SEPA
Scottish Environment Protection Agency

# Scotland's Water Environment Review 2000-2006: a summary report

# Foreword

Our environment is important to us. We depend upon it for the air we breathe, the water we drink and the food we eat. There is an increasing recognition of the role of our environment as a recreational resource and in supporting biodiversity. It is important to the economic success of our country, and quality of life of its citizens and visitors.

We have come a long way in the last 150 years since the days when sewage pollution was a significant threat to the health of a large proportion of the population. Improvements have been achieved through planning and expenditure on infrastructure carried out at a rate judged to be proportionate to the risks posed and affordability. For the last few decades, another factor determining the rate of improvements has been European legislation, delivered through the implementation of various directives agreed by the European Union as a whole.

With a population continually seeking a better quality of life, and new areas being developed for housing and industry, significant expenditure and work is required just to maintain environmental quality. Most pollution abatement measures have some energy demand and resource cost. A balance must be struck between expenditure made and benefits delivered. This report provides some feedback on overall progress made in respect of our fresh and marine waters.

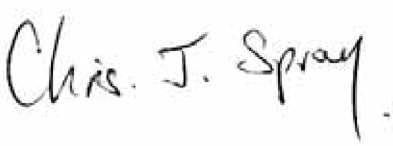
It is good news that during the last decade or so, sustainable urban drainage schemes (SUDS) have become the norm for new developments in Scotland. SUDS have prevented the further deterioration of many urban watercourses. All too often in the past, improvements in effluent quality have been offset by new problems from urban run-off or unsatisfactory combined sewer overflows elsewhere.

This report focuses on the chemical and biological quality of our water environment.

It is on balance a 'good news' story, but inevitably with some caveats. It shows what has been achieved. Past legislation concentrated on water quality and flood defence rather than physical habitat, so improvements relate to water quality. As illustrated in the forward looking Significant Water Management Issues (SWMI) reports produced recently by SEPA, other things – working with others, engineering and abstraction pressures – are at least as important in determining the overall quality of our aquatic environments.

Good, clean water flowing in a stream piped in a culvert flowing underneath a development has no real environmental value. Open that stream out, with green areas alongside to constrain floods, and it can become a refuge for wildlife and a recreational resource. It is far better if people have a pleasant walkway in their neighbourhood than having to drive to find somewhere more pleasant to take the daily exercise we should all have.

The work and improvements outlined in this report are the culmination of a lot of effort made by many people and organisations, and to which we have all contributed through water charges. I hope you find this backward look interesting and encouraging in respect of what should be delivered in the future. The success of the new River Basin Management Planning system which SEPA and the Scottish Government have put in place as part of the EU Water Framework Directive implementation, will be crucial to maintaining and enhancing Scotland's water environment.



**Dr Chris J Spray MBE**
**Director of Environmental Science**

# Executive Summary

SEPA has a duty to protect, and improve as necessary Scotland's water quality. This report provides a summary of information held by SEPA on water quality in rivers, canals, estuaries, coasts, lochs and groundwaters for the period from 2000 to 2006. A more detailed report is available on the SEPA website (www.sepa.org.uk/publications).

The assessment of water quality and trends is a substantial task. The information in this report is based upon sampling and analysis results from over 4,000 riverine sites, approximately 1,500 coastal and estuarine sites, 200 loch sites and over 250 groundwater sites across Scotland. Data from 1999 form the baseline year against which progress is measured, although longer datasets are used when possible.

### Overview

Water quality in Scotland is generally good and continues to improve. In recent years there have been major investments in sewage treatment and greater control of other sources of pollution from individual sites. Although diffuse pollution originating from farmland and urban areas is being reduced, it remains a significant issue and is now the largest source of pollution to Scotland's aqueous environment. Other pressures include fish farming, acidification, forestry and agricultural point sources. The increasing environmental awareness shown by the public and ease of reporting incidents has also helped tackle local environmental issues.

### Water quality targets

SEPA first set water quality targets in 1997 on the basis of water quality classification data for 1996. The targets represent planned reductions in the combined length of 'poor' or 'seriously polluted' waters. In 2000 SEPA repeated the target setting process. Based on 1999 results, targets were set to further reduce the extent of affected waters by 2006. The process was phased with Scottish Water's capital investment programmes which specify the investment timetables for improvement of its assets (i.e. sewerage and sewage treatment works).

### Headline figures

SEPA classifies over 25,000 km of **rivers and canals** in Scotland. In 2000 the target was set to reduce the length of poor and seriously polluted rivers from 1,169 km to 818 km by 2006. This target represented a 351 km (30%) reduction. The target was achieved. At the end of 2006 Scotland had only 734 km of these waters, a reduction of 37% since 2000.

SEPA classifies over 800 $km^2$ of **estuaries** in Scotland. In 2000 the target was set to reduce the area of unsatisfactory and seriously polluted estuaries by 6.5 $km^2$ (20%) from 32.5 $km^2$ to 26 $km^2$ by 2006. Although there were improvements, the target was not achieved. New data and assessment methods applied to the Montrose Basin resulted in the downgrading of this estuary.

SEPA classifies almost 12,000 km of **coasts** in Scotland. In 2000 the target was set to reduce the length of unsatisfactory and seriously polluted coastal waters from 322 km to 176 km by 2006. This target represented a 145 km (45%) reduction. This target was comfortably achieved. At the end of 2006 Scotland had only 90.5 km of these waters, a reduction of 72% since 2000.

SEPA classifies almost 200 of Scotland's **lochs**. In 2000 the target was set to achieve no deteriorations in loch water quality by 2005 and specifically to improve water quality in Loch Gelly, Fife. Final figures for the state of Scotland's lochs will be available in 2008 but Loch Gelly is known to have improved.

# Contents



Lerwick, Shetland

Water sampling


River Earn


Falls of Dochart

# 1 Introduction

In addition to regulatory duties, SEPA is responsible for monitoring and reporting on the condition of rivers, estuaries, coastal waters, lochs and groundwater across Scotland for national reporting and, increasingly, to demonstrate compliance with European environmental directives.

This report describes trends in water quality for rivers, estuaries, coastal waters, lochs and groundwater since 2000 (longer where datasets are available). It is a summary of a more detailed water environment review available on SEPA's website.[1] The web-based report includes a glossary of terms.

In 2000 SEPA set targets to improve Scotland's water quality by 2006 against a baseline year of 1999. An additional purpose of the review was to examine whether SEPA had achieved these targets. The report also considers future issues likely to apply to SEPA's monitoring strategies and the anticipated outcomes for Scotland's water environment.

2006 is the last year that SEPA will use the classification schemes reported here (and in previous years' reports). From 2007 onwards, new Water Framework Directive (WFD) quality classification schemes will be applied to all waters.[2] Other methods will be used to enable long-term water quality trends to be tracked across the changeover from SEPA to WFD methods.

[1] *Scotland's Water Environment Review 2000-2006* – available at www.sepa.org.uk
[2] See www.sepa.org.uk/wfd

# 2 River water quality 2000-2006

## 2.1 Overall picture

The quality classification of inland freshwater rivers in Scotland is expressed on a five-point scale using data gathered from:

- chemical and biological surveys;
- the aesthetic appearance of the water and the riverbanks.

The final allocation of the quality class is based on the lowest class for each of the individual inputs to the scheme.

The summary of the annual classification for rivers, streams and canals presented in Table 1 indicates that SEPA met its 2006 river quality target. Map 1 shows the river water quality classification for 2000 with the inevitable, poor water quality around cities and many unmonitored streams. The situation for 2006 is shown in Map 2; this shows improvement (though still with the poor water quality around urban areas) and an extended river network (i.e. fewer unmonitored rivers).

**Table 1: Scottish river quality classification, 1999-2006***

| Length | Year | A Unclassified | A1 Excellent | A2 Good | B Fair | C Poor | D Seriously Polluted | Total |
|---|---|---|---|---|---|---|---|---|
| km<br>(%) | 1999 | n/a | n/a | n/a | 2,577<br>(10.1) | 1,078<br>(4.2) | 91.2<br>(0.4) | 25,382<br>(100) |
| km<br>(%) | 2000† | 12,817<br>(50.3) | 3,173<br>(12.5) | 6,087<br>(23.9) | 2,453<br>(9.6) | 854<br>(3.4) | 73.4<br>(0.3) | 25,455<br>100.0 |
| km<br>(%) | 2001 | 11,960<br>(46.9) | 3,875<br>(15.2) | 6,325<br>(24.8) | 2,339<br>(9.2) | 929<br>(3.6) | 82.5<br>(0.3) | 25,511<br>(100) |
| km<br>(%) | 2002 | 7,988<br>(30.5) | 5,279<br>(20.1) | 8,656<br>(33) | 2,563<br>(9.8) | 903<br>(3.4) | 56.3<br>(0.2) | 25,445<br>(100) |
| km<br>(%) | 2003 | 5,903<br>(23.2) | 6,815<br>(26.8) | 9,540<br>(37.5) | 2,374<br>(9.3) | 751<br>(3.0) | 52.6<br>(0.2) | 25,436<br>(100) |
| km<br>(%) | 2004 | 3,807<br>(15) | 7,660<br>(30.1) | 10,613<br>(41.7) | 2,588<br>(10.2) | 717<br>(2.8) | 50.6<br>(0.2) | 25,434<br>(100) |
| km<br>(%) | 2005 | 2,126<br>(8.4) | 8,004<br>(31.5) | 12,053<br>(47.4) | 2,470<br>(9.7) | 724<br>(2.8) | 52.3<br>(0.2) | 25,429<br>(100) |
| **km<br>(%)** | **2006** | **2,076<br>(8.2)** | **7,861<br>(30.9)** | **12,333<br>(48.5)** | **2,425<br>(9.5)** | **699<br>(2.7)** | **35.1<br>(0.1)** | **25,429<br>(100)** |
| **Actual length of Classes C and D in 1999** | | | | | | | **1,169 km** | |
| **Actual length of Classes C and D in 2006** | | | | | | | **734 km** | |
| **Target length of Classes C and D by end 2006** | | | | | | | **818 km** | |
| **Actual change in length of Classes C and D 1999 to 2006** | | | | | | | **–435 km (–37%)** | |
| **Target change in length of Classes C and D 1999 to 2006** | | | | | | | **–351 km (–30%)** | |

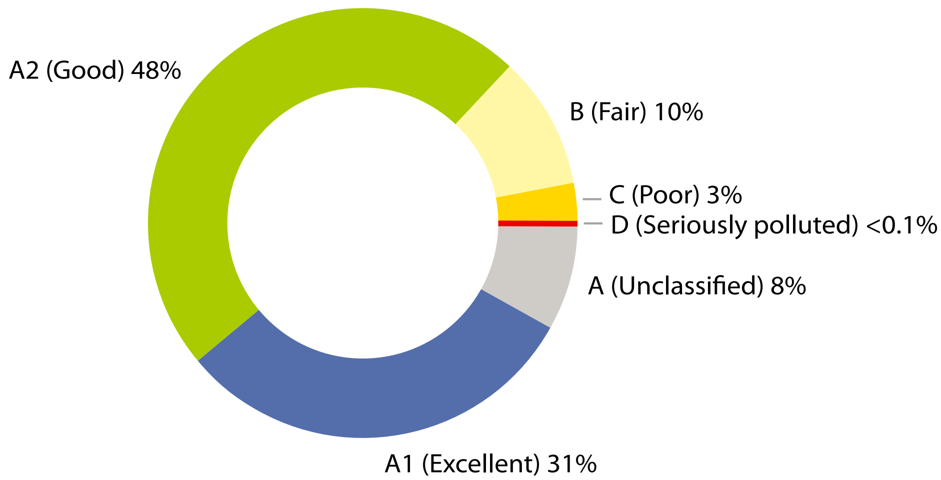
*Based on the Digitised River Network (DRN) for Scotland.
†Figures for 2000 are slightly amended from those previously reported due to inclusion of toxic substances classification previously accidentally omitted in one area.

River Fillan

River Tweed

The predominance of excellent and good quality Scottish rivers is illustrated in Figure 1, which shows the percentage totals for 2006.

**Figure 1: River class totals, 2006**

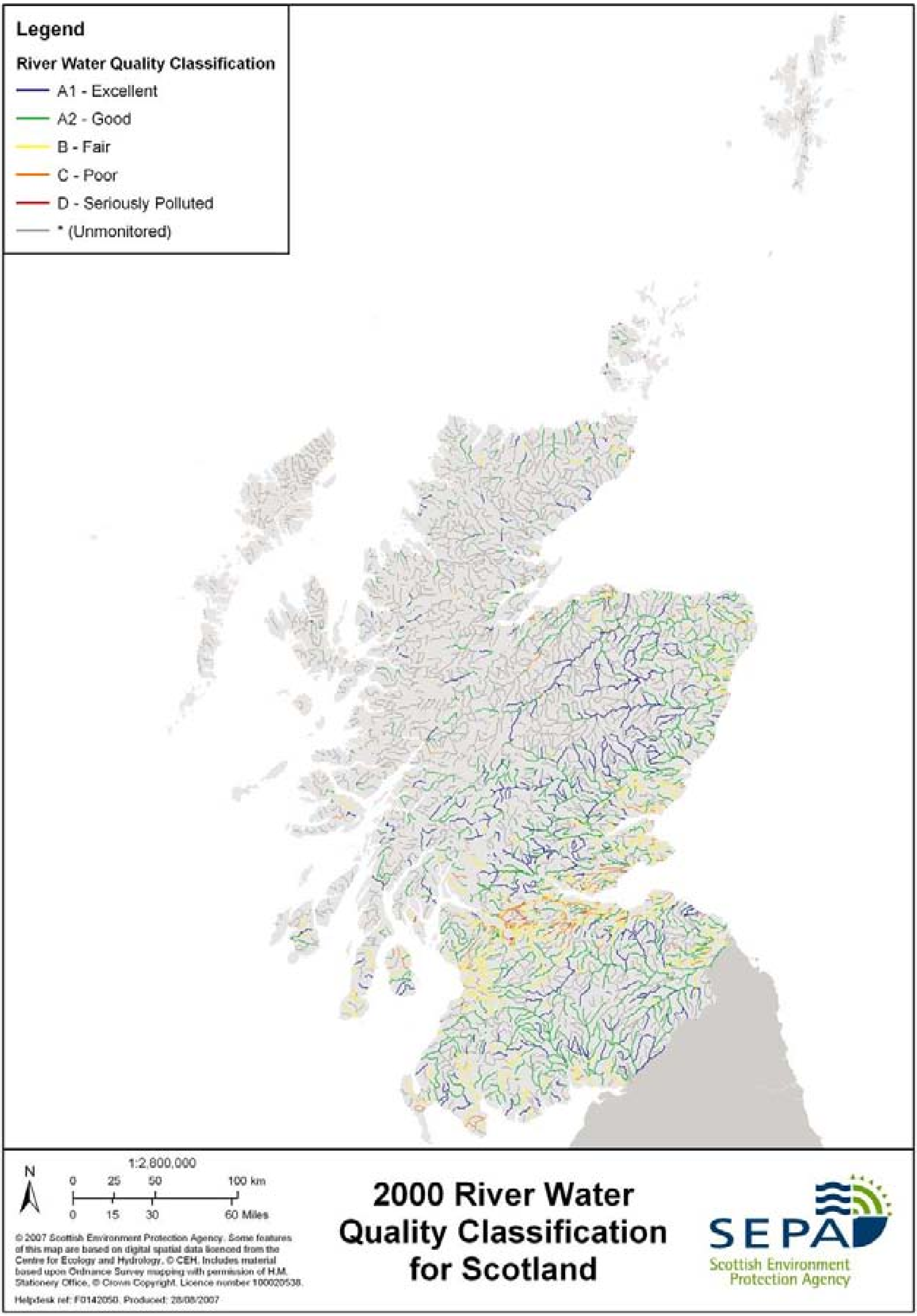



It is encouraging that, along with the substantial reductions in Class C and D rivers, there was also a five-fold increase (equal to an additional 10,000 km) in the amount of monitored rivers and a doubling of Class A1 (excellent) and Class A2 (good) rivers. This represents a remarkable achievement over the time period.

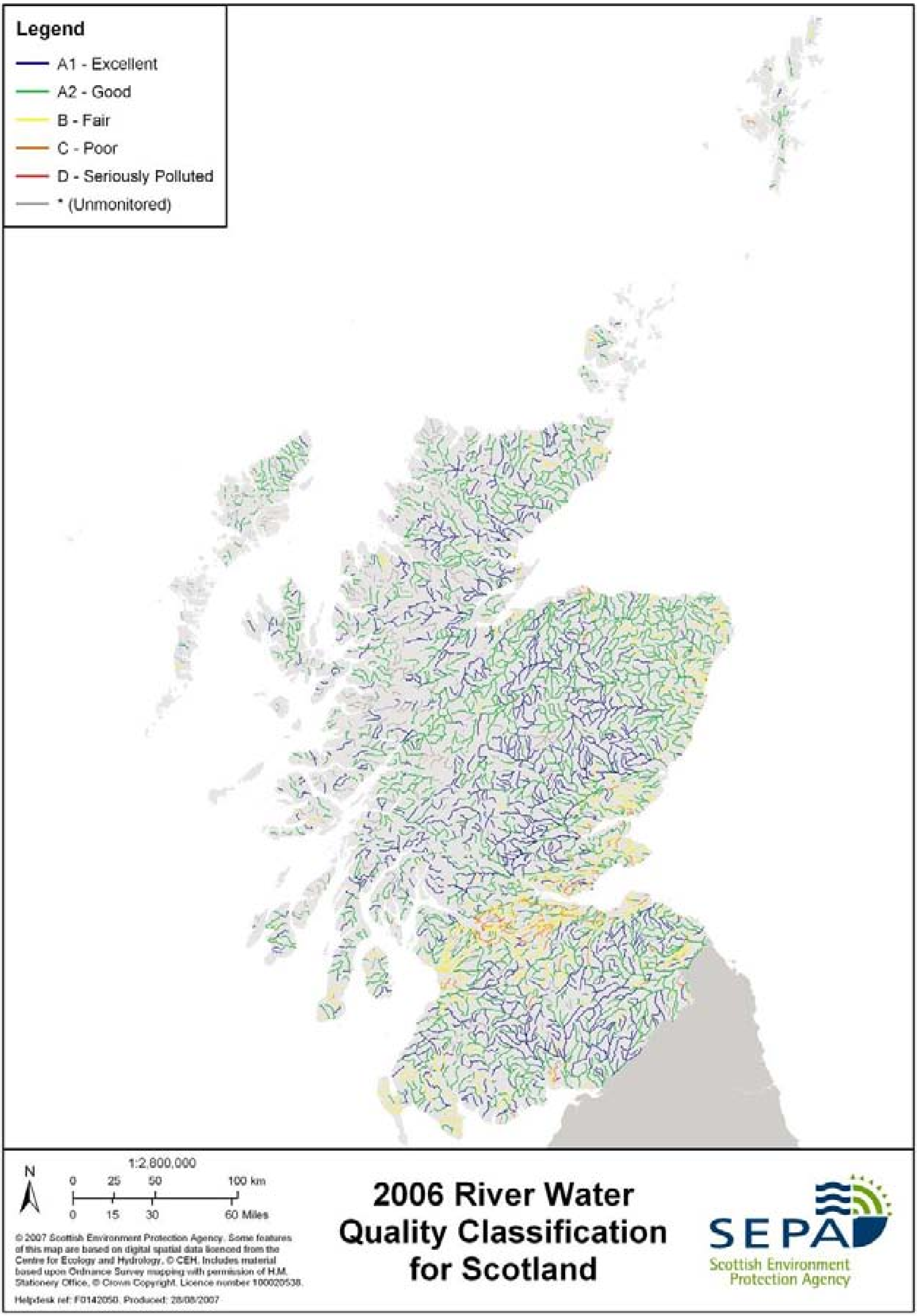
Most of the previously unclassified stretches now fall into the upper classes; only a handful fall into Classes C or D. Many of the previously unclassified stretches were remote water bodies whose ecology is now monitored once every three years. Any of these sites whose water quality was classed as Class of B or worse was investigated to determine the cause and revisited each year until the quality improved.

The complete list of monitored rivers and streams in Scotland, together with overall classification scores from 2000 to 2006, can be found in the web-based report.

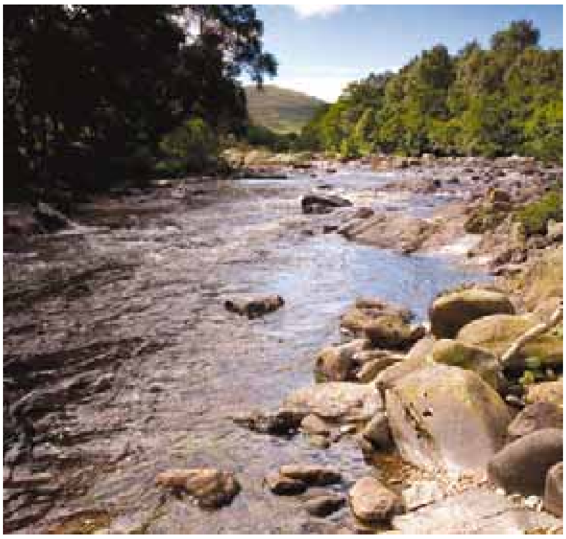
**Map 1: River water quality classification for Scotland, 2000**



**Map 2: River water quality classification for Scotland, 2006**



Kinlochewe River



River North Esk

### 2.2 Main impacts on river water quality

The main pressures on Scottish river water quality are from:

- agricultural run-off;
- sewage collection and disposal;
- urban development;
- forestry;
- mining and quarrying.

There are many places where river quality is affected by a combination of several different point sources of pollution (e.g. sewage disposal) and diffuse sources of pollution (e.g. farm run-off). To deal with these more complex cases, SEPA often develops specific Environmental Improvement Action Plans (EIAPs – also known as Action Plans). These aim to identify:

- the exact nature of polluting sources and their relative impacts;
- the range of actions needed to secure the required improvements in water quality.

Although water quality totals can show significant variations from year to year, the overall trend is one of improvement between 2000 and 2006. There was a particularly large improvement in 2003, which may have been helped by reduced diffuse pollution during the dry summer. To have maintained and consolidated progress in subsequent years is particularly encouraging.

Over the period from 2000 to 2006 there have been both improvements and deteriorations of particular rivers and streams throughout Scotland. Examples of key issues and impacts on river water quality can be found in the web-based report along with detailed case studies.

### 2.3 Improvements in river water quality

Most of the specific quality improvements expected by 2006 have been achieved and work on the remainder is continuing. Many of these improvements are a direct result of infrastructure investments made by Scottish Water, SEPA actions and work with other organisations such as the Coal Authority and the farming community.

In addition, numerous improvements have been achieved for watercourses which, when the targets were set in 2000, were not expected to improve by 2006. These include welcome work by the Coal Authority to intercept and treat previously polluting minewater arisings prior to their discharge to watercourses. Almost 24 km of rivers have improved as a result of minewater treatment schemes currently in operation in Scotland.[3]

[3]See the web-based report for details, *Scotland's Water Environment Review 2000-2006* – available at www.sepa.org.uk

River Tay

River Kelvin

There has also been significant upgrading of wastewater infrastructures and industrial premises, with some significant step changes in water quality due to the closure of sewage treatment works (STWs) and diversion of effluent to newer or larger works elsewhere. In particular, there has been welcome improvement in some of Scotland's largest river catchments including the River Clyde, River Kelvin, River Almond and Tay.[3]

The benefits of partnership working and education with the agricultural community are reflected by many improvements across the country. This is most notable in the Galloway area (an area stretching over 130 km from Dalbeattie to Stranraer) where almost all Class C and D rivers had been eliminated by 2006. SEPA will continue to engage all stakeholders, landowners and the local community to maintain these improvements.

## 2.4 Deterioration in river water quality

Not all recorded water quality changes over the period were positive. In some areas river water quality has deteriorated and some long-term problems remain.

Diffuse pollution from both agricultural land and urban areas remains a significant issue affecting river water quality in Scotland. Investment to improve or remove problematic point source pressures, e.g. STWs and combined sewer overflows (CSOs), must continue if water quality improvements are to be maintained – especially in urban areas. Funding is required to allow the Coal Authority, in collaboration with SEPA, to continue the good work to provide treatment for polluting non-coal mines. Effective regulation and adherence to official guidelines are beginning to tackle some of the more long-term problems such as acidification.

SEPA will continue to investigate all significant instances of deterioration in water quality, taking regulatory action where appropriate.

### Rivers

SEPA's target for 2000-2006 was to reduce the length of poor and seriously polluted waters (Class C and D) by 351 km, equivalent to 30%. The actual national reduction of these rivers over the period of was 435 km, equivalent to 37%. **This exceeded the target.**

# 3 Estuarine water quality 2000-2006

## 3.1 Overall picture

Since 1999 Scottish estuaries listed by the Scottish Government under the Urban Waste Water Treatment Directive (UWWTD) have been classified using a scheme developed by the former river purification boards. Under this scheme, a given area of estuary is classified by assessing all criteria and then allocated to the poorest class.

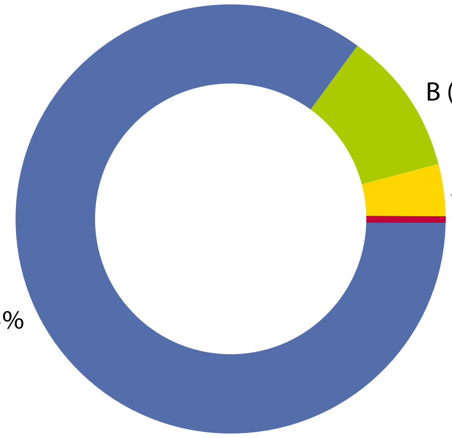
A summary of the annual classification for estuaries from 1999 to 2006 is given in Table 2. The class percentages for 2006 are shown in Figure 2.

**Table 2: Scottish estuarine water quality classification, 1999-2006**

| Area | Year | A Excellent | B Good | C Unsatisfactory | D Seriously Polluted | Total |
|---|---|---|---|---|---|---|
| km² (%) | 1999 | 633 (78.2) | 144 (17.7) | 31.6 (3.9) | 0.9 (0.1) | 809 (100) |
| km² (%) | 2000 | 637 (78.7) | 133 (16.4) | 38.2 (4.7) | 1.2 (0.1) | 809 (100) |
| km² (%) | 2001 | 661* (81.7) | 116* (14.3) | 31.8* (3.9) | 1.1 (0.1) | 809 (100) |
| km² (%) | 2002 | 645* (79.6) | 141 (17.4) | 23.1* (2.9) | 0.8 (0.09) | 809 (100) |
| km² (%) | 2003 | 651* (80.4) | 122* (15.1) | 35.5* (4.4) | 0.9 (0.1) | 809 (100) |
| km² (%) | 2004 | 688* (85.0) | 92 (11.4) | 29.3* (3.6) | 0.2 (0.02) | 809 (100) |
| km² (%) | 2005 | 684* (84.5) | 95 (11.7) | 30.1* (3.7) | 0.2 (0.02) | 809 (100) |
| **km² (%)** | **2006** | **694 (85.7)** | **86 (10.6)** | **29.5 (3.6)** | **0.2 (0.03)** | **809 (100)** |
| **Actual area of Classes C and D in 1999** | | | | | **32.5 km²** | |
| **Actual area of Classes C and D in 2006** | | | | | **29.7 km²** | |
| **Target area of Classes C and D by end 2006** | | | | | **26.0 km²** | |
| **Actual change in area of Classes C and D 1999 to 2006** | | | | | **–2.8 km² (–8.6%)** | |
| **Target change in area of Classes C and D 1999 to 2006** | | | | | **–6.5 km² (–20%)** | |

*Figures for 2001-2005 have been corrected relative to earlier SEPA publications to take account of the decision to retrospectively downgrade Montrose Basin to Class C as a consequence of the 2006 Oslo and Paris (OSPAR) Convention and UWWTD reviews of the Basin. This has led to 8.5 km² being downgraded from Class A/B to C between 2001 and 2003, and 8.4 km² being downgraded from Class A to C in 2004 and 2005 (0.1 km² was classified separately from 2004 onwards). The Montrose Basin classification before 2001 has been left as Class A (8.5 km²).

**Figure 2: Estuarine class totals, 2006**




SEPA's target for the period 2000-2006 was to reduce the length of unsatisfactory and seriously polluted estuarine waters (Class C and D) by 6.5 $km^2$, equivalent to 20%. Estuarine water quality totals have varied each year during this period (see Table 2), resulting in an overall decrease of only 2.8 $km^2$ (8.6%) of Class C and D estuaries. But if the Montrose Basin is excluded (the changes in its classification[4] affect the baseline against which progress is measured), a total area of 11.2 $km^2$ improved from Classes C and D to Classes A and B between 1999 and 2006 – ahead of the target of 6.5 $km^2$.

### 3.2 Main impacts on estuarine water quality

The main pressures on Scottish estuarine water quality are from:

- sewage collection and disposal;
- manufacturing;
- agricultural run-off.

The data show that Scotland's estuaries are dominantly of excellent quality.

The weather can have a significant impact on the classification of estuarine waters. Wetter weather, as in 2002, results in higher river inflows to the major estuaries and consequent higher dilution and greater mixing. This in turn improves oxygen levels and potentially the estuary's water quality classification. These weather-induced changes mean that the three-year average figure of the total area of Class C and D estuarine waters gives a clearer picture of change in these waters over time (see Figure 3).

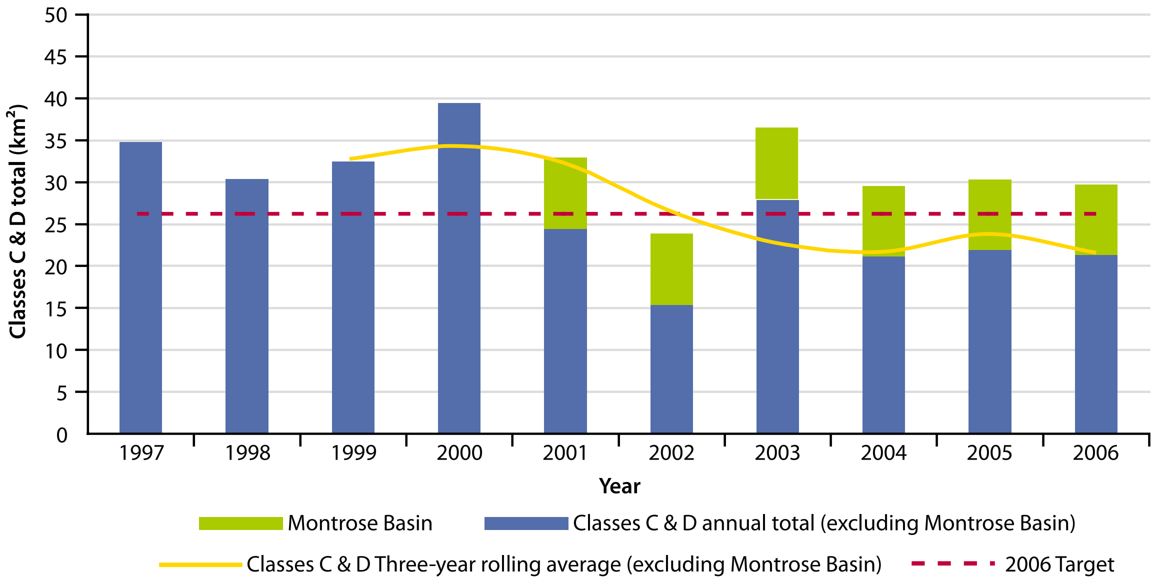
The 2002 improvement was assisted by the very wet summer of that year and, as expected, the dry weather of 2003 reversed this trend. The summer of 2004 again brought wet weather and this aided estuarine water quality. Plotting a trend line depicting a three-year rolling average reduces these annual fluctuations (see Figure 3).

[4]See footnote to Table 2 and Section 3.3 of web-based report, *Scotland's Water Environment Review 2000-2006* – available at www.sepa.org.uk

River Clyde

River Clyde

**Figure 3: Annual totals and three-year rolling average for Class C and D estuarine waters**




## 3.3 Improvements in estuarine water quality

Continuing investment by both Scottish Water and industrial dischargers is resulting in estuarine waters with lower contaminant concentrations. The longer term trend is one of significant improvement as illustrated by two of Scotland's largest estuaries – the Forth and Clyde.

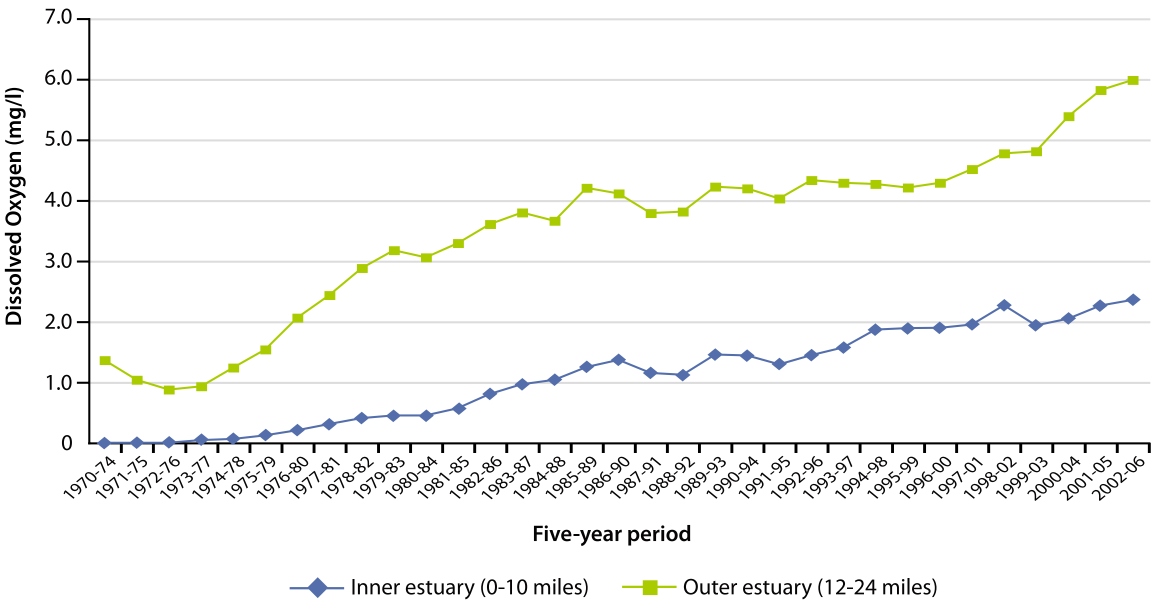
### Clyde Estuary

Water quality further from Glasgow has improved in recent years, reducing the areas of poorer water quality. However, the inner estuary retained its Class C (unsatisfactory) quality designation in 2006 due to low dissolved oxygen levels and aesthetic/litter problems. These trends are illustrated in Maps 3 and 4.

The improvement in water quality in the Clyde Estuary over the years is illustrated further by the gradual but steady increase in dissolved oxygen. Figure 4 shows dissolved oxygen levels as five-year mean values for the two parts of the estuary. The water quality in the inner estuary can be described as 'poor' (>2.0 mg/litre but <3.0 mg/litre) while, in the outer estuary, it is 'good' (>5.0 mg/litre).

Clyde Estuary

**Figure 4: Dissolved oxygen levels in the Clyde Estuary, 1970-2006, as five-year mean values (as 95th percentile)**



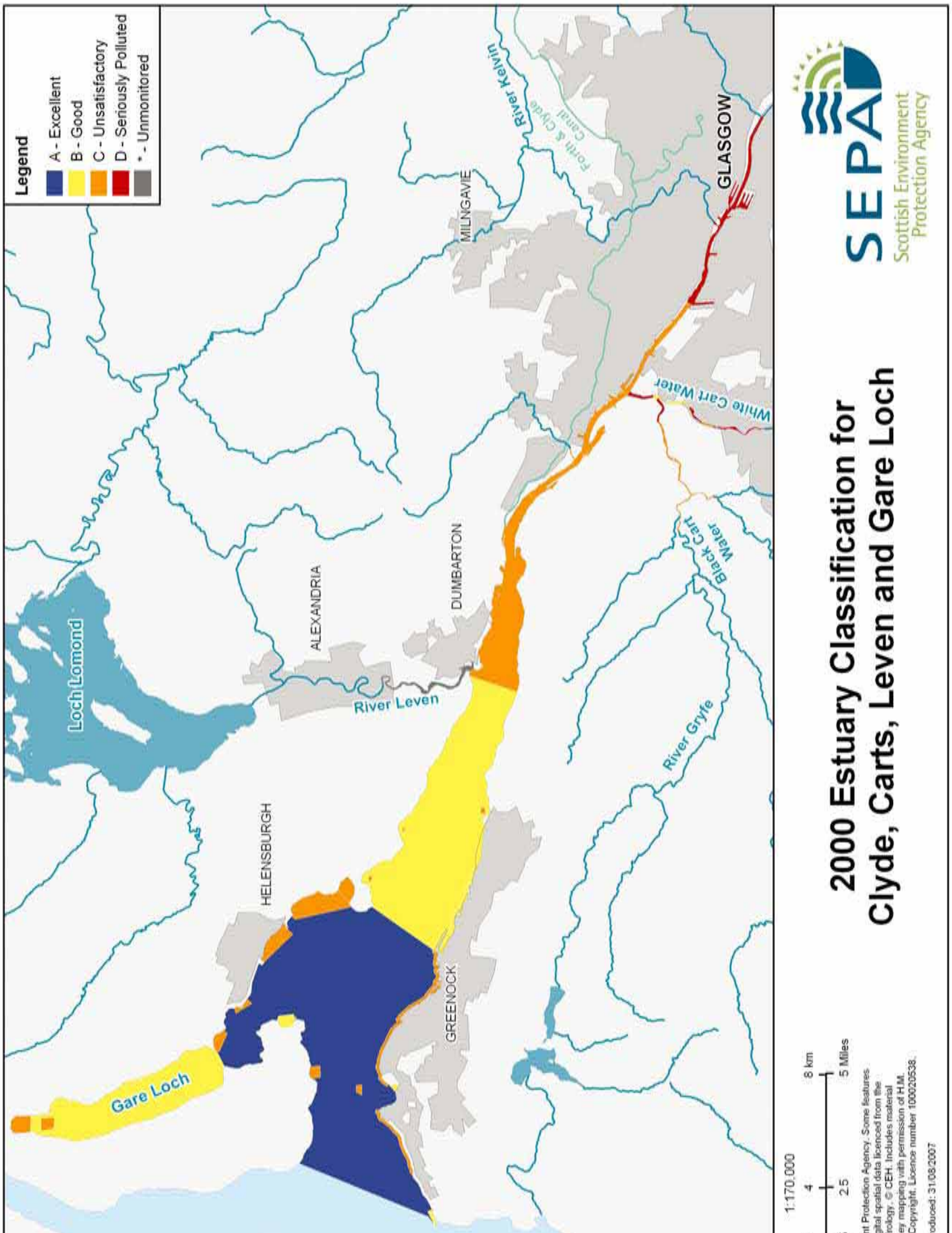

A number of pressures (both current and historic) mean the improvement in water quality in the inner estuary is more modest than that of the outer estuary. The general improvement is a consequence of:

- decline of ship building and other industry on the Clyde;
- more integrated pollution control;
- improvements to the surrounding sewerage systems.

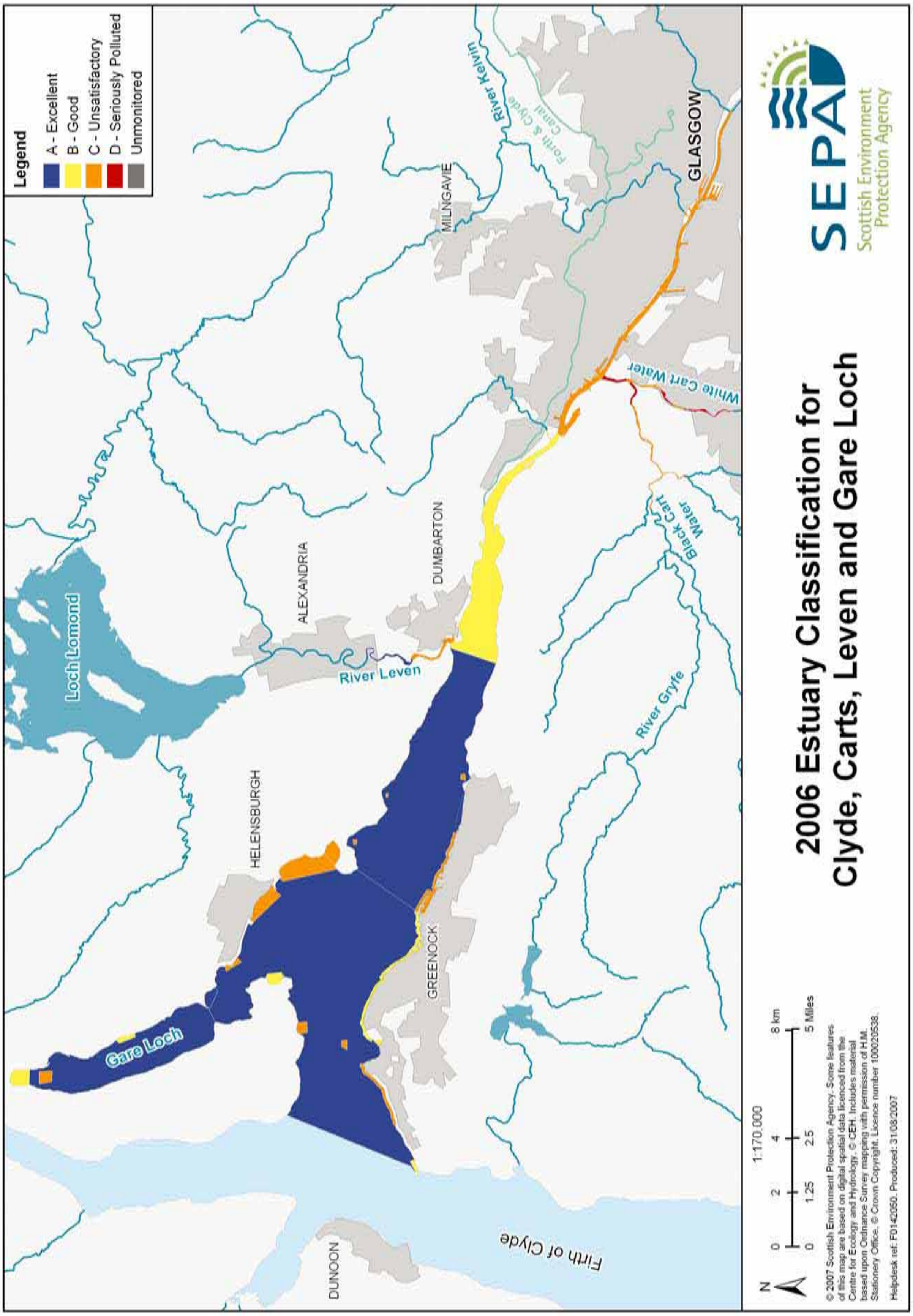
The inner estuary from Glasgow to near Erskine was completely devoid of oxygen at certain seasons during the 1970s (see Figure 4). The steady improvement in the 1980s coincided with the return of salmon to the Clyde in 1983 after an absence of over 120 years. This marked the culmination of a century of effort to restore to health one of the worst polluted river basins in Britain.[5]

[5] *Cleaning the Clyde – A Century of Progress*, D Hammerton, Journal of the Operational Research Society, 1986, Volume 37, pages 911-921.

**Map 3: Clyde Estuary classification, 2000**



**Map 4: Clyde Estuary classification, 2006**



Forth Estuary

## Forth Estuary

The Forth Estuary is not expected to achieve excellent status because of its intrinsically turbid nature and the number of industrial and domestic wastewater discharges it receives. However, there were areas of improvement between 2000 and 2006 (see Maps 5 and 6).

The Forth Estuary is now largely Class B (good), with some intertidal areas downgraded to poor as a result of historic discharges. There is also an area of Class C in the upper estuary resulting from low dissolved oxygen concentrations during summer 2006. The quality of estuary around Grangemouth remained Class C between 2000 and 2006 due to organic enrichment (although areas and boundaries have changed). The current elimination of Class D waters in the Forth Estuary reflects the success of the sustained programme of improvement in the treatment of discharges

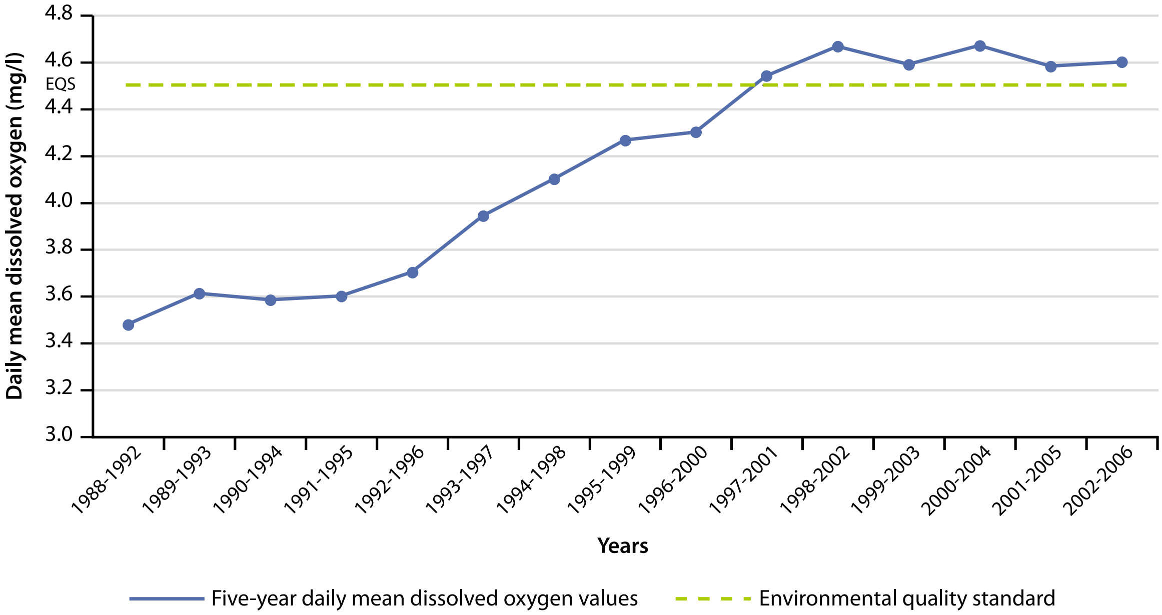
The improvement in water quality in the Forth Estuary over the years is illustrated further by the gradual but steady increase in dissolved oxygen in the estuary. As shown in Figure 5, the five-year rolling daily mean improved steadily from 3.5 mg/litre (1988 to 1992) to above the Environmental Quality Standard (EQS) of 4.5 mg/litre (1997 to 2001). Since 2001 it has remained steady at around 4.6 mg/litre.

In addition, discharges of organic waste to the upper estuary have fallen substantially, mostly through improvements to the treatment of both domestic sewage and industrial effluents.

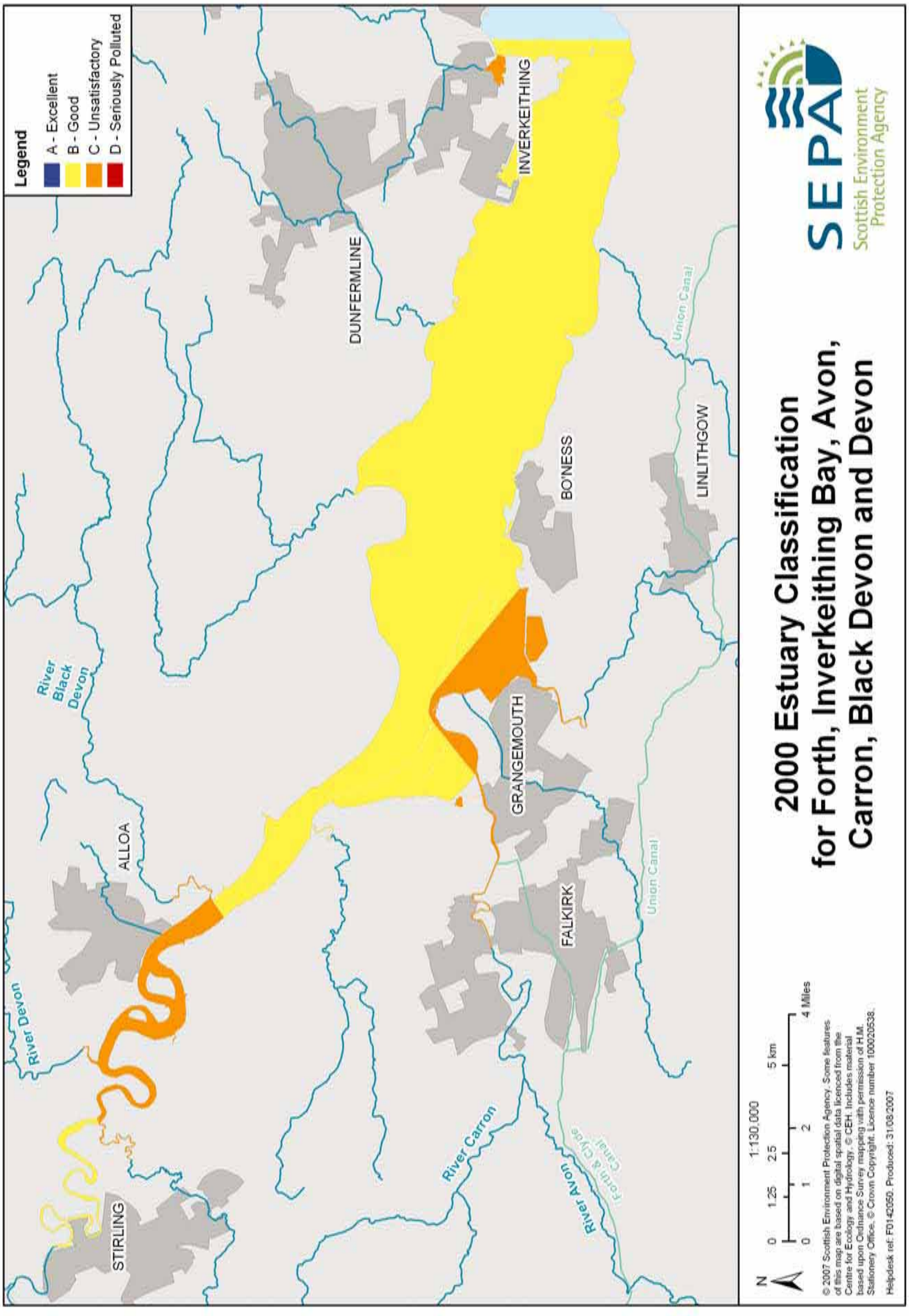
Further improvements are expected as the contaminant load from diffuse sources carried by inflowing rivers (e.g. nutrients from agricultural activities) is reduced by measures arising from implementation of European directives.

Forth Estuary

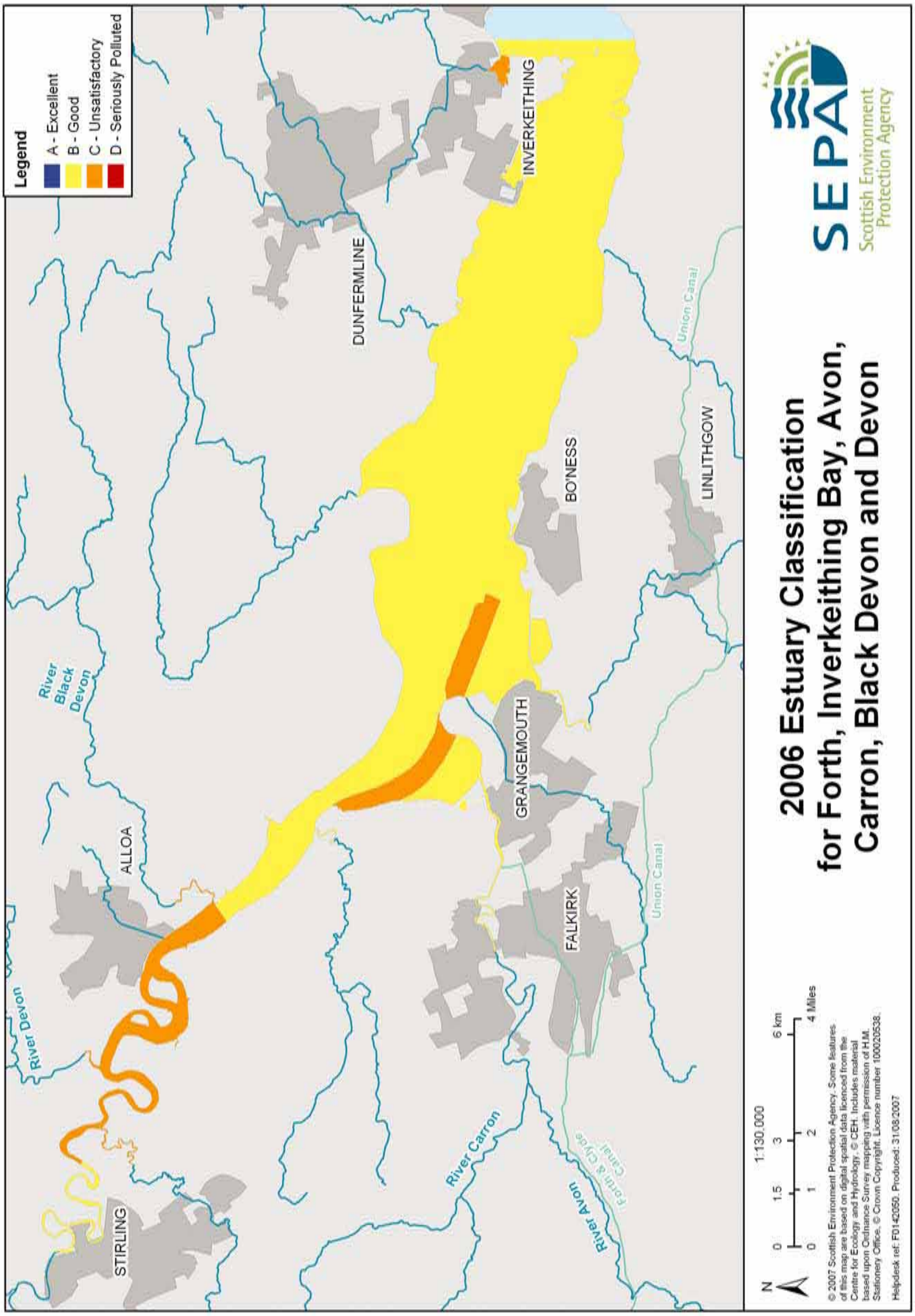
**Figure 5: Dissolved oxygen levels in the Forth Estuary at Alloa, 1988-2006, as five-year daily mean values (as 95th percentile)**



**Map 5: Forth estuary classification, 2000**



**Map 6: Forth estuary classification, 2006**



Forth Estuary

Water sampling

### 3.4 Deterioration in estuarine water quality

In 2006 the Montrose Basin covering an area of 8.4 $km^2$ in the South Esk Estuary was downgraded from Class A to Class C. This followed a SEPA review of its eutrophication status using new criteria based on components such as algal cover and nutrient levels. Because the review was based on survey work that began in 2001, SEPA decided to downgrade the Montrose Basin to Class C retrospectively all the way back to 2001. However, there is no evidence that quality in 2001 was different from the 1999 baseline year against which SEPA targets are set.

The main areas of further downgrading in Scotland are in the heavily urbanised Clyde and Forth estuaries, which receive many effluent discharges (either intermittently from CSOs or continuously from STWs). Better treatment of these discharges is gradually improving environmental quality. However, the sediments of these estuaries still carry a burden of organic matter and some toxic contaminants from historic discharges.

Like many estuaries, the water quality of Scotland's two major estuaries, the Forth and Clyde, depends significantly on weather-influenced river flows and historically polluted sediments. The dry summers of 2003 and 2006, which reduced the rate of water exchange throughout the Clyde and Forth estuaries, led to poor quality in parts of these estuaries. This contributed to the overall net downgrading of quality of Scotland's estuaries.

Details of other significant quality changes in Scotland's estuaries are given in the web-based report.

**Estuaries**

SEPA's target for the period 2000-2006 was to reduce the length of unsatisfactory and seriously polluted waters (Class C and D) by 6.5 $km^2$, equivalent to 20%. The actual national reduction of these waters over the period of was 2.8 $km^2$, equivalent to 8.6%. **The target was not achieved.**

# 4 Coastal water quality 2000-2006

## 4.1 Overall picture

The quality of Scottish coastal waters has been classified each year using a scheme developed by the former river purification boards. The class is based on the poorest outcome of four criteria.

A summary of the annual classification for coasts from 1999 to 2006 is given in Table 3. The class percentages for 2006 are shown in Figure 6.

**Table 3: Scottish coastal waters classification, 1999-2006**

| Length | Year | A Excellent | B Good | C Unsatisfactory | D Seriously Polluted | Total |
|---|---|---|---|---|---|---|
| km (%) | 1999* | 10,906 (92.4) | 569.4 (4.8) | 271.3 (2.3) | 50.3 (0.4) | 11,797 (100) |
| km (%) | 2000† | 10,980 (93.1) | 556.3 (4.7) | 224.7 (1.9) | 37.1 (0.3) | 11,798 (100) |
| km (%) | 2001 | 10,996 (93.2) | 559.7 (4.8) | 217.5 (1.8) | 24.8 (0.2) | 11,798 (100) |
| km (%) | 2002 | 11,032 (93.5) | 549.6 (4.7) | 191.6 (1.6) | 22.9 (0.2) | 11,796 (100) |
| km (%) | 2003 | 11,080 (94.0) | 566.5 (4.8) | 127.7 (1.1) | 22.3 (0.2) | 11,796 (100) |
| km (%) | 2004 | 11,091 (94.0) | 568.3 (4.8) | 123.6 (1.0) | 11.6 (0.1) | 11,795 (100) |
| km (%) | 2005 | 11,103 (94.1) | 579.0 (4.9) | 101.6 (0.9) | 11.2 (0.09) | 11,795 (100) |
| **km (%)** | **2006** | **11,114 (94.2)** | **591.1 (5.0)** | **80.5 (0.7)** | **10.0 (0.09)** | **11,796 (100)** |
| **Actual length of Classes C and D in 1999** | | | | | **322 km** | |
| **Actual length of Classes C and D in 2006** | | | | | **90.5 km** | |
| **Target length of Classes C and D by end 2006** | | | | | **176 km** | |
| **Actual change in length of Classes C and D 1999 to 2006** | | | | | **–231.5 km (–72%)** | |
| **Target change in length of Classes C and D 1999 to 2006** | | | | | **–145 km (–45%)** | |

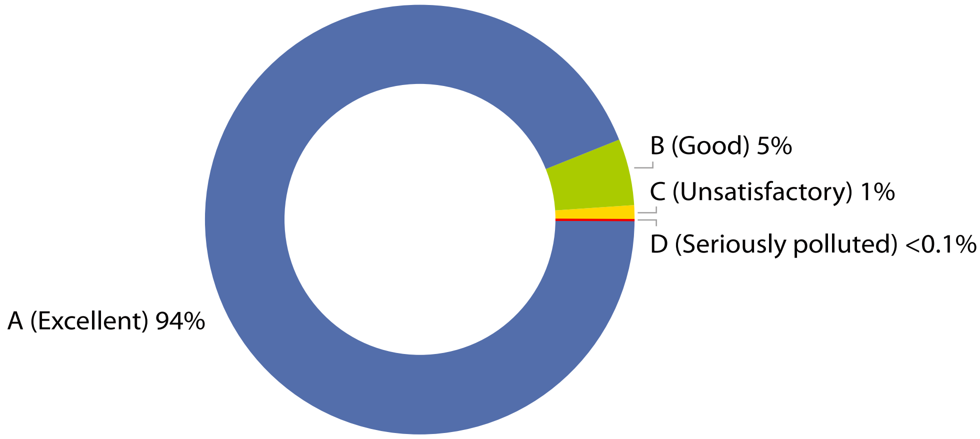
*1999 figures have been corrected relative to some earlier SEPA publications to take account of data for some islands which were unavailable at that time.

†Relative to previous annual reports, length of Class A reduced by 4.8 km and class B by 1.5 km to eliminate double counting of Tyne Estuary.

Coastal waters were predominantly of excellent quality throughout the period. In 1999 the lengths making up the total of 322 km that required improvement were mostly next to significant population centres with inadequate sewage disposal arrangements, or were affected by agricultural or urban diffuse pollution.

SEPA's target was to reduce the length of poor or seriously polluted coastal waters (Classes C and D) by 145 km before the end of 2006 compared with the 1999 baseline – equivalent to a 45% reduction. As shown in Table 3, this target has been comfortably exceeded. The length of lower quality coastal water has fallen by more than two-thirds and is now only 90 km.

**Figure 6: Coastal water class totals, 2006**




### 4.2 Main impacts on coastal water quality

The main pressures on Scottish coastal water quality are from:

- sewage collection and disposal;
- manufacturing;
- agricultural run-off;
- aquaculture (e.g. fish farming).

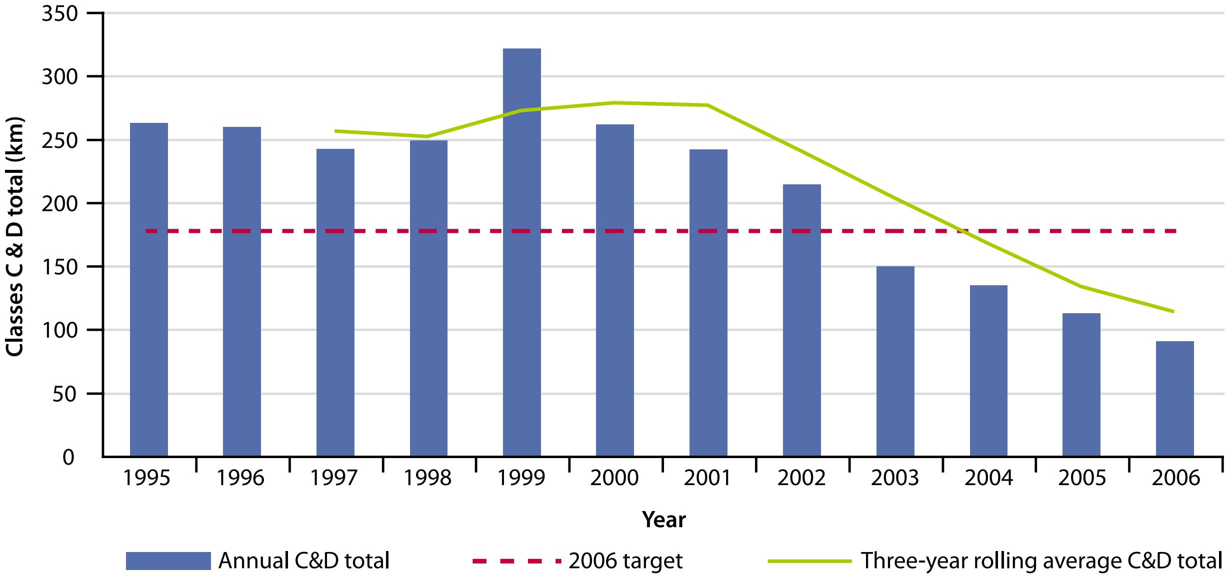
The data show that Scotland's coastline is predominantly of excellent quality.

Although having a less obvious affect than in estuaries, weather influences cause coastal water quality to vary from year-to-year. Wetter weather results in higher river flows which can, in turn, increase diffuse pollution. Diffuse run-off may contain pollutants as well as faecal indicator organisms (FIOs). Coastal quality in 2003 was undoubtedly helped by the reduced run-off resulting from the dry weather. Despite the generally wetter weather of 2004-2006, progress in improving water quality has been maintained though it is nonetheless still vulnerable to weather patterns.

Ettrick Bay

Presenting coastal water quality trends as a three-year rolling average of the total length of Class C and D waters smoothes out the influence of particularly wet or dry years. As shown in Figure 7, the rolling average continued to fall in 2006 as it has done every year since 2000.

**Figure 7: Annual totals and three-year rolling average for Class C and D coastal waters**




## 4.3 Improvements in coastal water quality

The major improvements in coastal water quality are primarily due to better treatment of sewage discharges as a result of Scottish Water's ongoing capital investment programmes and action to reduce diffuse inputs such as agricultural pollution. This continuing work is expected to further improve the quality of coastal waters.

Many of Scotland's more remote communities now have sewerage systems (previously their sewage was not treated prior to discharge) and all the main coastal discharges now have at least full secondary treatment. Tertiary treatment is in place at many STWs near bathing or shellfish growing waters.

Another important factor has been SEPA's continuing work with the Scottish Government, Scottish Agricultural College and the National Farmers Union Scotland (NFUS) to help farmers to tackle the multiple sources of diffuse agricultural pollution. However, much more work still needs to be done to secure good quality when heavy rainfall makes it more difficult to avoid diffuse pollution.

One example of the return for this level of investment and partnership working is the improvement of almost 18 km of Ayrshire's coastline and waters around the Isle of Arran. Furthermore, the effective provision of sewage treatment to all the significant coastal towns and cities between Inverness and Aberdeen has led to improvements to the water quality of a large part of the Moray coastline.

Livestock, Iona

Fish farm, Western Isles

### 4.4 Deterioration in coastal water quality

The hard work to minimise sources of diffuse agricultural pollution has paid dividends. However, agricultural run-off remains a major threat to water quality and the cause of problems at numerous coastal bathing areas. Tackling diffuse pollution will continue to require co-operation between a number of organisations and the adoption of a wide range of methods and initiatives. SEPA is committed to working with other stakeholders to maintain and build upon the improvements seen between 2000 and 2006.

SEPA's work with Scottish Water to bring about continued improvements in the sewage infrastructure is crucial. The capital investments made so far have brought about real and increasingly visible environmental benefits. SEPA will continue to monitor existing facilities to ensure they are working properly so that the risks of pollution are minimised.

The period between 2000 and 2006 also saw further expansion of fish farming in Scotland, predominantly on the west coast and around islands. The rate and scale of effluent discharges including organic matter and medicine residues from fish farms is regulated by SEPA. However, it does not regulate potential impacts arising from salmon farms such as releases of parasitic sea lice or escapes of stock from their cages. New regulations include powers to better control these potential impacts and address current concerns.

Other changes in coastal water quality were dominated by minor variations between different years. These were associated with the results of bacteriological monitoring, many of which were influenced by weather conditions at time of sampling. More details of the most significant changes in water quality around Scotland's coastline are given in the web-based report.

**Coasts**

SEPA's target for the period 2000-2006 was to reduce the length of unsatisfactory and seriously polluted waters (Class C and D) by 145 km, equivalent to 45%. The actual national reduction of these waters over the period of was 231.5 km, equivalent to 72%. **The target was comfortably achieved.**

# 5 Loch water quality 2000-2006

## 5.1 Overall picture

SEPA aims to protect and improve the valuable good water quality of freshwater lochs, which are one of Scotland's main natural assets. They are of major conservation, amenity and tourist value and many are used for recreation, potable water supply, hydropower generation or aquaculture.

Lochs are placed into one of four quality classes (see Table 4) based on criteria such as total phosphorus content and acid neutralising capacity. Class 1 lochs are those whose water quality and aquatic ecology is not significantly altered by human activity. Class 4 lochs are assessed as being severely polluted and incapable of supporting fisheries due to eutrophication, acidification, the presence of toxins or deoxygenation.

**Table 4: Loch water quality classes**

| Class | Description |
|---|---|
| 1 | Excellent/good – lochs not significantly altered by human activity |
| 2 | Fair – lochs significantly altered by human activity |
| 3 | Poor – lochs seriously downgraded by human activity |
| 4 | Seriously polluted – lochs incapable of supporting fisheries |

All standing waters ≥1 $km^2$ are included in the scheme together with some smaller water bodies deemed to be of particular significance.

Lochs currently recovering from past pollution or potentially subject to adverse trends are monitored every year. However, the much longer residence time of water in lochs compared with rivers means that their water quality is usually subject to much more gradual change. It is therefore unnecessary for them to be classified annually and hence they have often been classified on a five-year cycle.

Loch water quality for 1995 and 2000 is summarised in Table 5.

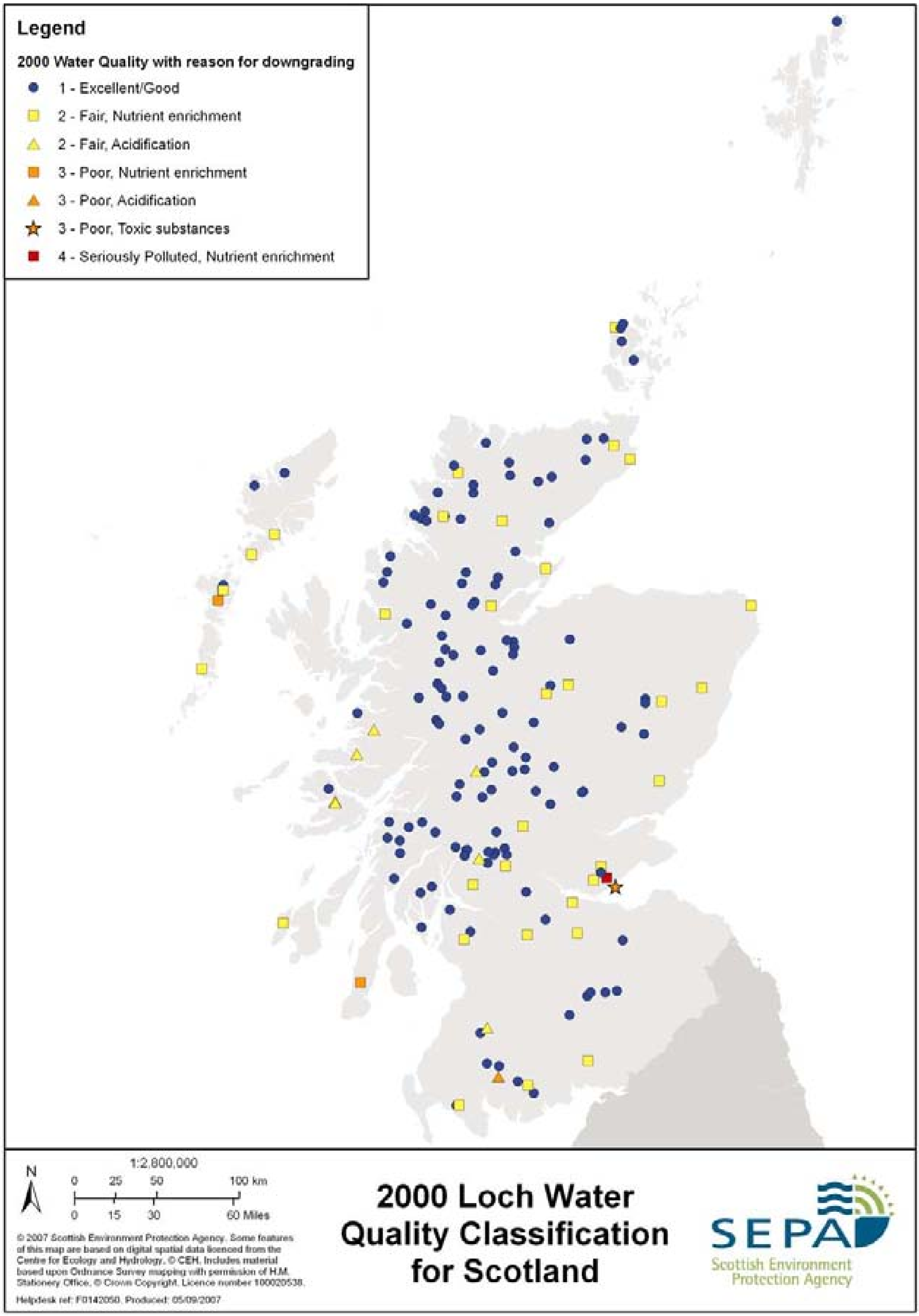
**Table 5: Loch classification for 1995 and 2000***

| Area | Year | Class 1 Excellent/ Good | Class 2 Fair | Class 3 Poor | Class 4 Seriously Polluted | Total |
|---|---|---|---|---|---|---|
| $km^2$ (%) | 1995 | 143 (82%) | 27 (16%) | 2 (1%) | 1 (<1%) | 173 |
| $km^2$ (%) | 2000† | 149 (75%) | 44 (22%) | 4 (2%) | 1 (<1%) | 198 |
| $km^2$ (%) | 2005 | * | * | * | * | 199 |

*2005 classification results were not available at the time of this report.
†The statistical confidence in several of the 2000 loch quality classifications was not adequate. In these cases, the 1995 classifications were rolled forward to 2000.

Map 7 shows those lochs classified as fair, poor or seriously polluted in 2000.

**Map 7: Lochs classified as fair, poor or seriously polluted in 2000**



Loch Ness

Loch Garry

SEPA's targets for the period from 2000 to 2006 are to:

- prevent any deterioration in loch water quality;
- further improve Loch Gelly from Class 4 (seriously polluted) to Class 3 (poor);
- maintain the quality of any additional lochs classified for first time in 2000.

It is not possible to fully assess progress against these targets until the complete results for 2005 become available. However, three of the country's five largest lochs – Ness, Morar and Shiel – maintained Class 1 (excellent/good) quality in 2005 and the water quality of Loch Gelly is known to have improved to Class 3 in 2005.

In recent years several issues have affected the quality and consistency of data used for classifying lochs. On a more positive note, the datasets on which the 2005 classification is based are more comprehensive than those used in 1995 and 2000. Some of these datasets are available and have been used in the case studies in the web-based report. When available the latest classification results from Scotland's monitored lochs will also be found on SEPA's website (www.sepa.org.uk).

## 5.2 Main impacts on loch water quality

The main pressures on Scottish loch water quality are from:

- forestry;
- agricultural run-off;
- aquaculture (e.g. fish farming).

SEPA considers all Class 2, 3 and 4 lochs to be downgraded. The cause of the downgrading of the majority of these lochs – especially in the south and east – is elevated phosphorus concentrations arising from diffuse agricultural sources, sewage discharges and/or urban diffuse pollution.

In the north and west of Scotland where natural and semi-natural land cover are more prevalent, identified impacts are related to commercial forestry and point sources (e.g. fish farms). Interactions between deposition rates, land use and soils are all known to be important in terms of loss of acid neutralising capacity.

Nutrient loss to lochs from commercial forests is a significant problem. Upland lochs considered to have high ecological status are very vulnerable to increased nutrient inputs associated with inappropriate cultivation or felling practices. Until recently SEPA had only partial control over diffuse pollution from forestry. However, forestry best practice is now promoted by the Forestry Commission and through national guidelines.

Freshwater cage fish farming[6] has become a significant threat to lochs because of untreated phosphorus inputs from the floating cage units. Most of the lochs affected are small, so it may be that their volumes and flushing rates are simply insufficient to deal with these inputs.

Improvements in the control of pollution from point sources have made the significance of diffuse pollution resulting from the use of fertilisers more apparent. Until recently there was little control over diffuse pollution sources. Best practice guidance and policies are now helping to guard against diffuse agricultural pollution and prevent any potential deterioration in water quality.

Another diffuse source, atmospheric pollution, remains an ongoing problem. The sulphur dioxide and nitrogen oxides responsible for 'acid rain' can travel long distances before being deposited and almost 90% of the fallout over Scotland comes from sources outside its borders. The effects can be exacerbated by coniferous forests, which remove acidic particles from cloud or mist more effectively than open moor land. If there is little acid neutralising capacity in the soils, most of this acidic deposition can end up in rivers and lochs. Unfortunately, many of the more susceptible geological areas are also subject to high rainfall rates.

### Lochs

SEPA's target for the period from 2000 to 2005 was to prevent any deterioration in loch water quality, further improve Loch Gelly from Class 4 (seriously polluted) to Class 3 (poor) and maintain the quality of any additional lochs classified for first time in 2000.

It has not been possible to fully assess progress against these targets as the data from all Scotland's lochs are still being assessed. However, Loch Gelly is known to have improved to Class 3 in 2005.

**SEPA is on target (full classification results expected 2008).**

Loch Morlich

Loch Shieldaig

[6]The rearing of young salmon before transfer to marine cages and the rearing of other salmonids for stocking, etc.

# 6 Groundwater quality

Because groundwater is not easily seen its importance can be overlooked. However, around 30,000 private supplies are taken from the groundwater in Scotland. These are vital to many households and small businesses, particularly in rural areas. Groundwater is also used as a source for public water supply and by industries such as breweries and mineral water producers. Groundwater is essential for irrigation in some highly productive agricultural areas.

Groundwater is inextricably linked to surface water in the water cycle as it maintains wetlands and river flow during dry spells, and is essential to the maintenance of their rich ecology and biodiversity. If groundwater quality or quantity is not protected, our rivers and lochs will also be impacted as natural groundwater discharges into them.

SEPA's integrated groundwater monitoring programme is designed to meet all needs including those arising from the requirements of the EU Water Framework Directive, Nitrates Directive and Groundwater Directive. A groundwater classification scheme is currently being developed by the UK Technical Advisory Group (UKTAG) supporting the implementation of the Water Framework Directive. More details of SEPA monitoring to comply with the Nitrates and Groundwater Directives are given in the web-based report.

## 6.1 Main impacts on groundwater quality

The main pressures on Scottish groundwater quality are from:

- agriculture;
- mining and quarrying;
- waste disposal (e.g. landfills).

Monitoring results show that the majority of Scottish groundwaters continue to be of good quality.

Agricultural activity is believed to be the source of virtually all elevated concentrations of nitrates and agrochemicals in groundwater. However, significant contamination of groundwater with agrochemicals is not widespread. SEPA continues to expand its groundwater monitoring network, carrying out additional agrochemical programmes in Moray/Easter Ross and Strathmore/Angus in 2006.

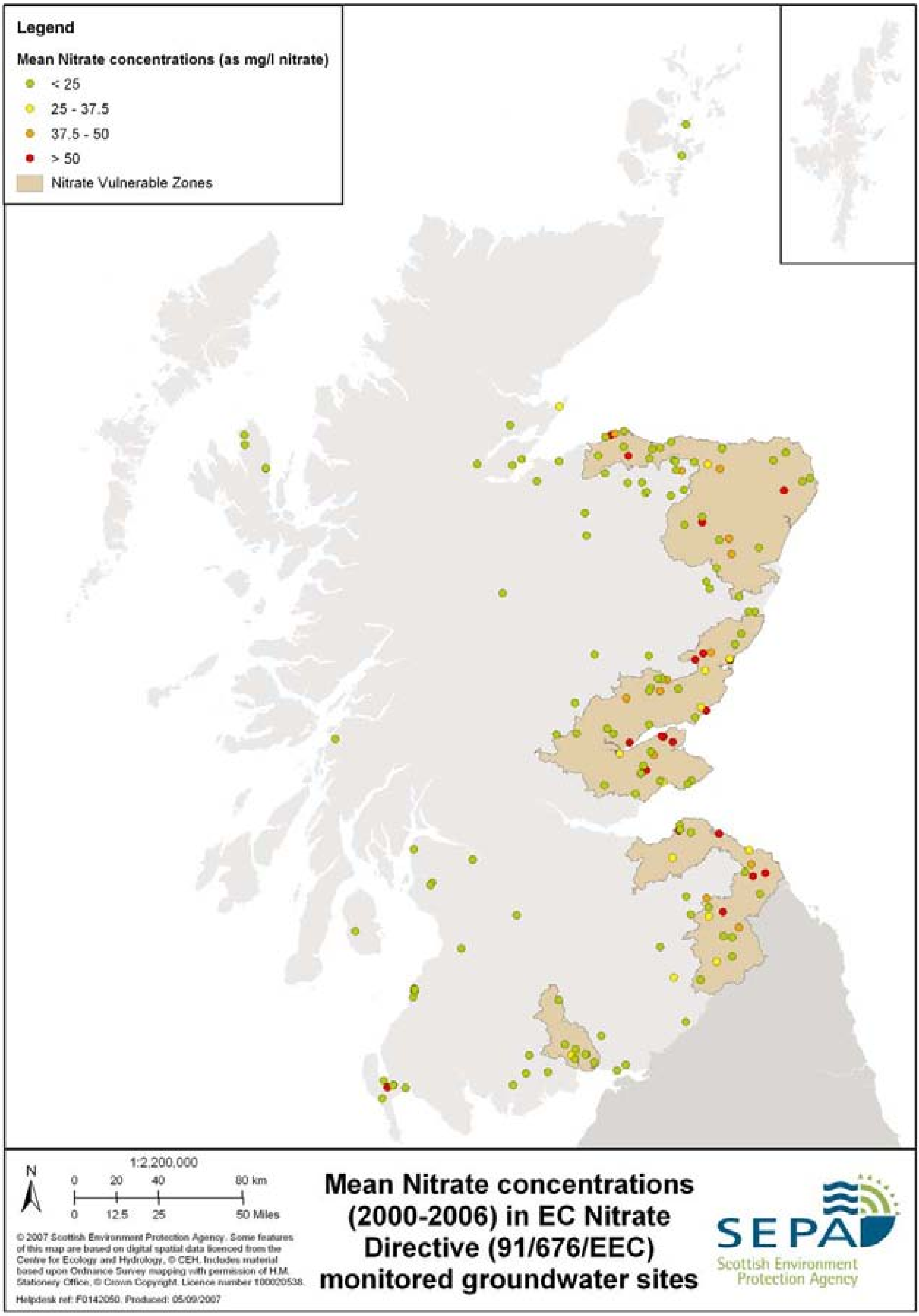
Recent results are of sufficient concern to justify continued sampling of industrial compounds at a number of selected sites in urban areas. SEPA also intends to expand monitoring of related parameters to new sites in urban areas, particularly in the Glasgow area.

### Nitrates Directive monitoring

In 2000 SEPA established a groundwater monitoring network to better comply with the requirements of the Nitrates Directive.

Map 8 shows the average levels of nitrate in groundwater sites monitored by SEPA from 2000 to 2006. It also shows the four current Nitrate Vulnerable Zones (NVZs) which cover almost 15% of the country. Nitrate concentrations at the majority of these sites were below the guideline value of 25 mg/litre. The map illustrates the high quality of Scottish groundwater with only 10% (19 sites) exceeding the upper threshold of 50 mg/litre.

**Map 8: Nitrate concentrations in Scottish groundwater, 2000-2006**




Dipping a farm borehole, Newton of Falkland, Fife


Groundwater sampling, Newton of Falkland, Fife

### Groundwater Directive monitoring

The Groundwater Regulations state that SEPA may only grant an authorisation to discharge prescribed chemicals to land or groundwater if the associated groundwater is subject to the requisite surveillance. SEPA monitors for sheep dip (e.g. cypermethrin) and agrochemical compounds (e.g. atrazine) at a small number of selected sites.

As with nitrate monitoring, the network has evolved over time with sites added where necessary and removed where conditions indicate they are not under any threat or not representative. In general the number of sites where sheep dip has been detected is declining, but the detection of other agrochemicals has increased. Not all of these detections are significant.

In 2002 mandatory limits for sheep dip compounds were exceeded at 10% of the sites sampled and for agrochemical compounds at 20% of the sites sampled. In 2006 levels of sheep dip compounds were too high at only 8% of sites sampled and too high for agrochemical compounds at 10% of sites sampled. Appropriate action was taken in these cases.

More details of these findings are given within the case studies presented in the web-based report.

# 7 Conclusions

This report summaries the results and outcomes of SEPA's monitoring and classification of Scotland's water quality, and overall trends in the quality of the aqueous environment.

In 2000 SEPA set itself water quality improvement targets to be met during 2006. This report focuses mainly on this period but also provides data on more long-term trends where available. The improvement targets were essentially met, though the cost and effort involved in achieving these targets serves to emphasise the size of the task required to meet future EU Water Framework Directive objectives.

Some year-on-year fluctuations have been brought about by uncontrollable factors such as rainfall. However, these do not mask the overall long-term improvements; these can be attributed to a range of factors including:

- investment in new sewage treatment schemes and improved sewerage infrastructure;
- improved levels of effluent treatment by industrial operators;
- continuing work by SEPA and others to minimise diffuse pollution from agricultural and urban sources;
- implementation of new legislation;
- increasing public awareness and reporting of pollution incidents.

Combined with routine monitoring, SEPA maintains a programme of Environmental Improvement Action Plans, many of which are directed at problems arising from more diffuse, currently unregulated sources. These plans will also produce environmental quality improvements in the future.

This publication is the last time water quality will be reported using SEPA's classification methodology. Future annual classifications from 2007 will be undertaken using the new WFD classification tools.

Much remains to be done to bring the quality of all waters up to desired standards. This ongoing work is being given fresh impetus by the new requirements of the WFD. To meet these SEPA is implementing a new water quality classification scheme along with new regulatory regimes for abstractions and engineering works. These will bring under control many activities that impact on ecological quality but which have not previously been subject to direct regulation.[7]

The high ecological and economic value of Scotland's waters must be maintained as a valuable resource for fish and wildlife, recreation, the transport of well-treated wastes, abstractions, impoundments and power generation. Through its policies and actions SEPA aims to ensure that:

- the future for the quality of all waters and aquatic environments remains positive;
- current improvement trends are maintained for the enhancement of all uses and benefit of users.

[7]See *Significant Water Management Issues for Scotland*, SEPA, 2007 (www.sepa.org.uk/pdf/consultation/current/swmi/swmi_scotland_main.pdf)

# 8 Abbreviations and acronyms

| | |
|---|---|
| **CSO** | combined sewer outflow |
| **DRN** | Digitised Rivers Network |
| **EIAP** | Environmental Improvement Action Plan |
| **EQS** | Environmental Quality Standard |
| **FIOs** | faecal indicator organisms |
| **NVZ** | Nitrate Vulnerable Zone |
| **OSPAR** | Oslo and Paris Convention |
| **SEPA** | Scottish Environment Protection Agency |
| **STW** | sewage treatment works |
| **SUDS** | sustainable urban drainage system |
| **UWWTD** | Urban Waste Water Treatment Directive |
| **WFD** | Water Framework Directive |

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