)	54 km² (4)	17 km² (3)	578 km² (6)	1,765 km² (14)
	Urban development	497 km (35)	–	77 km² (4)	98 km² (1)	–
	Forestry	201 km (20)	64 km² (5)	–	10 km² (1)	–
	Sea and coastal water transport	–	–	90 km² (5)	242 km² (4)	–
	Recreational, cultural and sporting activities	–	52 km² (1)	–	–	–
Point source pollution	Collection and treatment of sewage	1,076 km (75)	54 km² (4)	90 km² (4)	992 km² (10)	–
	Manufacturing	51 km (5)	–	77 km² (3)	115 km² (3)	1,028 km² (3)
	Mining and quarrying	122 km (12)	–	–	–	3,282 km² (9)
	Refuse disposal	69 km (5)	–	–	81 km² (1)	1,333 km² (4)
Abstraction and flow regulation	Public water supplies	316 km (28)	15 km² (10)	–	–	–
Morphology	Historical engineering	595 km (45)	15 km² (8)	75 km² (4)	139 km² (2)	–
	Land claim	–	–	77 km² (4)	–	–
	Flood defence	360 km (22)	–	–	–	–
	Other community, social and personal	–	52 km² (1)	–	98 km² (1)	–
	Construction	–	–	75 km² (2)	54 km² (2)	
Alien species	Various	98 km (4)	–	–	–	–

Table C3: Significant issues within the Forth sub-basin

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	627 km (56)	18 km² (5)	2 km² (1)	–	3,391 km² (22)
	Forestry	35 km (3)	15 km² (7)	–	–	–
	Urban development	400 km (39)	1 km² (2)	–	–	–
	Sea and coastal water transport	–	–	38 km² (1)	167 km² (1)	–
	Mining and quarrying	212 km (20)	–	–	–	–
Point source pollution	Collection and treatment of sewage	669 km (62)	20 km² (5)	48 km² (2)	90 km² (1)	–
	Aquaculture	29 km (2)	18 km² (4)	–	–	–
	Manufacturing	138 km (12)	14 km² (1)	48 km² (2)	257 km² (2)	16 km² (1)
	Mining and quarrying	229 km (23)	–	–	–	1,523 km² (4)
	Refuse disposal	53 km (6)	–	–	167 km² (1)	668 km² (4)
	Electricity supply	14 km (1)	–	38 km² (1)	–	–
Abstraction and flow regulation	Public water supplies	180 km (18)	25 km² (7)	–	–	78 km² (1)
	Electricity supply	11 km (1)	–	48 km² (2)	–	–
Morphology	Historical engineering	273 km (30)	20 km² (5)	38 km² (1)	257 km² (2)	–
	Agriculture	476 km (43)	1 km² (1)	–	–	–
	Land claim	–	–	40 km² (2)	167 km² (1)	–
	Urban development	242 km (23)	–	–	–	–
	Sea and coastal water transport	–	–	–	167 km² (1)	–
Alien species	Aquaculture	24 km (2)	3 km² (2)	–	–	–

Table C4: Significant issues within the North East Scotland sub-basin

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	995 km (73)	5 km^2 (3)	3 km2 (1)	154 km^2 (2)	6,271 km^2 (37)
	Sea and coastal water transport	–	–	1 km^2 (1)	138 km^2 (2)	–
	Recreational, cultural and sporting activities	–	3 km^2 (2)	–	–	–
	Electricity, gas and water supply	41 km (3)	2 km^2 (1)	–	–	–
Point source pollution	Collection and treatment of sewage	510 km (32)	4 km^2 (3)	1 km^2 (1)	353 km^2 (4)	–
	Manufacturing	99 km (8)	–	–	50km^2 (1)	1,399 km^2 (2)
	Refuse disposal	11 km (2)	–	–	149 km^2 (1)	2,405 km^2 (4)
Abstraction and flow regulation	Public water supplies	184 km (8)	–	–	–	190 km^2 (1)
Morphology	Historical engineering	446 km (34)	–	1 km^2 (1)	–	–
	Agriculture	327 km (29)	–	–	–	–
	Electricity generation	48 km (2)	2 km^2 (2)	–	–	–
	Land claim	–	–	1 km^2 (1)	46 km^2 (1)	–
Alien species	Various	–	–	–	–	–

Table C5: Significant issues within the North Highland sub-basin

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	264 km (31)	39 km^2 (4)	113 km^2 (2)	132 km^2 (2)	1,658 km^2 (17)
	Transport, storage and communication	–	–	51 km (1)	–	–
Point source pollution	Collection and treatment of sewage	124 km (11)	1 km^2 (1)	188 km^2 (4)	306 km^2 (4)	–
	Aquaculture	9 km (1)	34 km^2 (2)	–	–	–
	Manufacturing	19 km (4)		51 km^2 (1)	173 km^2 (1)	223 (1)
	Refuse disposal	6 km (1)	–	113 km^2 (2)	–	–
Abstraction and flow regulation	Electricity generation	344 km (39)	182 km^2 (18)	–	–	–
	Aquaculture	64 km (6)	57 km^2 (2)	–	–	–
	Transport, storage and communication	–	55 km^2 (1)	–	6.7 km^2 (1)	–
Morphology	Historical engineering	279 km (29)	–	–	–	–
	Electricity generation	391 km (40)	132 km^2 (18)	–	–	–
	Land claim	–	–	77 km^2 (4)	6.7 km^2 (1)	–
	Forestry	291 km (28)	15 km^2 (7)	–	–	–
Alien species	Recreational, cultural and sporting activities	–	–	91 km^2 (1)	–	–

Table C6: Significant issues within the Orkney and Shetland sub-basin

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	33 km (6)	13 km^2 (3)	–	11 km^2 (2)	–
	Sea and coastal water transport	–	–	–	465 km^2 (5)	–
Point source pollution	Collection and treatment of sewage	–	–	–	263 km^2 (1)	–
	Manufacturing	–	–	–	444 km^2 (3)	–
	Sea and coastal water transport	–	–	–	263 km^2 (1)	–
Abstraction and flow regulation	Public water supplies	18 km (4)	4 km^2 (3)	–	–	81 km^2 (2)
Morphology	Historical engineering	36 km (5)	1 km^2 (1)	–	–	–
	Agriculture	19 km (4)	–	–	–	–
	Recreational, cultural and sporting activities	–	10 km^2 (1)	–	–	–
	Land transport	–	–	–	263 km^2 (1)	–
	Commercial fishing (scallop dredging)	–	–	–	No data available	–

Table C7: Significant issues within the Tay sub-basin

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Agriculture	891 km (66)	14 km^2 (6)	14 km^2 (2)	–	3,832 km^2 (38)
	Electricity, gas and water supply	–	32 km^2 (5)	–	–	–
Point source pollution	Collection and treatment of sewage	591 km (45)	9 km^2 (1)	14 km^2 (2)	–	–
	Manufacturing	35 km (3)	–	14 km^2 (2)	–	16 km^2 (1)
	Mining and quarrying	12 km (1)	–	–	–	1,623 km^2 (1)
Abstraction and flow regulation	Electricity generation	416 km (29)	37 km^2 (8)	–	–	–
	Agriculture	549 km (43)	–	–	–	1,678 km^2 (12)
	Manufacturing of bottled water	36 km (3)	–	–	–	138 km^2 (1)
Morphology	Historical engineering	364 km (24)	9 km^2 (1)	9 km^2 (1)	–	–
	Agriculture	622 km (48)	–	–	–	–
	Electricity generation	277 km (20)	57 km^2 (13)	–	–	–
	Land claim	–	–	9 km^2 (1)	–	–
	Recreational, cultural and sporting activities	91 km (5)	19 km^2 (1)	–	–	–
	Manufacturing	39 km (3)	–	9 km^2 (1)	–	–
Alien species	Sea and coastal water transport		–	5 km^2 (1)	–	–

Table C8: Significant issues within the West Highland sub-basin

Pressure type	Key sector	Rivers	Lochs	Transitional	Coastal	Groundwater
Diffuse source pollution	Forestry	7 km (1)	4 km^2 (3)	–	–	–
Point source pollution	Collection and treatment of sewage	15 km (2)	0.5 km^2 (1)	–	116 km^2 (8)	–
	Aquaculture	29 km (7)	18 km^2 (13)	–	–	–
	Refuse disposal	–	–	–	49 km^2 (2)	–
Abstraction and flow regulation	Electricity generation	86 km (9)	6 km^2 (5)	–	–	–
Morphology	Aquaculture	69 km (12)	–	–	–	–
Alien species	Recreational, cultural and sporting activities	–	–	–	46 km^2 (1)	–

Annex D: Alternative objectives and exemptions

D1 Water bodies that may not achieve good status in 2015

SEPA has used expert judgement to predict the degree of improvement that can be achieved for all at risk (1a and 1b) water bodies by 2015 by taking into account indicative measures. From now until the publication of the draft river basin management plan, the Area Advisory Groups (AAGs) will be refining these predictions. They will also identify indicative measures that can be undertaken by stakeholders.

Environmental objectives will be set for individual water bodies in conjunction with the Area Advisory Groups and other partnership organisations. The objectives will be presented in the draft plan for consultation. The Water Framework Directive requires factors such as technical feasibility, disproportionate costs and cost-effectiveness of measures to be taken into account when setting the environmental objectives.

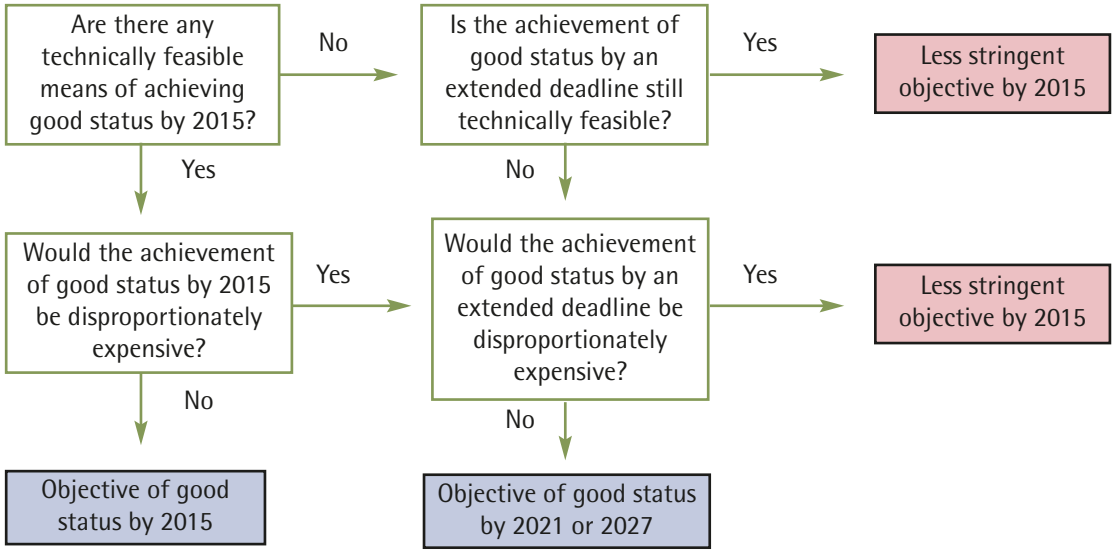
D2 Extended deadlines and less stringent objectives

Extended deadlines or less stringent objectives can be set if achieving good status by 2015 is not possible for one of the following reasons:

- the costs involved in restoring the water body to good status are disproportionate in relation to the benefits of improving the water environment;
- it is not technically feasible to improve the water body to good status by 2015;
- natural conditions prevent the objective being met by 2015.

Figure D1 sets out the process for deciding whether extended deadlines or less stringent objectives should be applied. Table D1 lists those water bodies that are currently expected to fail to achieve good status by 2015.

Figure D1: Stepped approach to the main tests justifying the use of extended deadlines and less stringent objectives



Source: Draft principles for an objective setting framework for river basin management planning in accordance with the Water Framework Directive, UKTAG, November 2004. Available at: www.wfduk.org/tag_guidance/Article%20_11/POMObjectivesetting/WFD13cObjectivesetting

Table D1: Water bodies in the Scotland river basin district expected to fail to achieve good status by 2015

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
Argyll	River	10217	Kinglas Water	No	No	12.6
Argyll	River	10218	River Fyne	No	Yes	17.5
Argyll	River	10220	River Shira (d/s Lochan Shira)	No	Yes	10.7
Argyll	River	10222	Kilblaan Burn	No	Yes	6.8
Argyll	River	10223	Brannie Burn	No	Yes	7.0
Argyll	River	10225	Erallich Water	No	No	8.4
Argyll	River	10227	Leacann Water	No	No	7.7
Argyll	River	10233	Chiscan Water	No	No	10.1
Argyll	River	10234	Glenlussa Water (d/s Lussa Loch)	No	Yes	8.5
Argyll	River	10238	Barr Water	No	No	14.3
Argyll	River	10239	Abhainn a Chnoeain	No	Yes	6.2
Argyll	River	10241	Carradale Water/Narachan Burn	No	No	21.1
Argyll	River	10248	Allt Mor (u/s Loch Ciaran)	No	No	3.5
Argyll	River	10249	Claonaig Water	No	No	9.7
Argyll	River	10251	Abhainn Learg an Uinnsinn/Allt Caoi-rain	No	Yes	9.8
Argyll	River	10253	Ormsary Water/Abhainn Mhor	No	No	10.2
Argyll	River	10254	Allt Doire Duibhe	No	No	5.5
Argyll	River	10255	Abhainn na Cuile/Allt Mor	No	Yes	9.8
Argyll	River	10256	Baranlongart Burn/Eas Dubh	No	No	7.7
Argyll	River	10259	The Lussa	No	Yes	6.8
Argyll	River	10262	Dippin/Cuilarstich Burn	No	No	7.9
Argyll	River	10314	Allt Easach	No	No	6.6
Argyll	River	10324	Glashan Burn	No	Yes	2.1
Argyll	River	10325	Un-named trib of Loch Glashan	No	No	2.5
Clyde	River	10326	Abhainn Mor (Catacol Burn)	No	No	5.7
Argyll	River	10329	Abhainn Tir Chonhuill/Allt an Fhir eoin	No	No	4.5
Argyll	River	10332	Coladoir River	No	No	11.0
Argyll	River	10335	River Ba/Glencannel River (u/s Loch Ba)	No	No	6.0
Argyll	River	10336	River Clachaig	No	No	5.9
Argyll	River	10340	Mingary Burn	No	No	7.8
Argyll	River	10341	Tobermory River	No	No	7.0
Argyll	River	10349	River Leoig	No	Yes	5.1
Argyll	River	10353	River Sorn/Ballygrant Burn	No	No	10.7
Argyll	River	10357	Duich River/Torra River/Uisge Gleann a Chromain	No	No	14.7
Clyde	River	10372	Kip Water	No	Yes	7.8
Clyde	River	10380	River Garnock (Rye Water to Caaf Water)	No	No	2.2
Clyde	River	10382	River Garnock (u/s Powgree Burn)	No	No	13.0
Clyde	River	10383	Lugton Water	No	No	26.8
Clyde	River	10389	Caaf Water	No	No	13.6

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
Clyde	River	10390	Rye Water	No	Yes	13.7
Clyde	River	10391	River Irvine (Cessnock conf to Tidal Weir)	No	No	25.3
Clyde	River	10392	River Irvine (Glen Burn to Cessnock conf)	No	No	10.5
Clyde	River	10394	Annick Water	No	No	31.3
Clyde	River	10022	Candrens Burn	No	Yes	9.2
Clyde	River	10023	Old Patrick Water	No	No	10.8
Clyde	River	10025	Dubbs Water	No	Yes	4.2
Clyde	River	10027	Roebank Burn (d/s Barcraigs Reservoir)	No	Yes	6.8
Clyde	River	10029	River Calder (u/s Castle Semple Loch)	No	No	16.6
Clyde	River	10031	River Gryfe (Gryfe Reservoirs to Barochan Burn conf)	No	Yes	21.4
Clyde	River	10034	Barochan Burn	No	No	9.0
Clyde	River	10040	River Clyde (North Calder to Tidal Weir)	No	Yes	15.3
Clyde	River	10043	Daer Water (d/s Daer Reservoir)	No	Yes	6.4
Clyde	River	10047	Molendinar Burn	No	Yes	8.4
Clyde	River	10048	Tollcross Burn	No	Yes	8.4
Clyde	River	10060	North Calder Water (Luggie Burn to Clyde)	No	No	4.9
Clyde	River	10060	North Calder Water (Luggie Burn to Clyde)	No	No	4.9
Clyde	River	10067	Shirrel Burn/Thankerton Burn/ Legbranock Burn	No	No	9.0
Clyde	River	10071	Wellshaw/Earnock Burn	No	Yes	7.5
Clyde	River	10074	South Calder Water (u/s Auchter Water)	No	Yes	10.2
Clyde	River	10082	Logan Water	No	Yes	11.1
Clyde	River	10084	Mouse Water (Dippool Water to Clyde)	No	No	12.8
Clyde	River	10091	Netherton Burn	No	Yes	6.1
Clyde	River	10092	Douglas Water (Poneil to Clyde)	No	No	5.3
Clyde	River	10093	Douglas Water ((Parkhall Burn to Poneil)	No	No	4.5
Clyde	River	10097	Poniel Water	No	No	15.0
Argyll	River	10263	Lower Badden Burn to conf with and inc the Auchoish Burn	No	No	7.7
Argyll	River	10266	River Add/Abhainn Bheag an Tunns (u/s Kilmartin Burn)	No	Yes	27.0
Argyll	River	10268	River Add (u/s Abhainn Bheag an Tunns confluence)	No	Yes	12.4
Argyll	River	10270	River Liever	No	Yes	9.5
Argyll	River	10272	Abhainn a Bhealaich	No	Yes	8.3
Argyll	River	10276	Abhainn Fionain	No	Yes	8.0
Argyll	River	10280	River Awe	No	Yes	6.2
Argyll	River	10281	Cladich River/Allt an Stacain	No	Yes	13.1
Argyll	River	10283	Allt Mhoille	No	No	5.0
Argyll	River	10285	River Orchy	No	No	26.0
Argyll	River	10288	Allt Kinglass	No	Yes	12.5

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
Argyll	River	10294	River Oude (d/s Loch Tralaig)	No	Yes	6.0
Argyll	River	10295	River Oude (u/s Loch Tralaig)	No	Yes	4.2
Argyll	River	10300	River Nant (d/s Loch Nant)	No	Yes	8.8
Argyll	River	10304	Black Lynn Burn	No	No	5.3
Argyll	River	10307	Dearg Abhainn	No	No	6.7
Argyll	River	10309	Abhainn Teithil	No	Yes	6.6
Argyll	River	10310	Abhainn Dalach	No	No	5.7
Argyll	River	10311	River Noe	No	No	6.4
Argyll	River	10312	River Liver	No	No	7.5
Clyde	River	10159	Finlas Water	No	Yes	8.0
Clyde	River	10162	Inveruglas Water	No	Yes	4.6
Clyde	River	10164	Allt Coiregrogain	No	Yes	5.0
Clyde	River	10167	Dubh Eas/Allt nan Caorainn	No	Yes	11.3
Clyde	River	10169	Arklet Water	No	Yes	2.2
Clyde	River	10177	North Sannox	No	No	6.9
Clyde	River	10199	Glentarsan Burn/Garbh Allt	No	Yes	1.9
Clyde	River	10205	River Eachaig	No	Yes	6.6
Tay	River	6525	Coupar Burn/Kinochtry	No	No	16.8
Tay	River	6526	Burrelton Burn	No	No	9.0
Tay	River	6535	R Ericht	No	No	38.4
Tay	River	6537	Lornty Burn	No	Yes	11.2
Tay	River	6553	Unnamed trib of Isla at Aberbothy	No	No	7.4
Tay	River	6555	Dean Water/Treacle Burn (Kerbet Water to R Isla Confluences)	No	No	16.4
Tay	River	6556	Dean Water/Treacle Burn (Forfar to Kerbet Water Confluence)	No	No	5.6
Tay	River	6559	Commerton Burn	No	Yes	9.8
Tay	River	6561	Glamis Burn	No	No	10.7
Tay	River	6562	Kerbet Water	No	No	21.9
Tay	River	6563	Gairie Burn	No	No	11.7
Tay	River	6587	River Gaur	No	Yes	5.0
Tay	River	6605	River Bruar	No	Yes	17.2
Tay	River	6608	Allt Anndeir	No	Yes	33.0
Tay	River	6620	Allt a Chreagain Odhair	No	Yes	15.8
Tay	River	6623	Killichonan Burn	No	Yes	9.3
Tay	River	6630	Allt Chaldar	No	Yes	11.0
Tay	River	6631	Abhainn Duibhe	No	Yes	24.8
Tay	River	6639	River Lyon	No	Yes	44.3
Tay	River	6653	Lawers Burn	No	Yes	7.3
Tay	River	6655	Burn of Edramucky	No	Yes	4.8
Tay	River	6657	Allt Breaclaich (Breaclaich Res to Loch Tay)	No	Yes	3.5
Tay	River	6659	Achmore Burn	No	No	6.0

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
Tay	River	6660	River Lochay (Allt Dhuin Croisg Confluence to Loch Tay)	No	No	8.0
Tay	River	6661	River Lochay (Source to Allt Dhuin Croisg Confluence)	No	Yes	26.9
Tay	River	6700	Deich Burn	No	No	6.3
Tay	River	6701	River Farg	No	Yes	16.5
Tay	River	6800	River Earn	No	No	33.2
Tay	River	6804	Dunning Burn	No	No	10.2
Tay	River	6809	Pow Water	No	Yes	44.2
Tay	River	6810	Drummond Burn	No	No	4.9
Tay	River	6820	Tarken Burn	No	No	6.1
Clyde	River	10000	White Cart Water (Kittoch Water to Hamills Weir)	No	Yes	20.0
Clyde	River	10002	Kittoch Water	No	Yes	12.2
Clyde	River	10003	Capelrig/Auldhouse Burn	No	No	15.8
Clyde	River	10007	Levern Water	No	Yes	15.7
Clyde	River	10009	Dunwan Burn/Polnoon Water (d/s Dunwan Dam)	No	Yes	6.5
Tay	River	5602	Raesmill Burn	No	Yes	3.6
Tay	River	5603	Brothock Water	No	No	11.7
Tay	River	5700	River North Esk (Confluence with Cruick Water to Estuary)	No	No	12.7
Tay	River	5702	River North Esk/Water of Lee (Water of Mark to Water of Effock Confluences)	No	No	1.9
Tay	River	5703	River North Esk/Water of Lee (Loch Lee to Water of Mark Confluence)	No	No	1.9
Tay	River	5706	Luther Water (Source to Dowrie Burn Confluence)	No	No	18.5
Tay	River	5709	Ducat Water	No	No	5.8
Tay	River	5802	Pow Burn	No	No	30.2
Tay	River	5805	Noran Water	No	Yes	21.1
Tay	River	5806	Lemno Burn	No	Yes	13.9
Tay	River	5812	Burn of Heughs	No	No	7.2
Tay	River	5900	Lunan Water (Friockheim to Estuary)	No	No	11.2
Tay	River	5901	Lunan Water (Rescobie Loch to Friockheim)	No	No	7.3
Tay	River	5903	Gighty Burn	No	No	7.8
Tay	River	5952	Monikie Burn	No	Yes	28.1
Tay	River	5953	Barry Burn	No	No	14.4
Tay	River	5954	Buddon Burn	No	No	12.1
Tay	River	6000	Dighty Water (lower)	No	Yes	4.8
Tay	River	6001	Dighty Water	No	Yes	20.6
Tay	River	6002	Murroes Burn (lower section)	No	No	5.0
Tay	River	6003	Murroes Burn (upper section)	No	No	4.5

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
Tay	River	6004	Fithie Burn	No	No	11.2
Tay	River	6101	Moonzie Burn	No	No	12.2
Tay	River	6102	Motray Water	No	No	20.6
Tay	River	6104	Lead Burn Drain	No	No	5.9
Tay	River	6105	Lundin Water	No	Yes	7.4
Tay	River	6106	Tentsmuir Sands Burn/Drain	No	No	6.1
Tay	River	6107	Kinness Burn	No	Yes	15.7
Tay	River	6108	Kenly Water (Confluence with Kinaldy Burn to Estuary)	No	No	5.9
Tay	River	6109	Kinaldy Burn u/s confluence with Kenly Water	No	No	11.4
Tay	River	6110	Kenly Water (Source to confluence with Kinaldy Burn)	No	Yes	10.6
Tay	River	6200	River Eden (Confluence with Rossie Drain to Estuary)	No	No	23.5
Tay	River	6202	Ceres Burn	No	No	15.0
Tay	River	6205	Foodieash Burn	No	No	4.8
Tay	River	6206	Fernie Burn	No	No	16.8
Tay	River	6209	Kettle Burn	No	No	5.7
Tay	River	6213	Ballingall Burn/Falkland Burn	No	No	8.8
Forth	River	6300	River Leven (Markinch to Estuary)	No	No	10.7
Forth	River	6303	Kennoway Burn/Back Burn	No	Yes	23.0
Forth	River	6304	River Ore (Cardenden to River Leven)	No	No	15.3
Forth	River	6306	Kelty Burn	No	No	8.0
Forth	River	6310	Den Burn	No	No	5.4
Forth	River	6311	Den Burn/Lochgelly Burn	No	No	6.6
Forth	River	6312	Lochty Burn	No	No	14.4
Forth	River	6315	Gairney Water	No	No	13.1
Forth	River	6316	Greens Burn	No	No	7.9
Tay	River	6401	Errol Pow	No	No	13.4
Tay	River	6402	Grange Pow	No	No	10.5
Tay	River	6413	Annaty Burn	No	No	11.3
Tay	River	6508	R Almond (Source to Fendoch Burn Confluence)	No	Yes	28.5
Tay	River	6510	East Pow (d/s of Methven to R Almond Confluence)	No	No	7.3
Clyde	River	10102	South Medwin	No	No	24.5
Clyde	River	10107	Culter Water	No	No	12.7
Clyde	River	10108	Cow Gill/Eastside Burn/Duncan Gill	No	Yes	7.3
Clyde	River	10116	Glengonnar Water	No	No	11.1
Clyde	River	10117	Camps Water	No	Yes	6.5
Clyde	River	10130	River Kelvin (Glazert Water to Tidal Limit)	No	Yes	22.0
Clyde	River	10131	River Kelvin (Glazert to Auchinstarry)	No	Yes	11.7

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
Clyde	River	10132	Allander Water	No	Yes	18.0
Clyde	River	10138	Bothlin Burn (Garnkirk Burn to Luggie conf)	No	Yes	4.7
Clyde	River	10144	Board Burn	No	Yes	6.6
Clyde	River	10145	Glazert Water/Finglen Burn	No	Yes	15.1
Clyde	River	10148	Garrel Burn	No	Yes	9.2
Clyde	River	10150	River Leven	No	Yes	7.0
Clyde	River	10154	Gallangad Burn/Catter Burn	No	No	15.4
Clyde	River	10155	Carnock Burn	No	Yes	12.0
Forth	River	4710	Achray Water	No	No	2.2
Forth	River	4722	Drunkie Burn (Reoidhte Lochan to Loch Drunkie)	No	No	1.9
Forth	River	4723	River Turk	No	Yes	1.7
Forth	River	4733	Duchray Water	No	No	23.8
Forth	River	5011	Eye Water (Source to Ale Water Confluence)	No	No	34.0
Forth	River	5013	Horn Burn	No	No	3.9
Forth	River	3001	River Almond (Breich Water confluence to Maitland Bridge)	No	No	17.5
Forth	River	3002	River Almond (Foulshiels Burn to Breich Water confluences)	No	No	1.9
Forth	River	3003	River Almond (Source to Foulshiels Burn confluence)	No	No	18.4
Forth	River	3004	Gogar Burn (Union Canal to River Almond)	No	Yes	8.9
Forth	River	3000	River Almond (Maitland Bridge to Crammond)	No	No	9.3
Forth	River	3020	Lochshot Burn	No	No	4.8
Forth	River	3021	Breich Water/Darmead Linn	No	No	15.1
Forth	River	3031	How Burn	No	No	8.0
Forth	River	3100	River Avon (Logie Water confluence to Estuary)	No	No	15.5
Forth	River	3102	River Avon (Source to Jawhills)	No	No	5.9
Forth	River	3103	Mains Burn	No	Yes	5.5
Forth	River	3106	Logie Water/Barbauchlaw Burn	No	Yes	18.5
Forth	River	3107	Boghead Burn/Bog Burn/Couston Water	No	No	9.8
Forth	River	3200	Pow Burn/Tor Burn (Abbeytown Bridge to Forth Estuary)	No	No	2.7
Forth	River	3202	Sauchenford Burn (Plean sewage works to Pow Burn)	No	No	3.0
Forth	River	3203	Sauchenford Burn (Source to Plean sewage works)	No	No	4.9
Forth	River	3400	Pardovan Burn (down to estuary)	No	No	6.5
Forth	River	3500	Braid Burn (Upstream Dreghorn Barracks to Portobello)	No	Yes	12.6
Forth	River	3600	Burdiehouse Burn/Swanston Burn	No	No	15.3
Forth	River	3701	Murray Burn	No	Yes	10.0

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
Forth	River	3703	Water of Leith (Harperrig Reservoir to Poet's Burn confluence)	No	Yes	14.1
Forth	River	3704	Water of Leith (Source to Harperrig Reservoir)	No	No	4.7
Forth	River	3801	River South Esk (Gore Water to N Esk confluences)	No	No	13.0
Forth	River	3803	River South Esk (Gladhouse Reservoir sluice to 7.2 Redside Burn confluence)		No	Yes
Forth	River	3809	River North Esk (Source to Penicuik House)	No	Yes	13.1
Forth	River	3813	Bilston/Boghall Burn	No	No	7.1
Forth	River	3814	Glencorse Burn	No	Yes	12.9
Forth	River	3820	Redside Burn	No	No	4.1
Forth	River	3908	Thornton Burn/Thurston Mains Burn	No	No	11.5
Forth	River	3910	East Peffer	No	Yes	14.1
Forth	River	3913	Gosford Burn	No	No	8.1
Forth	River	4003	Back Burn	No	No	5.5
Forth	River	4005	Gifford Water	No	No	13.8
Forth	River	4012	Bellyford Burn	No	No	7.8
Forth	River	4200	River Carron (Bonny Water confluence to Carron)	No	No	6.8
Forth	River	4201	River Carron (Avon Burn to Bonny Water Confluences)	No	No	4.4
Forth	River	4205	Bonny Water/Red Burn	No	No	13.9
Forth	River	4210	Auchenbowie Burn (Loch Coulter Reservoir to River Carron)	No	Yes	10.2
Forth	River	4300	Bluther Burn (Gibsley Farm to Estuary)	No	No	12.2
Forth	River	4301	Bluther Burn (Source to Gibsley Farm)	No	No	10.6
Forth	River	4305	Tower Burn	No	No	7.3
Forth	River	4308	Keithing Burn (Craiganet Burn to Estuary)	No	No	5.7
Forth	River	4310	Brankholme Burn	No	Yes	5.3
Forth	River	4320	Cocklemill Burn/Den Burn (Source to Saw Mill Bridge)	No	No	6.4
Forth	River	4321	Dreel Burn	No	No	11.8
Forth	River	4326	St. Monans Burn/Inverie Burn	No	No	4.3
Forth	River	4402	Black Devon (Birkhill Plantation to Forth Estuary)	No	No	6.0
Forth	River	4406	Foulbutts Burn	No	No	7.0
Forth	River	4500	River Devon (Gairney Burn confluence to Estuary)	No	No	24.4
Forth	River	4601	Allan Water (Source to Greenloaning)	No	No	11.7
North East Scotland	River	23179	River Isla - Keith to Shiel Burn	No	No	11.0
North East Scotland	River	23180	Crooksmill Burn/Haughs Burn	No	No	15.8
North East Scotland	River	23181	River Isla - source to Keith	No	No	26.1
North East Scotland	River	23188	River Bogie - Culdrain to Huntly	No	No	10.5

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
North East Scotland	River	23190	Priest s Water/Lag Burn	No	No	11.5
North East Scotland	River	23191	Kirkney Water	No	No	17.0
North Highland	River	23195	Belmack Burn	No	No	5.3
North East Scotland	River	23200	Water of Cruden - d/s Hatton WWTP	No	No	5.2
North East Scotland	River	23202	Laeca Burn	No	No	5.0
North East Scotland	River	23203	Forvie Burn	No	No	10.7
North East Scotland	River	23204	Burn of Auchmacoy	No	No	9.0
North East Scotland	River	23205	Tarty Burn	No	No	13.5
North East Scotland	River	23206	Foveran Burn	No	No	14.5
North East Scotland	River	23211	Potterton Burn	No	No	8.6
North East Scotland	River	23214	South Mundurno Burn	No	No	6.5
North East Scotland	River	23215	River Ugie - North/South confl to tidal limit	No	No	9.3
North East Scotland	River	23216	Crooko Burn	No	No	7.4
North East Scotland	River	23217	Faichfield Burn	No	No	9.7
North East Scotland	River	23221	North Ugie Water - lower catchment	No	No	14.7
North East Scotland	River	23222	North Ugie Water - upper catchment	No	No	28.9
North East Scotland	River	23223	Greenspeck Burn	No	No	5.1
North East Scotland	River	23224	South Ugie Water - Stuartfield to Longside	No	No	12.0
North East Scotland	River	23225	Burn of Ludquharn	No	No	8.0
North East Scotland	River	23226	Quhomery Burn	No	No	8.3
North East Scotland	River	23229	Water of Fedderate	No	Yes	9.1
North East Scotland	River	23230	South Ugie Water - New Deer to Stuartfield	No	No	15.5
North East Scotland	River	23231	River Ythan - Methlick to Ellon	No	No	14.3
North East Scotland	River	23232	River Ythan - Fyvie to Methlick	No	No	19.2
North East Scotland	River	23233	River Ythan - upper catchment above Fyvie	No	No	40.4
North East Scotland	River	23234	Fordoun Burn	No	No	18.2
North East Scotland	River	23235	Burn of Crichie (Fyvie)	No	No	6.9
North East Scotland	River	23236	Burn of Stonehouse	No	No	5.9
North East Scotland	River	23237	Little Water / Black Burn	No	No	21.0
North East Scotland	River	23238	Burn of Sessnie	No	No	8.1
North East Scotland	River	23239	Burn of Keithfield/ Raxton Burn	No	No	20.9
North East Scotland	River	23240	Ebrie Burn	No	No	22.8
North East Scotland	River	23241	Youlie Burn/Bronie Burn	No	No	30.2
North East Scotland	River	23289	Bonnyton Burn	No	No	7.9
North East Scotland	River	23290	Gadie Burn	No	No	21.1
North East Scotland	River	23293	River Don - Alford to Inverurie	No	No	37.0
North East Scotland	River	23315	River Dee - Peterculter to tidal limit	No	No	10.4
North East Scotland	River	23316	River Dee - Banchory to Peterculter	No	No	17.8
North East Scotland	River	23319	Culter Burn	No	No	3.1
North East Scotland	River	23320	Gormack Burn	No	No	18.9
North East Scotland	River	23321	Leuchar Burn	No	No	9.0

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
North East Scotland	River	23322	Brodiach Burn/Ord Burn	No	No	6.5
North East Scotland	River	23324	Bo Burn	No	No	16.3
North East Scotland	River	23325	Burn of Corrichie	No	No	7.8
North East Scotland	River	23328	Water of Dye - lower catchment	No	No	11.7
North East Scotland	River	23332	River Dee - Ballater to Banchory	No	No	42.5
North East Scotland	River	23333	Beltie Burn	No	No	21.9
North East Scotland	River	23336	Dess Burn / Lumphanan Burn	No	No	9.3
North East Scotland	River	23337	Dess Burn - upper stretch	No	No	5.2
North East Scotland	River	23338	Tarland Burn	No	No	20.6
North East Scotland	River	23354	River Muick - Allt an Dubh Loch	No	No	7.4
North East Scotland	River	23358	Gelder Burn	No	No	10.9
North East Scotland	River	23365	Ey Burn	No	No	23.0
Clyde	River	10713	Forth and Clyde Canal (Glasgow Branch to Kirkintilloch)	Yes	No	9.8
Forth	River	3	Forth and Clyde Canal (Wyndford to Rough Castle)	Yes	No	9.5
Forth	River	4	Union canal (Falkirk Wheel to Greenbank)	Yes	No	2.3
Forth	River	5	Union canal (Greenbank to Kirk Bridge)	Yes	No	9.7
Forth	River	6	Union canal (Kirk Bridge to Park Farm)	Yes	No	8.2
Forth	River	9	Union canal (Murray Burn to Fountainbridge)	Yes	No	7.3
Forth	River	7	Union canal (Park Farm to Craigton)	Yes	No	4.4
Forth	River	8	Union canal (Craigton to Murray Burn)	Yes	No	19.8
Clyde	River	10714	Forth and Clyde Canal (Glasgow Branch)	Yes	No	5.2
North East Scotland	River	23272	Tuach Burn/Tillakae Burn	No	No	9.1
North East Scotland	River	23103	Allt Choire Odhair	No	No	7.7
North East Scotland	River	23104	Glenbeg Burn	No	No	8.9
North East Scotland	River	23139	River Tromie - Loch an t-Seilich to Allt Bhran	No	Yes	13.6
North East Scotland	River	23142	River Spey - Loch Crunachulan to Loch Insh	No	Yes	34.8
North East Scotland	River	23146	River Truim - lower catchment	No	No	11.4
North East Scotland	River	23147	River Truim - upper catchment	No	Yes	25.7
North East Scotland	River	23149	River Mashie	No	Yes	16.5
North East Scotland	River	23155	River Deveron - Turriff to tidal limit	No	No	17.5
North East Scotland	River	23160	Burn of King Edward	No	No	34.7
North East Scotland	River	23161	Idoch Water	No	No	34.2
North East Scotland	River	23162	Burn of Turriff	No	No	3.2
North East Scotland	River	23165	River Deveron - Huntly to Turriff	No	No	35.5
North East Scotland	River	23167	Burn of Auchintoul - d/s Arkland Burn	No	No	2.3
NorthEast Scotland	River	23168	Burn of Auchintoul - u/s Arkland Burn	No	No	8.2
North East Scotland	River	23169	Crombie Burn	No	No	6.0
North East Scotland	River	23170	Keithny Burn / Forgue Burn	No	No	32.9
North East Scotland	River	23172	Cairnie Burn	No	No	13.5
North East Scotland	River	23173	Shiel Burn	No	No	8.0

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
West Highland	River	20798	Abhainn Eirearaigh - d/s Loch Urghag	No	No	2.5
West Highland	River	20800	Loch Mor Barvas outlet	No	No	0.2
West Highland	River	20807	Abhainn Dhail	No	No	10.6
West Highland	River	20818	Benbecula Main Drain	Yes	No	7.5
West Highland	River	20822	Burn d/s Loch Chill Donnain	No	No	1.4
North Highland	River	20839	River Grudie - outflow from Loch Fannich	No	Yes	1.3
North Highland	River	23000	River Findhorn - Dorback Burn to sea	No	No	16.2
North Highland	River	23008	Funtack Burn	No	No	3.5
North Highland	River	23012	River Findhorn - Tomatin to Garbole	No	No	8.8
North Highland	River	23013	Kyllachy Burn	No	No	9.0
North Highland	River	23015	Glenmazeran Burn	No	No	11.0
North Highland	River	23020	Mosset Burn - Forres to sea	No	No	2.2
North Highland	River	23025	Millie Burn	No	No	7.2
North Highland	River	23026	Spynie Canal	Yes	No	7.2
North Highland	River	23027	Terchick Burn	No	No	13.5
Forth	River	3912	West Peffer/Mill Burn	No	No	16.6
North Highland	River	23032	River Lossie - Waukmill to Arthurs Bridge	No	No	8.0
North Highland	River	23032	River Lossie - Waukmill to Arthurs Bridge	No	No	8.0
North Highland	River	23033	River Lossie - Mosstowie Canal to Waukmill	No	No	9.3
North Highland	River	23034	Linkwood Burn	No	No	14.0
North Highland	River	23037	Mosstowie Canal	No	No	11.8
North Highland	River	23039	River Lossie - Leanoch Burn to Mosstowie Canal	No	No	9.9
North Highland	River	23040	Leanoch Burn - d/s reservoir	No	Yes	2.6
North Highland	River	23041	Leanoch Burn - upper catchment	No	Yes	6.6
North Highland	River	23043	River Lossie - upper catchment	No	No	36.5
North East Scotland	River	23045	Stripe Burn	No	No	17.0
North East Scotland	River	23046	Pottie Burn	No	No	9.1
North East Scotland	River	23048	Buckie Burn	No	No	8.6
North East Scotland	River	23052	Fordyce Burn	No	No	7.2
North East Scotland	River	23054	Boyne Burn/Corncairn Burn	No	No	26.0
North East Scotland	River	23055	Boyndie Burn	No	No	10.6
North East Scotland	River	23060	Burn of Strathbeg	No	No	0.7
North East Scotland	River	23061	Burn of Savoch/ Logie Burn	No	No	14.8
North East Scotland	River	23062	Black Water - d/s St Fergus	No	No	1.3
North East Scotland	River	23064	Black Water - u/s St Fergus	No	No	6.0
North East Scotland	River	23066	River Spey - R. Avon to R. Fiddich	No	No	21.3
North East Scotland	River	23067	Burn of Fochabers	No	No	8.4
North East Scotland	River	23070	Broad Burn	No	Yes	6.1
North East Scotland	River	23071	Rothes Burn	No	Yes	11.5
North East Scotland	River	23079	Ballintomb Burn	No	No	7.6

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
North Highland	River	20601	Allt Dalharrold	No	No	7.1
North Highland	River	20627	Murkle Burn	No	Yes	5.0
North Highland	River	20628	Burn of Garth	No	Yes	6.8
North Highland	River	20629	Burn of Midsand	No	No	4.8
North Highland	River	20630	Burn of Ham - d/s Loch Heilen	No	Yes	5.8
North Highland	River	20632	Link Burn	No	No	10.0
West Highland	River	20652	Abhainn Ghriomarstaidh - d/s Loch Faoghail Charrasan	No	No	1.6
Orkney and Shetland	River	20658	Burn of Hourston	No	No	7.9
Orkney and Shetland	River	20659	Voy Burn	No	No	2.9
Orkney and Shetland	River	20661	Netherbrough Burn	No	No	7.8
Orkney and Shetland	River	20669	Burn of Roerwater	No	No	6.1
Orkney and Shetland	River	20670	Burn of Laxobigging	No	No	7.6
Orkney and Shetland	River	20679	Burn of Weisdale	No	No	8.6
Orkney and Shetland	River	20691	Swannay Burn - d/s Swannay Farm	No	Yes	0.9
West Highland	River	20703	Bearreraig River	No	Yes	0.7
West Highland	River	20711	Allt nan Criopag	No	No	4.9
West Highland	River	20749	Abhainn a Ghlinne Dhuibh	No	No	10.4
Argyll	River	20393	Rannoch River	No	No	9.4
Argyll	River	20399	River Tarbert	No	Yes	15.8
West Highland	River	20434	Allt Gleann Udalain	No	Yes	13.7
West Highland	River	20435	Allt Dhuirinish	No	No	7.9
West Highland	River	20482	Allt Beithe	No	No	2.5
West Highland	River	20485	Abhainn Bruachaig - headwaters	No	No	32.3
West Highland	River	20504	River Lael	No	No	16.9
West Highland	River	20514	River Polly	No	No	4.1
West Highland	River	20521	Abhainn Clais an Eas	No	No	8.9
West Highland	River	20522	Oldany River	No	No	1.9
West Highland	River	20523	Uidh na Tolla Bhaid	No	No	7.8
West Highland	River	20547	River Broom	No	No	6.8
West Highland	River	20548	Abhainn Droma	No	Yes	18.8
West Highland	River	20552	Abhainn Mhor	No	No	0.4
North East Scotland	River	23243	Den Burn	No	Yes	9.2
North East Scotland	River	23250	Findon Burn	No	No	4.7
North East Scotland	River	23251	Burn of Elsick	No	No	5.4
North East Scotland	River	23254	Cowie Water - Fetteresso Forest	No	No	15.5
North East Scotland	River	23255	Cowton Burn	No	No	7.0
North East Scotland	River	23258	Catterline Burn	No	No	9.5
North East Scotland	River	23263	Forthie Water	No	No	5.6
North East Scotland	River	23265	River Don - Dyce to tidal limit	No	Yes	10.7
North East Scotland	River	23265	River Don - Dyce to tidal limit	No	Yes	10.7

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
North East Scotland	River	23267	Elrick Burn - d/s Newmachar WWTP	No	No	3.7
North East Scotland	River	23269	River Don - Inverurie to Dyce	No	No	19.9
North East Scotland	River	23270	Black Burn	No	No	9.8
West Highland	River	20761	Abhainn Cheothadail	No	No	7.8
West Highland	River	20766	Abhainn Ruadh	No	No	7.1
West Highland	River	20780	Abhainn Thousaidh/Abhainn Mhor Ceann Reasort	No	No	17.6
West Highland	River	20781	Abhainn Tamanabhaigh	No	No	2.5
West Highland	River	20787	Abhainn Giosla - d/s Loch Gruineabhat	No	Yes	3.7
West Highland	River	20789	Abhainn Cleit Duastal	No	No	10.9
West Highland	River	20568	River Laxford - Allt Achadh Fairidh	No	No	6.0
North Highland	River	20209	River Beauly - Beauly Firth to Cannich	No	Yes	31.9
North Highland	River	20210	River Affric - Cannich to Loch Beinn a Mheadhoin	No	Yes	10.2
North Highland	River	20213	Bruiach Burn/Belladrum Burn	No	No	23.6
North Highland	River	20219	River Farrar - Beauly confluence to Loch Beannacharan	No	Yes	11.5
North Highland	River	20220	River Farrar - Loch Beannacharan to Loch Monar	No	Yes	12.3
North Highland	River	20223	Neaty Burn	No	Yes	7.8
North Highland	River	20224	Allt Coire nam Brathan	No	Yes	6.3
North Highland	River	20225	East Deanie Burn	No	Yes	4.7
North Highland	River	20226	Allt Coire Mhuillidh	No	No	5.6
North Highland	River	20227	Uisge Misgeach	No	Yes	9.9
North Highland	River	20232	River Cannich - Cannich to Loch Mullardoch	No	Yes	15.6
North Highland	River	20239	Mill Burn - sea to Hilton	No	Yes	2.8
North Highland	River	20240	Mill Burn - Hilton to source	No	No	4.2
North Highland	River	20245	Tributary of Ardersier Burn - sea to Mid Coul	No	Yes	6.5
North Highland	River	20247	Balnagowan Burn	No	No	8.1
North Highland	River	20253	River Oich	No	No	9.0
North Highland	River	20254	River Garry - Loch Oich to Loch Garry	No	Yes	6.0
North Highland	River	20260	Big Burn - Ness confluence to Loch Ashie	No	No	9.4
North Highland	River	20262	River Enrick - Loch Ness to Loch Meiklie	No	No	9.9
North Highland	River	20263	River Enrick - Loch Meiklie to Allt Seanabhaile confluence	No	No	2.1
North Highland	River	20267	Liath Burn Farigaig Forest	No	No	4.5
North Highland	River	20272	Allt an Loin	No	Yes	3.3
North Highland	River	20274	River E	No	No	11.4
North Highland	River	20280	River Moriston - River Loyne confluence to Loch Cluanie	No	Yes	3.9
North Highland	River	20282	Allt Bhlaraidh	No	No	11.1
North Highland	River	20283	Allt Lairairidh	No	No	6.4
North Highland	River	20286	Allt na Muic	No	No	8.9

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
North Highland	River	20287	River Doe	No	No	27.4
North Highland	River	20288	River Loyne - River Moriston confluence to Loch Loyne	No	Yes	3.0
North Highland	River	20305	River Nairn - Moray Firth to River Farnack confluence	No	No	34.2
North Highland	River	20306	River Nairn - River Farnack confluence to source	No	No	22.4
North Highland	River	20307	Auldearn Burn	No	No	11.2
North Highland	River	20308	Geddes Burn	No	Yes	7.4
North Highland	River	20321	Black Burn (Clunas)	No	No	12.1
Argyll	River	20323	River Duror	No	Yes	9.7
Argyll	River	20329	River Nevis	No	Yes	19.6
Argyll	River	20330	River Leven - sea to Blackwater Reservoir	No	Yes	7.4
Argyll	River	20332	Allt na h-Eilde	No	No	2.8
Argyll	River	20339	River Lochy - sea to Spean confluence	No	No	13.5
Argyll	River	20340	River Lochy - Mucomir Cut	Yes	No	0.7
Argyll	River	20342	Allt a Mhuilinn	No	No	7.4
Argyll	River	20343	River Lundy	No	No	12.6
Argyll	River	20349	The Cour	No	Yes	24.1
Argyll	River	20350	Allt Leachdach	No	Yes	6.4
Argyll	River	20359	Abhainn Rath	No	No	14.0
Argyll	River	20370	Mid Lochan na h-Earba	No	No	0.9
North Highland	River	20207	Moniack Burn - Beauly Firth to Kirkhill WWTP	No	No	1.0
North Highland	River	20034	Thrumster Burn - d/s Thrumster WWTW to Loch Hempriggs	No	No	1.2
North Highland	River	20035	Thrumster Burn - u/s Thrumster WWTW	No	No	5.9
North Highland	River	20039	Burn of Winless	No	No	7.8
North Highland	River	20041	Quoynee Burn - d/s Loch Scarmclate	No	No	3.5
North Highland	River	20042	Quoynee Burn - u/s Loch Scarmclate	No	No	2.0
North Highland	River	20079	River Evelix	No	No	31.0
North Highland	River	20083	Allt Mor	No	No	6.2
North Highland	River	20085	Culrain Burn	No	No	6.8
North Highland	River	20088	Easter Fearn Burn	No	No	9.0
North Highland	River	20089	Craigroy Burn - sea to Balblair Ditillery	No	No	1.1
North Highland	River	20090	Craigroy Burn - Balblair Distiilery to source	No	No	10.4
North Highland	River	20093	River Shin - Dornoch Firth to Loch Shin	No	Yes	11.7
North Highland	River	20098	Grudie Burn	No	Yes	15.8
North Highland	River	20111	River Cassley - Glenmuick to Fionn Loch Beag	No	Yes	13.6
North Highland	River	20116	River Oykel - Dornoch Firth to Loch Craggie	No	No	18.3
North Highland	River	20119	Tutim Burn	No	No	7.7
North Highland	River	20121	River Einig	No	Yes	6.4
North Highland	River	20126	Garbh Allt	No	No	8.5

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
North Highland	River	20130	River Carron - sea to Alladale Lodge	No	No	19.8
North Highland	River	20131	Abhainn a Ghlinne Mhoir	No	Yes	26.8
North Highland	River	20139	Fearn Canal	No	No	13.0
North Highland	River	20140	Garrick Burn	No	No	6.1
North Highland	River	20142	Pollo Burn	No	No	17.6
North Highland	River	20143	Rosskeen Burn - Cromarty Firth to Tomich	No	No	2.6
North Highland	River	20144	Rosskeen Burn - Tomich to source	No	No	6.4
North Highland	River	20148	Ussie Burn - sea to Loch Ussie	No	No	5.2
North Highland	River	20150	Newhall Burn	No	No	14.4
North Highland	River	20152	Roskill Burn	No	No	10.4
North Highland	River	20153	Killen Burn	No	No	11.2
North Highland	River	20154	Big Burn (Munlochy)	No	No	7.8
North Highland	River	20155	Allanglach Burn	No	No	6.2
North Highland	River	20166	River Conon - Orrin confluence to Loch Achonachie	No	Yes	7.7
North Highland	River	20167	River Conon - Loch Achonachie to Loch Luichart	No	Yes	5.7
North Highland	River	20168	River Bran - Loch Luichart to Loch Achanalt	No	Yes	5.1
North Highland	River	20173	Logie Burn - Muir of Ord to source	No	No	8.1
North Highland	River	20174	River Orrin - Conon confluence to Orrin Reservoir	No	Yes	15.1
North Highland	River	20183	Rogie Burn	No	No	8.6
North Highland	River	20187	Abhainn Srath a Bhathaich	No	Yes	6.0
North Highland	River	20190	River Meig - Conon confluence to Loch Meig	No	Yes	2.5
North Highland	River	20197	Allt a Ghlinne	No	No	6.2
North Highland	River	20198	Allt Coire Mhuilidh	No	No	8.9
North Highland	River	20199	River Grudie - Bran confluence to Loch Fannich	No	Yes	6.7
North Highland	River	20201	Allt Dearg	No	Yes	6.3
North Highland	River	20202	Allt a Choin Idhir	No	Yes	4.6
Clyde	River	10398	Carmel Water	No	No	19.6
Clyde	River	10399	Kingswell Burn/Fenwick Water/ Kilmarnock Water	No	No	23.7
Clyde	River	10401	Craufurdland Water/Dunton Water (u/s Hareshawmuir Water)	No	No	12.3
Clyde	River	10408	Avon Water/Glengavel Water (to Calder Water conf)	No	Yes	14.8
Clyde	River	10410	Kype Water	No	No	14.6
Clyde	River	10418	Rumbling Burn	No	No	7.6
Clyde	River	10419	Ladykirk Burn	No	Yes	8.2
Clyde	River	10420	River Ayr (d/s Greenock Water)	No	No	46.4
Clyde	River	10424	Taiglum Burn	No	No	8.8
Clyde	River	10425	Glenstang Burn/Trabboch Burn	No	No	7.4

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
Clyde	River	10426	Water of Fail	No	No	11.4
Clyde	River	10427	Lugar Water	No	No	14.4
Clyde	River	10431	Glaisnock Water	No	No	7.2
Clyde	River	10434	Burnock Water	No	No	21.2
Clyde	River	10437	Slaphouse Burn	No	No	8.0
Clyde	River	10438	River Doon	No	Yes	40.1
Clyde	River	10439	Carrick Lane	No	No	10.9
Clyde	River	10442	Purclewan Burn	No	No	10.4
Clyde	River	10443	Cummock Water	No	No	9.3
Clyde	River	10444	Muck Water	No	No	10.3
Clyde	River	10446	Garpel Burn	No	No	1.8
Clyde	River	10448	Gala Lane	No	No	9.2
Clyde	River	10449	Whitespout Lane	No	Yes	3.7
Clyde	River	10455	Water of Girvan (Dobbingstone Burn to Palmullan Burn)	No	No	27.4
Clyde	River	10456	Water of Girvan (d/s Loch Bradan to Palmullan Burn)	No	Yes	8.1
Clyde	River	10457	Water of Girvan (u/s Loch Bradan)	No	No	5.7
Clyde	River	10458	Penwhapple Burn	No	Yes	10.1
Clyde	River	10461	Barlewan Burn	No	No	10.2
Clyde	River	10462	Dyrock Burn	No	No	9.6
Clyde	River	10395	Glazert Burn	No	No	18.8
Forth	River	6831	Bannock Burn (Source to Sauchie Burn confluence)	No	Yes	11.3
Forth	River	6840	Hatton Burn/Kiel Burn	No	Yes	10.6
Forth	River	6832	Allan Water d/s of Dunblane	No	No	6.2
Forth	River	6835	Eas Gobhain	No	Yes	2.9
Tay	River	6836	River Garry (Errochty Water Confluence to L Faskally)	No	No	15.1
Clyde	River	10742	Luggie Burn	No	Yes	3.8
Clyde	River	10743	South Burn	No	Yes	5.3
Clyde	River	10745	Iorsa Water	No	No	13.7
Clyde	River	10757	Water of Girvan (d/s Dailly)	No	No	13.7
North Highland	River	23390	River Fleet - Loch Fleet to Rogart	No	No	7.7
North Highland	River	23379	Black Water - Garbat to Black Bridge	No	No	5.2
North Highland	River	23387	River Foyers - Loch Ness to Whitebridge	No	No	7.7
North Highland	River	23388	River Fechlin - Whitebridge to Loch Mhor Transfer	No	No	2.3
North Highland	River	23389	River Fechlin - Loch Mhor Transfer to Loch Killin	No	No	5.0
North Highland	River	23381	River Moriston - Loch Ness to Dundreggan Dam	No	Yes	8.8

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
North Highland	River	23382	River Moriston - Dundreggan Dam to Bun Loyne	No	Yes	17.7
West Highland	River	23384	River Kerry - Kerry Power Station to Loch Bad an Sgalaig	No	Yes	2.2
West Highland	River	23391	Allt Loch an Tuirc	No	No	6.3
West Highland	River	23399	An Lige Mor	No	No	0.7
West Highland	River	23395	Leacach How	No	No	3.0
North Highland	River	23377	Innes Canal / Lhanbryde Burn	No	Yes	12.0
Clyde	River	10746	Pow Burn	No	Yes	13.9
Clyde	River	10747	Black Cart Water	No	Yes	12.0
Clyde	River	10752	Monkland Canal	Yes	No	8.5
North Highland	River	23370	Ault na Skiah	No	No	8.2
North East Scotland	River	23372	Logie Burn/Loch Davan	No	No	9.8
North Highland	River	23394	River Ness - Inverness Firth to Loch Ness	No	Yes	10.6
North Highland	River	23398	Rough Burn	No	No	4.8
Clyde	River	10706	Duntocher Burn	No	Yes	10.2
Clyde	River	10723	River Calder (u/s Castle Semple Loch)	No	No	0.1
Clyde	River	10727	Powgree Burn	No	No	7.8
Clyde	River	10731	Stand Burn/Park Burn	No	Yes	8.1
Forth	River	6882	Tiel Burn	No	No	9.9
Argyll	River	10896	Machrihanish Water/Backs Water	No	No	12.1
Clyde	River	10918	River Clyde (Strathclyde Loch outflow to North Calder)	0	0	10.2
Forth	River	6907	Lyne Burn	No	Yes	15.6
Forth	River	6908	Brothie Burn (Gartmorn Reservoir to Forth Estuary)	No	Yes	4.4
Tay	River	6904	St Martins Burn/Balgray Burn	No	No	14.4
Tay	River	6906	Cambusmichael Burn	No	No	4.4
North East Scotland	River	23632	Cowie Burn	No	No	4.0
Argyll	Lake	100275	Loch Glashan	No	Yes	1.9
Clyde	Lake	100284	Loch Thom	No	Yes	1.5
Clyde	Lake	100313	Daer Reservoir	No	Yes	2.0
North East Scotland	Lake	100182	Loch Morlich	No	No	1.2
North East Scotland	Lake	100187	Loch Insh	No	No	1.3
North East Scotland	Lake	100195	Loch Crunachulan	No	Yes	0.9
North East Scotland	Lake	100199	Loch an t-Seilich	No	Yes	1.1
West Highland	Lake	100176	Loch Dùn na Cille	No	No	0.5
Argyll	Lake	100206	Loch Eilt	No	No	1.8
Clyde	Lake	100304	Dunwan Dam	No	Yes	0.5
Clyde	Lake	100299	Balgray Reservoir	No	Yes	0.6
Clyde	Lake	100314	Loch Doon	No	Yes	8.2
Clyde	Lake	100315	Loch Finlas	No	No	0.8

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
Clyde	Lake	100317	Loch Riecawr	No	Yes	0.9
Clyde	Lake	100318	Loch Macaterick	No	No	0.7
Clyde	Lake	100320	Loch Enoch	No	No	0.5
Clyde	Lake	100316	Loch Bradan	No	Yes	2.2
North Highland	Lake	100100	Loch Migdale	No	No	1.0
Tay	Lake	100223	Loch Laidon	No	No	4.8
Tay	Lake	100224	Loch Eigheach	No	Yes	1.3
Tay	Lake	100230	Loch Benachally	No	Yes	0.7
Tay	Lake	100218	Backwater Reservoir	No	Yes	1.8
Tay	Lake	100225	Loch of Lintrathen	No	Yes	1.7
Argyll	Lake	100241	Loch Ba	No	No	3.2
Clyde	Lake	100285	Gryfe Reservoirs	No	Yes	0.7
Orkney and Shetland	Lake	100007	Loch of Boardhouse	No	No	2.4
Orkney and Shetland	Lake	100012	Loch of Kirbister	No	No	1.0
West Highland	Lake	100095	Loch Ob an Lochain	No	No	0.7
North Highland	Lake	100107	Loch Eye	No	No	1.6
West Highland	Lake	100110	Loch Tollaidh	No	No	0.7
North East Scotland	Lake	100185	Loch of Skene	No	No	1.1
North East Scotland	Lake	100202	Loch Muick	No	No	2.2
Argyll	Lake	100247	Loch Awe (South)	No	No	30.5
Argyll	Lake	100340	Loch Awe (North)	No	No	7.5
Clyde	Lake	100260	Loch Sloy	No	Yes	1.3
Clyde	Lake	100263	Loch Arklet	No	Yes	2.2
Argyll	Lake	100252	Lochan Shira	No	Yes	1.3
Clyde	Lake	100287	Hillend Reservoir	No	Yes	1.3
Clyde	Lake	100308	Camps Reservoir	No	Yes	0.7
Forth	Lake	100277	Loch Gelly	No	No	0.6
Forth	Lake	100278	Loch Fitty	No	No	0.6
Forth	Lake	100269	Loch Leven	No	No	13.7
Clyde	Lake	100282	Loch Tarsan	No	Yes	1.0
Argyll	Lake	100303	Loch Garasdale	No	No	0.6
Argyll	Lake	100306	Lussa Loch	No	Yes	1.2
West Highland	Lake	100133	Loch Carabhat	No	No	1.5
West Highland	Lake	100144	Loch Sgamhain	No	No	0.6
Argyll	Lake	100208	Loch Shiel	No	No	19.9
Argyll	Lake	100219	Blackwater Reservoir	No	Yes	10.9
Forth	Lake	100261	Loch Katrine	No	Yes	13.3
Forth	Lake	100264	Loch Achray	No	No	0.7
Forth	Lake	100265	Loch Chon	No	No	1.1
Forth	Lake	100268	Loch Drunkie	No	Yes	0.6
Forth	Lake	100271	Lake of Menteith	No	No	2.5

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
Clyde	Lake	100305	Lochgoin Reservoir	No	Yes	0.6
North Highland	Lake	100065	Loch Shin	No	Yes	32.9
West Highland	Lake	100089	Loch Urigill	No	No	2.0
West Highland	Lake	100145	Loch Leathan	No	Yes	1.2
North East Scotland	Lake	100136	Loch of Strathbeg	No	No	2.1
Argyll	Lake	100250	Loch Nant	No	Yes	2.1
Forth	Lake	100295	Cobbinshaw Reservoir	No	Yes	1.3
Clyde	Lake	100292	Loch Fad	No	Yes	0.9
North Highland	Lake	100035	Loch More	No	No	2.0
North Highland	Lake	100022	Loch Watten	No	No	3.7
North Highland	Lake	100027	Loch of Toftingall	No	No	0.5
West Highland	Lake	100118	Loch Bad an Sgalaig	No	Yes	1.3
West Highland	Lake	100143	Loch Damh	No	No	3.3
Tay	Lake	100209	Loch Lee	No	No	0.9
Clyde	Lake	100294	Castle Semple Loch	No	No	0.8
Clyde	Lake	100298	Barcraigs Reservoir	No	Yes	0.7
Clyde	Lake	100300	Kilbirnie Loch	No	No	0.8
North Highland	Lake	100139	Loch Ussie	No	No	0.8
North Highland	Lake	100177	Loch Knockie	No	No	0.7
North Highland	Lake	100156	Loch Ness	No	No	55.3
Argyll	Lake	100194	Loch Lochy	No	Yes	17.2
Argyll	Lake	100200	Lochan na h-Earba (east)	No	No	0.6
Argyll	Lake	100204	Lochan na h-Earba (west)	No	No	1.1
Argyll	Lake	100205	Lower Loch Laggan	No	Yes	2.2
Orkney and Shetland	Lake	100008	Loch of Harray	No	No	9.8
Orkney and Shetland	Lake	100013	Heldale Water	No	No	0.6
West Highland	Lake	100054	Loch Orasaigh	No	No	0.6
West Highland	Lake	100070	Loch nan Ritheanan	No	No	0.5
North Highland	Lake	100034	Loch Hempriggs	No	No	0.9
North Highland	Lake	100086	Loch Ailsh	No	No	1.1
Forth	Transitional	200436	Middle Forth Estuary	No	Yes	38.2
Forth	Transitional	200437	Upper Forth Estuary	No	Yes	9.7
North Highland	Transitional	200440	Moray Firth	No	No	61.7
North Highland	Transitional	200442	Outer Cromarty Firth	No	No	51.4
North Highland	Transitional	200442	Outer Cromarty Firth	No	No	51.4
North Highland	Transitional	200443	Inner Cromarty Firth	No	No	39.5
Clyde	Transitional	200320	Clyde Estuary - Outer	No	No	70.7
North Highland	Transitional	200327	Muirtown Basin Lagoon. Inverness	No	No	0.0
North Highland	Transitional	200328	South Kessock Lagoon. Inverness	No	No	0.0
Clyde	Transitional	200014	Girvan Estuary	No	Yes	0.0
Clyde	Transitional	200018	Ayr Estuary	No	Yes	0.2

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
Clyde	Transitional	200022	Garnock/Irvine Estuary	No	Yes	1.6
Clyde	Transitional	200043	Gare Loch	No	No	12.9
Tay	Transitional	200079	Montrose Basin	No	No	8.5
North East Scotland	Transitional	200103	Dee (Aberdeen) Estuary	No	Yes	0.9
North East Scotland	Transitional	200113	Ythan Estuary	No	No	2.7
Clyde	Transitional	200510	Clyde Estuary - Inner	No	Yes	4.4
West Highland	Coastal	200418	Loch Bee. South Uist	No	No	7.0
Orkney and Shetland	Coastal	200460	Kirkwall Lagoon (Peerie Sea). Mainland.Orkney Islands	No	Yes	0.1
Orkney and Shetland	Coastal	200462	Loch of Stenness. Mainland. Orkney Islands	No	No	7.9
North Highland	Coastal	200473	Wick Bay	No	No	1.0
Orkney and Shetland	Coastal	200474	Scapa Flow	No	No	263.3
Orkney and Shetland	Coastal	200474	Scapa Flow	No	No	263.3
West Highland	Coastal	200391	Loch Maddy	No	No	15.2
North East Scotland	Coastal	200131	Ugie Estuary to Buchan Ness (Peterhead)	No	No	46.3
North Highland	Coastal	200148	Burghead to Lossiemouth	No	No	122.3
West Highland	Coastal	200154	The Obbe. Harris	No	No	0.3
West Highland	Coastal	200162	Little Loch Broom	No	No	24.3
West Highland	Coastal	200174	Summer Isles	No	No	18.5
West Highland	Coastal	200183	Loch Inver	No	No	3.8
West Highland	Coastal	200191	Stornoway Harbour	No	No	3.1
West Highland	Coastal	200211	Loch Inchard	No	No	4.0
Orkney and Shetland	Coastal	200260	Cat Firth	No	No	3.5
Clyde	Coastal	200020	Ayr Bay	No	No	98.3
Clyde	Coastal	200021	Irvine Bay	No	No	80.8
Clyde	Coastal	200026	Largs Channel (Fairlie Roads)	No	No	29.9
Clyde	Coastal	200027	Sound of Bute	No	No	217.9
North East Scotland	Coastal	200105	Don Estuary to Souter Head (Aberdeen)	No	No	50.2
North East Scotland	Coastal	200117	Cruden Bay to the Don Estuary	No	No	149.4
North East Scotland	Coastal	200497	Findochty to Knock Head	No	No	134.5
Tay	Groundwater	150255	Carse of Gowrie bedrock and localised sand and gravel aquifers	No	No	77.6
Clyde	Groundwater	150196	Ayr bedrock and localised sand and gravel aquifers	No	No	166.1
Clyde	Groundwater	150198	Kilmarnock bedrock and localised sand and gravel aquifers	No	No	294.6
Tay	Groundwater	150267	Montrose bedrock and localised sand and gravel aquifers	No	No	69.5
Tay	Groundwater	150272	Brothock Valley Sand and Gravel	No	No	16.7
Forth	Groundwater	150234	Stirling and Falkirk bedrock and localised sand and gravel aquifers	No	No	555.5
Forth	Groundwater	150238	Denny Sand and Gravel	No	No	7.0

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
Tay	Groundwater	150251	Newburgh bedrock and localised sand and gravel aquifers	No	No	55.4
Tay	Groundwater	150270	Brechin bedrock and localised sand and gravel aquifers	No	No	125.1
North East Scotland	Groundwater	150303	Peterhead bedrock and localised sand and gravel aquifers	No	No	185.8
Tay	Groundwater	150265	Arbroath bedrock and localised sand and gravel aquifers	No	No	64.2
Tay	Groundwater	150266	Lunan/Pow bedrock and localised sand and gravel aquifers	No	No	170.0
Tay	Groundwater	150253	Ordie Burn Valley Sand and Gravel	No	No	16.2
Forth	Groundwater	150240	South Fife bedrock and localised sand and gravel aquifers	No	No	361.4
Forth	Groundwater	150235	Alloa bedrock and localised sand and gravel aquifers	No	No	232.6
Clyde	Groundwater	150210	Glengavel Valley Sand and Gravel	No	No	14.1
Clyde	Groundwater	150218	Clydesdale bedrock and localised sand and gravel aquifers	No	No	498.8
Clyde	Groundwater	150219	Clydebank and Kirkintilloch bedrock and localised sand and gravel aquifers	No	No	310.2
Clyde	Groundwater	150220	Paisley and Rutherglen bedrock and localised sand and gravel aquifers	No	No	218.6
Forth	Groundwater	150226	Dalkeith bedrock and localised sand and gravel aquifers	No	No	373.5
Forth	Groundwater	150232	Humbie Sand and Gravel	No	No	10.8
Clyde	Groundwater	150221	Douglas Valley Sand and Gravel	No	No	57.6
Forth	Groundwater	150233	Esk Valley Sand and Gravel	No	No	31.2
Clyde	Groundwater	150197	Cumnock bedrock and localised sand and gravel aquifers	No	No	398.0
Clyde	Groundwater	150199	Kilwinning bedrock and localised sand and gravel aquifers	No	No	126.3
Clyde	Groundwater	150207	Irvine Valley Sand and Gravel	No	No	25.3
North East Scotland	Groundwater	150304	Newburgh Coastal Sand and Gravel	No	No	25.4
Tay	Groundwater	150269	Laurencekirk bedrock and localised sand and gravel aquifers	No	No	256.2
Tay	Groundwater	150273	South Esk Valley Sand and Gravel	No	No	56.3
Tay	Groundwater	150252	North Fife Sand and Gravel	No	No	19.9
Forth	Groundwater	150245	Markinch Sand and Gravel	No	No	21.1
Clyde	Groundwater	150211	Avon Valley Sand and Gravel	No	No	8.6
Forth	Groundwater	150281	Allan Valley Sand and Gravel	No	No	50.3
North East Scotland	Groundwater	150342	Fochabers bedrock and localised sand and gravel aquifers	No	No	190.0
North Highland	Groundwater	150345	Inverness Coastal Sand and Gravel	No	No	60.1
North East Scotland	Groundwater	150302	Fraserburgh bedrock and extensive sand and gravel aquifers	No	No	207.3

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
North East Scotland	Groundwater	150370	Blackdog Coastal Sand and Gravel	No	No	33.9
Tay	Groundwater	150271	Lunan Valley Sand and Gravel	No	No	23.8
Tay	Groundwater	150256	Dundee bedrock and localised sand and gravel aquifers	No	No	171.4
Tay	Groundwater	150260	Perth bedrock and localised sand and gravel aquifers	No	No	265.5
Tay	Groundwater	150242	Leslie bedrock and localised sand and gravel aquifers	No	No	160.1
Forth	Groundwater	150244	Leven Coastal Sand and Gravel	No	No	41.9
Clyde	Groundwater	150212	Kelvin Valley Sand and Gravel	No	No	36.6
Clyde	Groundwater	150222	South Medwin Valley Sand and Gravel	No	No	26.9
Forth	Groundwater	150225	Dunbar bedrock and localised sand and gravel aquifers	No	No	377.8
Tay	Groundwater	150257	Carnoustie bedrock and localised sand and gravel aquifers	No	No	138.3
Tay	Groundwater	150389	Cruick Valley Sand and Gravel	No	No	13.6
Forth	Groundwater	150246	Loch Leven bedrock and extensive sand and gravel aquifers	No	No	77.9
Clyde	Groundwater	150194	Girvan bedrock and localised sand and gravel aquifers	No	No	501.5
North Highland	Groundwater	150346	Conon Valley Sand and Gravel	No	No	52.4
North Highland	Groundwater	150348	Alness Coastal Sand and Gravel	No	No	15.9
North Highland	Groundwater	150349	Nigg Bay Coastal Sand and Gravel	No	No	68.2
North Highland	Groundwater	150350	Black Isle bedrock and localised sand and gravel aquifers	No	No	271.2
North Highland	Groundwater	150341	Forres bedrock and localised sand and gravel aquifers	No	No	152.5
North East Scotland	Groundwater	150306	South Ugie Valley Sand and Gravel	No	No	25.9
North East Scotland	Groundwater	150394	Middlemuir bedrock and localised sand and gravel aquifers	No	No	78.7
North East Scotland	Groundwater	150392	Gormack Valley Sand and Gravel	No	No	27.3
North East Scotland	Groundwater	150268	Stonehaven bedrock and localised sand and gravel aquifers	No	No	196.8
Tay	Groundwater	150274	Edzell Sand and Gravel	No	No	58.7
Tay	Groundwater	150261	Vale of Strathmore bedrock and extensive sand and gravel aquifers	No	No	402.1
Tay	Groundwater	150264	East Pow Valley Sand and Gravel	No	No	7.9
Tay	Groundwater	150247	Leuchars bedrock and extensive sand and gravel aquifers	No	No	53.5
Tay	Groundwater	150249	Ladybank Sand and Gravel	No	No	53.6
Tay	Groundwater	150243	East Fife bedrock and localised sand and gravel aquifers	No	No	213.0
Clyde	Groundwater	150217	Lanark bedrock and localised sand and gravel aquifers	No	No	767.7
Clyde	Groundwater	150223	Clyde Valley Sand and Gravel	No	No	34.5

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km^2)
Forth	Groundwater	150224	North Berwick bedrock and localised sand and gravel aquifers	No	No	114.6
Forth	Groundwater	150230	Tyne Estuary Sand and Gravel	No	No	20.1
Forth	Groundwater	150124	St Abbs bedrock and localised sand and gravel aquifers	No	No	251.4
North Highland	Groundwater	150347	Peffery Valley Sand and Gravel	No	No	9.5
North Highland	Groundwater	150356	Beauly Coastal Sand and Gravel	No	No	32.4
North East Scotland	Groundwater	150371	Lower Don Valley Sand and Gravel	No	No	84.4
North East Scotland	Groundwater	150393	Leuchar Valley Sand and Gravel	No	No	16.2
North East Scotland	Groundwater	150312	Lower Deveron Valley Sand and Gravel	No	No	22.4
North Highland	Groundwater	150340	Elgin bedrock and localised sand and gravel aquifers	No	No	222.7
North East Scotland	Groundwater	150315	Isla Valley Sand and Gravel	No	No	23.6
North East Scotland	Groundwater	150301	Ugie bedrock and localised sand and gravel aquifers	No	No	310.8
North East Scotland	Groundwater	150326	Upper Spey Valley Sand and Gravel	No	No	172.3
North East Scotland	Groundwater	150297	Lower Dee Valley Sand and Gravel	No	No	61.1
North East Scotland	Groundwater	150298	Feugh Valley Sand and Gravel	No	No	21.7
Tay	Groundwater	150292	Tummel Valley Sand and Gravel	No	No	16.6
Tay	Groundwater	150254	Forfar Sand and Gravel	No	No	26.7
Tay	Groundwater	150258	Forfar bedrock and localised sand and gravel aquifers	No	No	77.7
Tay	Groundwater	150259	Sidlaw Hills bedrock and localised sand and gravel aquifers	No	No	105.5
Tay	Groundwater	150277	Crieff bedrock and localised sand and gravel aquifers	No	No	313.1
Tay	Groundwater	150278	Earn Valley Sand and Gravel	No	No	79.8
Tay	Groundwater	150248	Eden Valley bedrock and localised sand and gravel aquifers	No	No	76.6
Forth	Groundwater	150241	Burntisland bedrock and localised sand and gravel aquifers	No	No	47.0
Forth	Groundwater	150236	Glen Devon bedrock and localised sand and gravel aquifers	No	No	217.5
Forth	Groundwater	150239	Crook of Devon Sand and Gravel	No	No	43.4
Forth	Groundwater	150229	Dunbar Coastal Sand and Gravel	No	No	27.3
Forth	Groundwater	150231	East Peffer Sand and Gravel	No	No	15.1
Tay	Groundwater	150263	Almond Valley Sand and Gravel	No	No	23.5
North Highland	Groundwater	150351	Beauly bedrock and localised sand and gravel aquifers	No	No	64.8
North Highland	Groundwater	150352	Dingwall bedrock and localised sand and gravel aquifers	No	No	158.9
North Highland	Groundwater	150354	Dornoch bedrock and localised sand and gravel aquifers	No	No	63.8
North East Scotland	Groundwater	150310	Deveron bedrock and localised sand and gravel aquifers	No	No	1023.2

Sub-basin	Category	Water body	Water body name	Artificial	Modified	Length (km)/ Area(km²)
North East Scotland	Groundwater	150311	Buchie bedrock and localised sand and gravel aquifers	No	No	231.0
North East Scotland	Groundwater	150313	Middle Deveron Valley Sand and Gravel	No	No	17.1
North East Scotland	Groundwater	150314	Huntly Sand and Gravel	No	No	26.7
North East Scotland	Groundwater	150316	Banff Coastal Sand and Gravel	No	No	16.7
North East Scotland	Groundwater	150300	Ythan bedrock and localised sand and gravel aquifers	No	No	495.1
North East Scotland	Groundwater	150305	North Ugie Valley Sand and Gravel	No	No	14.8
North East Scotland	Groundwater	150307	Turriff bedrock and localised sand and gravel aquifers	No	No	184.3
North East Scotland	Groundwater	150308	Idoch Valley Sand and Gravel	No	No	8.7
North East Scotland	Groundwater	150309	Upper Ythan Valley Sand and Gravel	No	No	16.4
North East Scotland	Groundwater	150318	Lower Spey Valley Sand and Gravel	No	No	56.8
North Highland	Groundwater	150335	Kirkhill Coastal Sand and Gravel	No	No	14.9
North East Scotland	Groundwater	150325	Dulnain Valley Sand and Gravel	No	No	27.4
North East Scotland	Groundwater	150372	Middle Don Valley Sand and Gravel	No	No	13.3
North East Scotland	Groundwater	150373	Upper Don Valley Sand and Gravel	No	No	16.2
North East Scotland	Groundwater	150374	Don bedrock and localised sand and gravel aquifers	No	No	1215.2
North East Scotland	Groundwater	150296	Lower Dee bedrock and localised sand and gravel aquifers	No	No	1071.8
North East Scotland	Groundwater	150299	Middle Dee Valley Sand and Gravel	No	No	49.6
North East Scotland	Groundwater	150390	Tarland Valley Sand and Gravel	No	No	15.1
North East Scotland	Groundwater	150288	Upper Dee Valley Sand and Gravel	No	No	59.6
Argyll	Groundwater	150378	Spean Valley Sand and Gravel	No	No	28.0
Tay	Groundwater	150388	North Esk Valley Sand and Gravel	No	No	12.1
Tay	Groundwater	150291	Upper Tay Valley Sand and Gravel	No	No	57.2
Tay	Groundwater	150262	Alyth bedrock and localised sand and gravel aquifers	No	No	134.2
Tay	Groundwater	150284	Upper Earn Valley Sand and Gravel	No	No	12.1
Tay	Groundwater	150250	Glenfarg bedrock and localised sand and gravel aquifers	No	No	368.9
Tay	Groundwater	150279	Pow Valley Sand and Gravel	No	No	19.5

Annex E: Results of applying the heavily modified water bodies screening tool

Table E1: Outcome of application of heavily modified water bodies screening tool

Note: If a water body is heavily modified according to the criteria for one use, then no further work will be done to assess that water body.

LAs = local authorities; SNH = Scottish Natural Heritage

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Forth	River	3004	Gogar Burn	No	No	No	No	Yes	Yes
Forth	River	3016	Bog Burn	Consultation with SNH and LAs required	No	No	No	Further work required	Further work required
Forth	River	3103	Mains Burn	No	No	No	No	Further work required	Further work required
Forth	River	3106	Logie Water/Barbauchlaw Burn	No	No	No	No	No	No
Forth	River	3300	Grange Burn/Westquarter Burn	No	No	No	No	Yes	Yes
Forth	River	3401	Pardovan Burn/Haugh Burn/Riccarton Burn	No	No	No	No	No	Further work required
Forth	River	3500	Braid Burn	No	No	No	No	Further work required	Further work required
Forth	River	3501	Braid Burn	No	Yes	No	No	No	Yes
Forth	River	3700	Water of Leith	No	No	No	No	Yes	Yes
Forth	River	3701	Murray Burn	No	No	No	No	Yes	Yes
Forth	River	3702	Water of Leith	No	No	No	No	Yes	Yes
Forth	River	3703	Water of Leith	No	No	No	No	Yes	Yes
Forth	River	3705	Bavelaw Burn	No	Yes	No	No	No	Yes
Forth	River	3800	River Esk	No	No	No	No	Further work required	Further work required
Forth	River	3803	River South Esk	Yes	Yes	No	No	No	Yes
Forth	River	3809	River Esk/River North Esk	No	No	No	No	No	No
Forth	River	3814	Glencorse Burn	No	No	No	No	No	Further work required
Forth	River	3910	East Peffer	No	No	No	No	No	Further work required
Forth	River	4202	River Carron	No	Yes	No	No	No	Yes
Forth	River	4210	Auchenbowie Burn	No	Yes	No	No	Further work required	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Forth	River	4212	Earls Burn	No	Yes	No	No	No	Yes
Forth	River	4310	Brankholme Burn	No	No	No	No	Yes	Yes
Forth	River	4501	River Devon	Consultation with SNH and LAs required	Yes		No	No	Yes
Forth	River	4723	River Turk	No	Yes	No	No	No	Yes
Tay	River	5602	Raesmill Burn	No	No	No	No	No	Further work required
Tay	River	5805	Noran Water	No	Further work required	No	No	No	Further work required
Tay	River	5806	Lemno Burn	No	No	No	No	No	Further work required
Tay	River	5952	Monikie Burn	No	No	No	No	No	Further work required
Tay	River	6000	Dighty Water (lower)	No	No	No	No	Yes	Yes
Tay	River	6001	Dighty Water	No	No	No	No	No	Further work required
Tay	River	6105	Lundin Water	No	No	No	No	No	Further work required
Tay	River	6107	Kinness Burn	No	No	No	No	Further work required	Further work required
Tay	River	6110	Kenly Water	Yes	No	No	No	No	Yes
Forth	River	6301	River Leven	No	No	No	No	Further work required	Further work required
Forth	River	6303	Kennoway Burn/Back Burn	Yes	Further work required	No	No	Yes	Yes
Forth	River	6313	Lothrie Burn	Yes	Further work required	No	No	No	Yes
Forth	River	6314	Lothrie Burn	Yes	Further work required	No	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Tay	River	6508	R Almond upper reach	No	No	Further work required	No	No	Further work required
Tay	River	6537	Lornty Burn	No	Further work required	No	No	No	Further work required
Tay	River	6557	Meigle Burn	No	No	No	No	No	Further work required
Tay	River	6559	Commerton Burn	No	No	No	No	No	Further work required
Tay	River	6567	Melgam Water/Glendamff Burn	Yes	Yes	No	No	No	Yes
Tay	River	6568	Melgam Water/Glendamff Burn	No	Yes	No	No	No	Yes
Tay	River	6574	Newton Burn/Finlet Burn	No	No	No	No	No	No
Tay	River	6584	River Tummel	Yes	No	Yes	No	No	Yes
Tay	River	6585	River Tummel	Yes	No	Yes	No	No	Yes
Tay	River	6586	River Tummel	Yes	No	Further work required	No	No	Yes
Tay	River	6587	River Gaur	Yes	No	Yes	No	No	Yes
Tay	River	6605	River Bruar	No	No	Further work required	No	No	Further work required
Tay	River	6608	Allt Anndeir	No	No	Further work required	No	No	Further work required
Tay	River	6611	Errochty Water	No	No	Yes	No	No	Yes
Tay	River	6620	Allt a Chreagain Odhair	No	No	Further work required	No	No	Further work required
Tay	River	6623	Killichonan Burn	No	No	Further work required	No	No	Further work required
Tay	River	6624	River Ericht	No	No	Yes	No	No	Yes
Tay	River	6630	Allt Chaldar	No	No	Further work required	No	No	Further work required
Tay	River	6631	Abhainn Duibhe	No	No	Further work required	No	No	Further work required

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Tay	River	6639	River Lyon	No	No	Yes	No	No	Yes
Tay	River	6639	River Lyon	No	No	Yes	No	No	Yes
Tay	River	6648	Allt Conait	No	No	Yes	No	No	Yes
Tay	River	6653	Lawers Burn	No	No	Further work required	No	No	Further work required
Tay	River	6655	Burn of Edramucky	Consultation with SNH and LAs required	No	Further work required	No	No	Further work required
Tay	River	6657	Allt Breaclaich	No	No	Yes	No	No	Yes
Tay	River	6661	River Lochay	No	No	Yes	No	No	Yes
Tay	River	6662	Auchlyne West Burn	No	No	Yes	No	No	Yes
Tay	River	6701	River Farg	No	Yes	No	No	Yes	Yes
Tay	River	6809	Pow Water	No	No	No	No	No	Further work required
Tay	River	6811	Turret Burn	No	Yes	No	No	No	Yes
Tay	River	6815	Lednock Burn	No	No	Yes	No	No	Yes
Tay	River	6828	River Tummel	Yes	No	Yes	No	No	Yes
Tay	River	6829	Loch Faskally	Yes	No	Yes	No	No	Yes
Forth	River	6831	Bannock Burn	No	Yes	No	No	No	Yes
Forth	River	6835	Eas Gobhain	No	Yes	No	No	No	Yes
Tay	River	6837	River Garry	No	No	Further work required	No	No	Further work required
Forth	River	6840	Hatton Burn	No	No	No	No	No	No
Forth	River	6907	Lyne Burn	Yes	No	No	No	Yes	Yes
Forth	River	6908	Brothie Burn (Gartmorn Reservoir to Forth Estuary)	Yes	Further work required	No	No	Yes	Yes
Clyde	River	10000	White Cart Water (Kittoch Water to Hamills Weir)	No	No	No	No	Yes	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Clyde	River	10002	Kittoch Water	No	No	No	No	Yes	Yes
Clyde	River	10006	Brock Burn	No	No	No	No	Yes	Further work required
Clyde	River	10007	Levern Water	No	No	No	No	Yes	Yes
Clyde	River	10009	Dunwan Burn/Polnoon Water (d/s Dunwan Dam)	No	Yes	No	No	No	Yes
Clyde	River	10022	Candrens Burn	No	No	No	No	Yes	Yes
Clyde	River	10025	Dubbs Water	Yes	No	No	No	Yes	Yes
Clyde	River	10027	Roebank Burn (d/s Barcraigs Reservoir)	No	Yes	No	No	No	Yes
Clyde	River	10031	River Gryfe (Gryfe Reservoirs to Barochan Burn conf)	No	Yes	No	No	Further work required	Yes
Clyde	River	10040	River Clyde (North Calder to Tidal Weir)	No	No	No	No	Yes	Yes
Clyde	River	10043	Daer Water (d/s Daer Reservoir)	No	Yes	No	No	No	Yes
Clyde	River	10047	Molendinar Burn	No	No	No	No	Yes	Yes
Clyde	River	10048	Tollcross Burn	No	No	No	No	Yes	Yes
Clyde	River	10062	North Calder Water (d/s Hillend Reservoir to Shotts Burn)	No	No	No	No	No	No
Clyde	River	10071	Wellshaw Burn	No	No	No	No	Yes	Yes
Clyde	River	10072	South Calder Water (Tillan Burn to Strathclyde Park)	No	No	No	No	No	No
Clyde	River	10073	South Calder Water (Auchter Water to Tillan Burn)	No	No	No	No	No	No
Clyde	River	10074	South Calder Water (u/s Auchter Water)	No	No	No	No	No	No
Clyde	River	10091	Netherton Burn	No	Yes	No	No	No	Yes
Clyde	River	10108	Cow Gill/Eastside Burn/Duncan Gill	No	Yes	No	No	No	Yes
Clyde	River	10117	Camps Water	No	Yes	No	No	No	Yes
Clyde	River	10130	River Kelvin (Glazert Water to Tidal Limit)	No	No	No	No	Yes	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Clyde	River	10131	River Kelvin (Glazert to Auchinstarry)	No	No	No	No	Yes	Yes
Clyde	River	10132	Allander Water	No	No	No	No	Yes	Yes
Clyde	River	10138	Bothlin Burn (Garnkirk Burn to Luggie conf)	No	No	No	No	Yes	Yes
Clyde	River	10144	Board Burn	No	No	No	No	Yes	Yes
Clyde	River	10145	Glazert Water/Finglen Burn	No	No	No	No	Yes	Yes
Clyde	River	10148	Garrel Burn	No	Yes	No	No	Yes	Yes
Clyde	River	10150	River Leven	Consultation with SNH and LAs required	No	No	Yes	Yes	Yes
Clyde	River	10155	Carnock Burn	No	Yes	No	No	No	Yes
Clyde	River	10159	Finlas Water	No	Yes	No	No	No	Yes
Clyde	River	10162	Inveruglas Water	No	No	Yes	No	No	Yes
Clyde	River	10164	Allt Coiregrogain	No	No	Yes	No	No	Yes
Clyde	River	10167	Dubh Eas/Allt nan Caorainn	No	No	Yes	No	No	Yes
Clyde	River	10169	Arklet Water	No	Yes	No	No	No	Yes
Clyde	River	10199	Glentarsan Burn/Garbh Allt	No	No	Yes	No	No	Yes
Clyde	River	10205	River Eachaig	No	Yes	No	No	No	Yes
Clyde	River	10214	Donich Water/Allt Coire Odhair	No	No	No	No	No	Further work required
Argyll	River	10218	River Fyne	No	No	Further work required	No	No	Further work required
Argyll	River	10219	Allt na Lairige	No	No	Yes	No	No	Yes
Argyll	River	10220	River Shira (d/s Lochan Shira)	No	No	Yes	No	No	Yes
Argyll	River	10222	Kilblaan Burn	No	No	Yes	No	No	Yes
Argyll	River	10223	Brannie Burn	No	No	Yes	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Argyll	River	10234	Glenlussa Water (d/s Lussa Loch)	Consultation with SNH and LAs required	No	Yes	No	No	Yes
Argyll	River	10239	Abhainn a Chnoeain	No	No	Yes	No	No	Yes
Argyll	River	10251	Abhainn Learg an Uinnsinn/Allt Caoi-rain	No	No	No	No	No	No
Argyll	River	10255	Abhainn na Cuile/Allt Mor	No	No	No	No	No	No
Argyll	River	10259	The Lussa	No	No	No	No	No	No
Argyll	River	10266	River Add/Abhainn Bheag an Tunns (u/s Kilmartin Burn)	No	No	Further work required	No	No	Further work required
Argyll	River	10268	River Add (u/s Abhainn Bheag an Tunns confluence)	No	No	Yes	No	No	Yes
Argyll	River	10270	River Liever	No	No	No	No	No	No
Argyll	River	10272	Abhainn a Bhealaich	No	No	Further work required	No	No	Further work required
Argyll	River	10276	Abhainn Fionain	No	No	Yes	No	No	Yes
Argyll	River	10280	River Awe	No	No	Yes	No	No	Yes
Argyll	River	10281	Cladich River/Allt an Stacain	No	No	Yes	No	No	Yes
Argyll	River	10288	Allt Kinglass	No	No	Yes	No	No	Yes
Argyll	River	10294	River Oude (d/s Loch Tralaig)	No	No	Yes	No	No	Yes
Argyll	River	10295	River Oude (u/s Loch Tralaig)	No	No	No	No	No	No
Argyll	River	10300	River Nant (d/s Loch Nant)	Consultation with SNH and LAs required	No	Further work required	No	No	Further work required
Argyll	River	10309	Abhainn Teithil	No	No	Further work required	No	No	Further work required
Argyll	River	10324	Glashan Burn	No	No	Yes	No	No	Yes
Argyll	River	10325	un-named trib of Loch Glashan	No	No	No	No	No	No

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Argyll	River	10349	River Leoig	Consultation with SNH and LAs required	No	No	No	No	No
Clyde	River	10390	Rye Water	Consultation with SNH and LAs required	Yes	No	No	No	Yes
Clyde	River	10408	Avon Water/Glengavel Water (to Calder Water conf)	No	Yes	No	No	No	Yes
Clyde	River	10419	Ladykirk Burn	No	No	No	No	Yes	Yes
Clyde	River	10438	River Doon	Yes	No	No	No	No	Yes
Clyde	River	10449	Whitespout Lane	No	Yes	No	No	No	Yes
Clyde	River	10456	Water of Girvan (d/s Loch Bradan to Palmullan Burn)	No	Yes	No	No	No	Yes
Clyde	River	10458	Penwhapple Burn	No	Yes	No	No	No	Yes
Clyde	River	10706	Duntocher Burn	No	No	No	No	Yes	Yes
Clyde	River	10731	Stand Burn/Park Burn	No	No	No	No	Yes	Yes
Clyde	River	10742	Luggie Burn	No	No	No	No	Yes	Yes
Clyde	River	10743	South Burn	No	No	No	No	Yes	Yes
Clyde	River	10746	Pow Burn	No	No	No	No	Yes	Yes
Clyde	River	10747	Black Cart Water	No	No	No	No	Yes	Yes
North Highland	River	20093	River Shin - Dornoch Firth to Loch Shin	No	No	Yes	No	No	Yes
North Highland	River	20098	Grudie Burn	No	No	Yes	No	No	Yes
North Highland	River	20111	River Cassley - Glenmuick to Fionn Loch Beag	No	No	Yes	No	No	Yes
North Highland	River	20121	River Einig	Consultation with SNH and LAs required	Further work required	No	No	No	Further work required

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
North Highland	River	20131	Abhainn a Ghlinne Mhoir	No	No	Further work required	No	No	Further work required
North Highland	River	20166	River Conon - Orrin confluence to Loch Achonachie	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North Highland	River	20167	River Conon - Loch Achonachie to Loch Luichart	No	No	Yes	No	No	Yes
North Highland	River	20168	River Bran - Loch Luichart to Loch Achanalt	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North Highland	River	20174	River Orrin - Conon confluence to Orrin Reservoir	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North Highland	River	20186	Abhainn Srath Rannoch	No	No	Further work required	No	No	Further work required
North Highland	River	20187	Abhainn Srath a Bhathaich	No	No	Yes	No	No	Yes
North Highland	River	20188	Allt Tom nan Muc	No	No	No	No	No	No
North Highland	River	20189	Abhainn an Torrain Duibh	No	No	No	No	Further work required	Further work required
North Highland	River	20190	River Meig - Conon confluence to Loch Meig	No	No	Yes	No	No	Yes
North Highland	River	20199	River Grudie - Bran confluence to Loch Fannich	No	No	Yes	No	No	Yes
North Highland	River	20201	Allt Dearg	No	No	Yes	No	No	Yes
North Highland	River	20202	Allt a Choin Idhir	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North Highland	River	20209	River Beauly - Beauly Firth to Cannich	No	No	Yes	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
North Highland	River	20210	River Affric - Cannich to Loch Beinn a Mheadhoin	Yes	No	Yes	No	No	Yes
North Highland	River	20219	River Farrar - Beauly confluence to Loch Beannacharan	No	No	Yes	No	No	Yes
North Highland	River	20220	River Farrar - Loch Beannacharan to Loch Monar	No	No	Yes	No	No	Yes
North Highland	River	20223	Neaty Burn	No	No	Further work required	No	No	Further work required
North Highland	River	20224	Allt Coire nam Brathan	No	No	Further work required	No	No	Further work required
North Highland	River	20225	East Deanie Burn	No	No	Further work required	No	No	Further work required
North Highland	River	20227	Uisge Misgeach	No	No	Yes	No	No	Yes
North Highland	River	20232	River Cannich - Cannich to Loch Mullardoch	No	Yes	Yes	No	No	Yes
North Highland	River	20239	Mill Burn - sea to Hilton	No	No	No	No	Yes	Yes
North Highland	River	20245	Tributary of Ardersier Burn - sea to Mid Coul	No	No	No	No	Yes	Yes
North Highland	River	20254	River Garry - Loch Oich to Loch Garry	No	No	Yes	No	No	Yes
North Highland	River	20255	River Garry - Loch Garry to Loch Poulary	No	No	Yes	No	No	Yes
North Highland	River	20256	River Garry - Loch Poulary to Loch Quoich	No	No	Yes	No	No	Yes
North Highland	River	20272	Allt an Loin	No	No	Yes	No	No	Yes
North Highland	River	20280	River Moriston - River Loyne confluence to Loch Cluanie	No	No	Yes	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
North Highland	River	20288	River Loyne - River Moriston confluence to Loch Loyne	No	No	Yes	No	No	Yes
North Highland	River	20296	Aldernaig Burn - hatchery to source	No	Yes	Yes	No	No	Yes
North Highland	River	20308	Geddes Burn	No	Yes	No	No	No	Yes
Argyll	River	20323	River Duror	No	No	No	No	No	No
Argyll	River	20329	River Nevis	Consultation with SNH and LAs required	No	Further work required	No	No	Further work required
Argyll	River	20330	River Leven - sea to Blackwater Reservoir	No	No	Yes	No	No	Yes
Argyll	River	20346	River Spean - Lochy to Laggan Dam	No	No	Yes	No	No	Yes
Argyll	River	20349	The Cour	No	No	Further work required	No	No	Further work required
Argyll	River	20350	Allt Leachdach	No	No	Further work required	No	No	Further work required
Argyll	River	20355	Allt Laire	No	No	Further work required	No	No	Further work required
Argyll	River	20356	River Treig - Spean confluence to Loch Treig	No	No	Yes	No	No	Yes
Argyll	River	20391	Abhainn na Coinnich	No	No	No	No	No	No
Argyll	River	20399	River Tarbert	Consultation with SNH and LAs required	No	Further work required	No	No	Further work required
West Highland	River	20434	Allt Gleann Udalain	No	No	Yes	No	No	Yes
West Highland	River	20548	Abhainn Droma	Consultation with SNH and LAs required	No	Yes	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
North Highland	River	20627	Murkle Burn	No	No	No	No	No	No
North Highland	River	20628	Burn of Garth	Yes	No	No	No	No	No
North Highland	River	20630	Burn of Ham - d/s Loch Heilen	No	No	No	No	No	No
North Highland	River	20643	Calder Water - d/s Loch Calder	No	No	No	No	No	No
Orkney and Shetland	River	20691	Swannay Burn - d/s Swannay Farm	No	No	No	No	No	Further work required
West Highland	River	20703	Bearreraig River	Consultation with SNH and LAs required	No	Yes	No	No	Yes
West Highland	River	20716	Abhainn Cille Mhaire	No	No	No	No	No	Further work required
West Highland	River	20787	Abhainn Giosla - d/s Loch Gruineabhat	No	No	Yes	No	No	Yes
West Highland	River	20817	Loch nan Geireann inlet burn	No	No	No	No	No	No
North Highland	River	20839	River Grudie - outflow from Loch Fannich	No	No	Yes	No	No	Yes
Argyll	River	20840	River Spean - Loch Moy to Loch Laggan	No	No	Yes	No	No	Yes
North Highland	River	23040	Leanoch Burn - d/s reservoir	No	Yes	No	No	No	Yes
North Highland	River	23041	Leanoch Burn - upper catchment	No	Yes	No	No	No	Yes
North East Scotland	River	23070	Broad Burn	No	No	No	No	No	Further work required
North East Scotland	River	23071	Rothes Burn	No	No	No	No	Yes	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
North East Scotland	River	23139	River Tromie - Loch an t-Seilich to Allt Bhran	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North East Scotland	River	23142	River Spey - Loch Crunachulan to Loch Insh	Consultation with SNH and LAs required	No	Further work required	No	No	Further work required
North East Scotland	River	23147	River Truim - upper catchment	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North East Scotland	River	23149	River Mashie	Consultation with SNH and LAs required	No	Further work required	No	No	Further work required
North East Scotland	River	23229	Water of Fedderate	No	No	No	No	No	No
North East Scotland	River	23243	Den Burn	No	No	No	No	Yes	Yes
North East Scotland	River	23265	River Don - Dyce to tidal limit	No	No	No	No	No	No
North Highland	River	23377	Innes Canal / Lhanbryde Burn	No	No	No	No	No	No
North Highland	River	23380	Glascarnoch River - Black Bridge to Loch Glascarnoch	No	No	Yes	No	No	Yes
North Highland	River	23381	River Moriston - Loch Ness to Dundreggan Dam	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North Highland	River	23382	River Moriston - Dundreggan Dam to Bun Loyne	Consultation with SNH and LAs required	No	Yes	No	No	Yes
West Highland	River	23384	River Kerry - Kerry Power Station to Loch Bad an Sgalaig	Consultation with SNH and LAs required	No	Yes	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
West Highland	River	23385	River Canaird	No	No	Further work required	No	No	Further work required
North Highland	River	23394	River Ness - Inverness Firth to Loch Ness	No	No	No	No	Further work required	Further work required
West Highland	River	23581	An Lige Mor	No	No	No	No	No	No
North Highland	Lake	100065	Loch Shin	Yes	No	Yes	No	No	Yes
West Highland	Lake	100094	Locanan Lacasdail	No	No	No	No	No	Further work required
West Highland	Lake	100102	Loch a Bhaid-luachraich	Consultation with SNH and LAs required	Yes	No	No	No	Yes
North Highland	Lake	100108	Loch Vaich	Yes	No	Yes	No	No	Yes
North Highland	Lake	100113	Loch Glascarnoch	Yes	No	Yes	No	No	Yes
West Highland	Lake	100118	Loch Bad an Sgalaig	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North Highland	Lake	100124	Loch Fannich	Yes	No	Yes	No	No	Yes
North Highland	Lake	100131	Loch Luichart	Yes	No	Yes	No	No	Yes
North Highland	Lake	100142	Loch Achonachie	No	No	Yes	No	No	Yes
West Highland	Lake	100145	Loch Leathan	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North Highland	Lake	100148	Orrin Reservoir	No	No	Yes	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
North Highland	Lake	100151	Loch Monar	No	No	Yes	No	No	Yes
North Highland	Lake	100153	Loch Beannacharan	No	No	Yes	No	No	Yes
North Highland	Lake	100163	Loch Mullardoch	Yes	No	Yes	No	No	Yes
North Highland	Lake	100168	Loch Beinn a Mheadhoin	Yes	No	Yes	No	No	Yes
North Highland	Lake	100171	Loch Mhor	No	No	Yes	No	No	Yes
North Highland	Lake	100178	Loch Cluanie	Yes	No	Yes	No	No	Yes
North Highland	Lake	100184	Loch Loyne	No	No	Yes	No	No	Yes
North Highland	Lake	100186	Loch Quoich	Yes	No	Yes	No	No	Yes
North Highland	Lake	100190	Loch Garry	No	No	Yes	No	No	Yes
Argyll	Lake	100194	Loch Lochy	No	No	Yes	No	Yes	Yes
North East Scotland	Lake	100195	Loch Crunachulan	Consultation with SNH and LAs required	No	Yes	No	No	Yes
North East Scotland	Lake	100199	Loch an t-Seilich	Consultation with SNH and LAs required	No	Yes	No	No	Yes
Tay	Lake	100203	Loch Ericht	No	No	Yes	No	No	Yes
Argyll	Lake	100205	Lower Loch Laggan	No	No	Yes	No	No	Yes
Argyll	Lake	100211	Loch Treig	No	No	Yes	No	No	Yes
Tay	Lake	100216	Loch Errochty	No	No	Yes	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Tay	Lake	100218	Backwater Reservoir	No	Yes	No	No	No	Yes
Argyll	Lake	100219	Blackwater Reservoir	Consultation with SNH and LAs required	No	Yes	No	No	Yes
Tay	Lake	100220	Loch Tummel	Consultation with SNH and LAs required	No	Yes	No	No	Yes
Tay	Lake	100221	Loch Rannoch	Consultation with SNH and LAs required	No	Yes	No	No	Yes
Tay	Lake	100222	Dunalastair Water	Yes	No	Yes	No	No	Yes
Tay	Lake	100224	Loch Eigheach	No	No	Yes	No	No	Yes
Tay	Lake	100225	Loch of Lintrathen	Yes	Yes	No	No	No	Yes
Tay	Lake	100230	Loch Benachally	Consultation with SNH and LAs required	Further work required	No	No	No	Further work required
Tay	Lake	100232	Loch an Daimh	No	No	Yes	No	No	Yes
Tay	Lake	100239	Loch Lyon	No	No	Yes	No	No	Yes
Tay	Lake	100240	Loch na Lairige	No	No	Yes	No	No	Yes
Tay	Lake	100243	Lochan Breaclaich	No	No	Yes	No	No	Yes
Tay	Lake	100244	Loch Lednock Reservoir	No	No	Yes	No	No	Yes
Tay	Lake	100245	Loch Turret Reservoir	No	Yes	No	No	No	Yes
Argyll	Lake	100250	Loch Nant	No	No	Yes	No	No	Yes
Argyll	Lake	100252	Lochan Shira	No	No	Yes	No	No	Yes
Clyde	Lake	100260	Loch Sloy	No	No	Yes	No	No	Yes
Forth	Lake	100261	Loch Katrine	No	Yes	No	No	No	Yes
Forth	Lake	100262	Glen Finglas Reservoir	No	Yes	No	No	No	Yes
Clyde	Lake	100263	Loch Arklet	No	Yes	No	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Forth	Lake	100266	Loch Venacher	Consultation with SNH and LAs required	Yes	No	No	No	Yes
Forth	Lake	100267	Ballo Reservoir	Yes	Yes	No	No	No	Yes
Forth	Lake	100268	Loch Drunkie	No	Yes	No	No	No	Yes
Forth	Lake	100273	Loch Glow	No	No	No	No	No	No
Argyll	Lake	100275	Loch Glashan	No	No	Yes	No	No	Yes
Forth	Lake	100276	Gartmorn Dam	Yes	Further work required	No	No	No	Yes
Forth	Lake	100279	Loch Coulter Reservoir	No	Yes	No	No	No	Yes
Clyde	Lake	100282	Loch Tarsan	No	No	Yes	No	No	Yes
Forth	Lake	100283	Carron Valley Reservoir	No	Yes	No	No	No	Yes
Clyde	Lake	100284	Loch Thom	No	Yes	No	No	No	Yes
Clyde	Lake	100285	Gryfe Reservoirs	No	Yes	No	No	No	Yes
Clyde	Lake	100287	Hillend Reservoir	Consultation with SNH and LAs required	No	No	No	Further work required	Yes
Clyde	Lake	100290	Roughrigg Reservoir	No	No	No	No	No	No
Forth	Lake	100291	Threipmuir Reservoir	Yes	No	No	No	No	Yes
Clyde	Lake	100292	Loch Fad	Yes	No	No	No	No	Yes
Forth	Lake	100293	Harperigg Reservoir	No	No	No	No	Yes	Yes
Forth	Lake	100295	Cobbinshaw Reservoir	Consultation with SNH and LAs required	No	No	No	No	Further work required
Clyde	Lake	100298	Barcraigs Reservoir	No	Yes	No	No	No	Yes
Clyde	Lake	100299	Balgray Reservoir	No	Yes	No	No	No	Yes
Forth	Lake	100302	Gladhouse Reservoir	Yes	Yes	No	No	No	Yes

Sub-basin name	Category	Water body ID	Name	Wider environment	Drinking water storage	Hydropower generation	Ports and harbours	Urban development	Heavily modified?
Clyde	Lake	100304	Dunwan Dam	No	Yes	No	No	No	Yes
Clyde	Lake	100305	Lochgoin Reservoir	No	Yes	No	No	No	Yes
Argyll	Lake	100306	Lussa Loch	Yes	No	Yes	No	No	Yes
Clyde	Lake	100308	Camps Reservoir	No	Yes	No	No	No	Yes
Clyde	Lake	100313	Daer Reservoir	No	Yes	No	No	No	Yes
Clyde	Lake	100314	Loch Doon	No	No	Yes	No	No	Yes
Clyde	Lake	100316	Loch Bradan	No	Yes	No	No	No	Yes
Clyde	Lake	100317	Loch Riecawr	No	Yes	No	No	No	Yes
Tay	Lake	100349	Loch Garry	No	No	Yes	No	No	Yes
Clyde	Transitional	200014	Girvan Estuary	No	No	No	Yes	Yes	Yes
Clyde	Transitional	200018	Ayr Estuary	No	No	No	Yes	Yes	Yes
Clyde	Transitional	200022	Garnock/Irvine Estuary	No	No	No	Yes	Further work required	Yes
Forth	Transitional	200033	Tyne Estuary	No	No	No	No	No	Further work required
North East Scotland	Transitional	200103	Dee (Aberdeen) Estuary	Further work required	No	No	Yes	Yes	Yes
Forth	Transitional	200436	Middle Forth Estuary	No	No	No	Yes	Yes	Yes
Forth	Transitional	200437	Upper Forth Estuary	No	No	No	No	Yes	Further work required
Clyde	Transitional	200510	Clyde Estuary - Inner	No	No	No	Yes	Yes	Yes
Orkney and Shetland	Coastal	200460	Kirkwall Lagoon (Peerie Sea). Mainland. Orkney Islands	No	No	No	No	Yes	Yes
North Highland	Coastal	200475	Loch Fleet	Yes	No	No	No	Yes	Yes