Waste water treatment in the United Kingdom – 2012

Implementation of the European Union Urban Waste Water Treatment Directive – 91/271/EEC

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Contents

Preface 2

Introduction 3

Waste water collection 4

Waste water collection – current developments 5

Waste water treatment 7

Waste water treatment – current developments 9

Sensitive areas 11

Sensitive areas – recent developments 14

Monitoring of waste water discharges to the environment 16

Sewage sludge utilisation and disposal 19

Investments 20

Are you doing your bit? What we all can do 23

UK Urban Waste Water Treatment Directive maps 25

Figures 5 to 10: English maps 25

Figure 11: Northern Irish map 31

Figures 12 to 14: Scottish maps 32

Figure 15: Welsh map 35

Figure 16: Sewage treatment stages and sewage sludge re-use and disposal routes 36

Tables comparing agglomerations, treatment plants and compliance 37

Key organisations and information links 40

Glossary 41

Preface

This publication fulfils the requirement under Article 16 of the European Union Urban Waste Water Treatment Directive to periodically produce reports on the collection and treatment of urban waste water, and on the re-use and disposal of the residual sewage sludge.
The publication is available as a downloadable file from the Department for Environment, Food and Rural Affairs' website:
www.defra.gov.uk/environment/quality/water/sewage/sewage-treatment

This publication is not available as a printed document but the file can be freely circulated.

The report includes prescribed content of maps and tabulated information derived from data submitted to the European Commission for 2008 and 2010 monitoring years under Article 15 of the Directive. The prime purpose of Article 16 reporting is to provide the public with up to date situation reports on the collection and treatment of waste water and this edition includes information available at the time the report was compiled during 2012. This publication is intended for a wide age-range of the general public, from primary school-age upwards.

Look out for **keyword** links with explanations in the Glossary, '**Section title**' links to other sections of the report and links to websites for further information.

Introduction

Without treatment the water from toilets, baths, sinks and washing machines from domestic and residential premises, industrial waste water discharges to sewers and the rainwater contaminated with metals, oils and other pollutants in rainwater run-off from urban areas draining to sewers would have significant adverse impacts on the water environment. This report sets out information on the collection and treatment of waste water, and on the appropriate disposal or reuse of sewage sludge, and ultimately how these measures protect the water environment from human activities and help the United Kingdom meets its commitments under the Urban Waste Water Treatment Directive.

Urban Waste Water Treatment Directive (91/271/EEC)

The Urban Waste Water Treatment Directive ('the Directive') is one of a number of European Union (EU) Directives that have the objective of protecting the water environment for the animals and plants that live in and around water, for recreation, and its use as a resource for drinking water, sanitation, industry and commerce. The Directive was adopted on 21 May 1991. EU Member States are required to implement the Directive through their national legislation. The '**Key organisations and information links**' section of this report includes links to the EU website page on the Directive and to UK legislation transposing its requirements.

What is 'urban waste water'?

Urban waste water is defined in the Directive as the mixture of domestic waste water from kitchens, bathrooms and toilets, the waste water from industries discharging to sewers and rainwater run-off from roads and other impermeable surfaces such as roofs, pavements and roads draining to sewers. Urban waste water is often referred to as 'sewage', but in this publication the term 'waste water' will generally be used.

Why treat urban waste water?

Although untreated waste water is mostly water, (generally less than 0.1% is solid material), without treatment the waste water produced every day would cause significant damage to the environment. The impacts of untreated waste water range from, chronic **ecosystem** damage due to oxygen depletion of receiving waters from the **biodegradation** of organic matter; ecosystem damage of **eutrophication** of waters resulting from excessive inputs of nutrients present in waste water; potential health risks from water-borne **pathogens** from discharges to waters used for recreational activities, such as swimming and canoeing. Untreated waste water also contains **sewage litter** and other **sewage solids** that can impact the environment, for example, through the smothering of river beds or posing a hazard through its ingestion by wildlife. Sewage solids can also damage commerce by making beach and riverside resorts unattractive to potential visitors.

Different types of waste water treatment are designed to remove the various contaminants of sewage solids, pathogens, nutrients, toxic chemicals and metals dangerous to wildlife and humans alike. Effective treatment also means treated waste water can be returned to the environment to maintain river flows for conservation, fisheries and recreational interests. The other by-product of sewage treatment is sewage sludge, which needs to be appropriately re-utilised or disposed of. What happens to sewage sludge following waste water treatment is discussed later in this report in the section '**Sewage sludge utilisation and disposal**'.

Waste water collection

Before waste water can be treated it needs to be collected. Every day in the UK over 624,200 kilometres of sewers collect over 11 billion litres of waste water from homes, municipal, commercial and industrial premises and rainwater run-off from roads and other impermeable surfaces. The UK's **sewerage undertakers** are responsible for building, maintaining and improving main sewers, pumping stations, and waste water treatment facilities that service around 96% of the UK population. The remaining 4% of the population, represented by the smallest of communities and individual properties in rural areas remote from mains sewers, are generally served by privately owned, small-package treatment plants catering for small groups of houses, to septic tanks, cesspits and other in-situ treatment systems, generally serving individual properties.

There are three main types of collection system:

- surface-water drainage that collects rainwater run-off from roads and urban areas and discharge direct to local waters;
- combined sewerage that collects rainwater run-off and waste water from domestic, industrial, commercial and other premises; and
- foul drainage that collects domestic waste water from premises (no rainwater is collected).

Both surface water and foul drainage may eventually connect to combined sewerage where there are no local environmental waters to which surface water drainage can discharge.

Combined sewerage systems are not uncommon in the UK and elsewhere in Europe. A basic requirement of combined sewerage systems is that they need to cater for all normal local climatic conditions. In other words, they need to be large enough to receive and effectively manage storm water from peak seasonal wet weather. However, even when designed to deal with such weather, there may be times when heavy continuous rainfall will temporarily exceed the capacity of combined sewerage systems. To deal with such situations 'combined sewer overflows' are designed and built as an integral part of combined sewerage systems. The purpose of combined sewer overflows is to allow excess waste water to be discharged to local waters to avoid sewers being overwhelmed and waste water 'backing up' along sewers and flooding streets and properties, or overwhelming waste water treatment plants. The backflow of waste water to properties and streets would present human health hazards and flooded and overflowing treatment plants would disrupt treatment processes and have the potential to cause more environmental damage than can be caused by discharges from combined sewer overflows.

Waste water collection – current developments

Transfer of private sewers in England and Wales

From 1 October 2011, ownership of private sewers moved from homeowners to English and Welsh sewerage companies, with responsibility for repair of collapsed and blocked, formerly private, sewers now resting with sewerage companies. The ten English and Welsh sewerage companies were previously responsible for approximately 323,000km of public sewers. With the transfer they are now responsible for a further 184,000km of private sewers and 36,000km of private 'lateral' sewers connecting to and affecting the public system but which had no planned operational maintenance regime. This results in a total of 543,000km of sewerage under English and Welsh sewerage companies' ownership. The transfer of the additional 220,000km of private sewers puts everyone in England and Wales on an equal footing by spreading the cost of maintenance and repairs across all sewerage bill payers. It will ensure a better maintained, less polluting, and more efficient sewerage system. Further information on the transfer of private sewers is on Defra's website at: www.defra.gov.uk/environment/quality/water/sewage/sewers.

London Lee Tunnel Project

Currently, around 16 million tonnes of untreated waste water is discharged in a typical year from overflows at Abbey Mills pumping station to the River Lee in the Stratford area of London. This represents around 40% of the total annual volume of discharges from combined sewer overflows affecting the tidal reaches of the Thames. The environmental impacts of discharges from Abbey Mills will be dealt with by construction of the £635 million, seven metre diameter, 6.5 kilometre long Lee Tunnel that will carry the waste water from Abbey Mills for secondary treatment at Beckton, site of Europe's largest waste water treatment plant. The Lee Tunnel is being excavated by a 120 metre long tunnel boring machine, which in a tradition of giving tunnel boring machines female names for good luck, was named 'Busy Lizzie' by Ryan Waters, a student of the Maryland Primary School, following a competition between Newham primary schools. 'Busy Lizzie' is expected to have completed the tunnelling work late in 2013, with tunnel finishing and commissioning work and the provision of secondary treatment at Beckton expected to be completed in 2015. Further information on the Lee tunnel can be found at Thames Water's website at: www.thameswater.co.uk.

Figure 1: 'Busy Lizzie' Tunnel boring machine and Martin Baggs, Thames Water Chief Executive Officer

Belfast Sewers Project

Northern Ireland Water invested £160 million in the Belfast Sewers Project, completed in May 2010. The Project involved work to upgrade the existing sewer networks and the construction of a large diameter drainage tunnel to increase storm water capacity. As a result, a significant number of combined sewer overflows were closed, reducing the pollutant load from the sewerage system on the River Lagan and its tributaries by 85%. The project also involved more than 500 repairs to the sewer network which also contributed significantly towards increasing the city's storm water capacity.

Meadowhead & Stevenston Project

Scottish Water is investing over £90m to improve and protect the environment in local coastal waters and rivers in the Ayrshire areas served by Meadowhead and Stevenston Waste Water Treatment Works. Improving a significant number of storm overflow facilities, installing a new storm water network from the towns of Kilmarnock and Irvine, and constructing three new storm water pumping stations to transfer storm flows away from the local watercourses will reduce the number of discharges from storm overflows. This will help improve the quality of local watercourses and reduce risks to nearby bathing waters from faecal bacteria. Work on the project started on site in October 2010, and is expected to be complete by November 2013, by which time some 70 individual storm water assets will have been improved.

Waste water treatment

Treatment levels

The treatment provided at waste water treatment plants can involve:

- **Preliminary treatment** – to remove grit and gravel and screening of large solids.
- **Primary treatment** – to settle larger suspended, generally organic, matter.
- **Secondary treatment** – to biologically break down and reduce residual organic matter.
- **Tertiary treatment** – to address different pollutants using different treatment processes.

The 'size' of a community, (the Directive uses the term **agglomerations** to refer to communities), is measured using its **population equivalent** (p.e.), and is one factor used to determine the treatment waste water receives. Other factors are the sensitivity to pollutants of the waters receiving discharges, and whether treated waste water is discharged to inland, estuarine or coastal waters. As 'population equivalent' measures the oxygen used to break down organic matter it provides a common measure for the organic content or 'organic load' in waste water, whether the waste water is from domestic type properties, containing human metabolic wastes; food processing plants, containing food particles and food preparation washings, or rainwater run-off containing organic debris washed from roads and draining to sewers.

The largest collection systems in the UK are linked to around 9,000 waste water treatment plants. Approximately 1,900 of these plants serve agglomerations of greater than 2,000 p.e., above which the Directive's secondary treatment standards applies to discharges from agglomerations made to freshwaters and estuaries, and to discharges from agglomerations of greater than 10,000 p.e. made to coastal waters. The Directive and other water quality directives may also require tertiary treatment to protect waters sensitive to discharges of waste water treated to secondary standards alone.

Just as combined sewers need to cater for peak seasonal wet weather flows, waste water treatment plants also need to have sufficient capacity to deal with such weather. They also need to cater for seasonal changes in the organic load they receive for treatment, for example, to cater for increases in the populations of seaside towns, capital cities and other tourist destinations during holiday seasons. At such times treatment processes may need to be optimised to deal with variations in organic load concentrations associated with seasonal population changes.

Primary treatment of discharges to 'less sensitive areas'

The Directive provides Member States with the option of identifying **less sensitive areas** in estuarine and coastal waters. Where identified, discharges to less sensitive areas may be subject to a minimum of primary treatment provided comprehensive studies undertaken demonstrate no adverse impact on the environment from such discharges.

Around the mid-1990s a number of less sensitive areas were identified across the UK. As the findings from comprehensive studies became known, indicating the likelihood of adverse impacts from primary treatment discharges to their receiving waters, between the late 1990s to the early 2000s the less sensitive areas designated across the UK were progressively withdrawn, and the UK no longer has less sensitive area designations.

Secondary treatment of discharges to 'normal areas'

The major impact from untreated waste water arises from the biodegradable organic content of waste water such as carbohydrates, fats, proteins in human metabolic waste, food and other biodegradable waste matter. Whilst bacteria naturally present in the water environment can break down this organic matter, they use significant amounts of dissolved oxygen. Continuous discharges of untreated waste water would therefore result in chronic hypoxic (low oxygen) or anoxic (no oxygen) conditions which would create oxygen depleted 'dead zones' and severely affect the ability of a wide range of aquatic life to survive. As many animals rely on aquatic plants and animals the effects can go considerably beyond the affected waters. The objective of secondary treatment is to therefore carry out the process of bacterial breakdown of organic matter under controlled conditions in waste water treatment plants.

The Directive required secondary treatment for agglomerations greater than 15,000 p.e. by the 31 December 2000 and at that date the UK was 90% compliant with the requirement. By the end of 2007 the UK was 99.9% compliant. Since then, Brighton and Hove in England is the only UK agglomeration greater than 15,000 p.e. without secondary treatment. The '**Brighton and Hove sewage treatment scheme**' section in this report has information on progress with the secondary treatment scheme for the Brighton and Hove area.

Although the Directive requires secondary treatment of discharges to coastal waters from agglomerations above 10,000 p.e., in England and Wales secondary treatment has generally been provided for coastal discharges from agglomerations between 2,000 and 10,000 p.e. Scotland may also provide secondary treatment for coastal discharges in this size bracket on a case by case basis depending on environmental need.

In Northern Ireland one agglomeration greater than 10,000 p.e., Ballycastle, that discharges to coastal waters is currently without secondary treatment. Northern Ireland Water has applied for planning permissions to upgrade the treatment works serving Ballycastle.

The UK was generally compliant with the Directive deadline of 31 December 2005 for the provision of secondary treatment for agglomerations between 2,000 and 15,000 p.e. In 2010 Dunoon and Stranraer in Scotland, were the only of the UK's smaller agglomerations without secondary treatment. Although, secondary treatment at Dunoon was required in 2010 construction of the works was underway, and the new waste water treatment works was completed in March 2012. At Stranraer, an extension was agreed between the sewerage undertaker and the Scottish environmental regulator for works to be completed by 31 December 2008. This deadline was missed and legal action was taken. Progress to ensure secondary treatment is provided has commenced.

Tertiary treatment provided for sensitive areas

Secondary treatment alone may not protect waters from other types of contaminants present in waste water and tertiary treatment may be required at waste water treatment plants to protect water ecosystems, abstraction source waters or to meet water quality standards of a number of directives. The type of tertiary treatment provided would therefore be tailored to address specific pollutants. Environmental waters in need of more protection than is provided by secondary treatment are generally designated as 'sensitive areas' as required by the Directive and discussed in the '**Sensitive areas**' section of this report.

Waste water treatment – current developments

London sewage plant capacity upgrades projects

Allied to the Lee Tunnel construction project reported in the 'Waste water collection – current developments' section earlier in this report, is the Beckton treatment plant capacity and treatment improvement scheme project, currently in progress. This scheme will result in a significant 60% increase in the capacity of Beckton treatment plant. Once completed the scheme will accommodate the additional waste water to be conveyed for treatment by the Lee Tunnel, and ultimately, flows from the proposed Thames Tunnel. The upgrade at Beckton is part of a £675 million Thames Tideway improvement project to increase the capacities of a further four large London treatment plants of Crossness, Mogden, Riverside and Long Reach discharging to the tidal Thames. The capacity increases will reduce the need to discharge untreated waste water from combined sewer overflows to the Thames tideway and are expected to be completed in 2015. Further information on the Tideway improvements scheme can be found on Thames Water's website: www.thameswater.co.uk.

Brighton and Hove sewage treatment scheme

Only Brighton and Hove of the agglomerations greater than 15,000 p.e. in the UK remains without secondary treatment, a situation which has arisen largely from planning approval delays. Since October 2009, when planning approval was finally obtained for construction of a waste water treatment plant at Peacehaven, East Sussex, Southern Water Services has made good progress with the £300 million scheme that will deliver cleaner seas for Sussex. New tunnels leading to the plant and a pipe that will discharge the treated water out to sea have been completed. Construction of the plant is well advanced, with the scheme on schedule to provide secondary treatment by 31 March 2013.
More information on the scheme is on Southern Water's website:
www.southernwater.co.uk/Environment/inYourArea/sussex/cleanerseas.

Figure 2: Brighton and Hove treatment scheme in construction – December 2010

Loch Ryan sewage treatment scheme

Waste water from the communities of Stranraer, Cairnryan, Kirkcolm and Leswalt currently only receive primary treatment at the four local treatment works prior to discharge into Loch Ryan. To meet the legislative requirements of the Urban Waste Water Treatment Directive, the Shellfish Waters Directive and Shellfish Hygiene Directive, over £25 million is being invested in a strategic solution. New pumping stations and rising mains will replace existing primary treatment works and collect wastewater from the four communities and transfer it to a new secondary treatment works (Loch Ryan waste water treatment works) near Leswalt prior to discharge to the Irish Sea via a new marine outfall. This will remove continuous discharges from Loch Ryan. Construction works began in January 2011 and are forecast to be complete by spring 2013.

Sensitive areas

Where secondary treatment is not sufficient to protect waters, **tertiary treatment** may be required. Tertiary treatment can involve the reduction of nutrients (phosphorus or nitrogen compounds) to protect waters from **eutrophication** caused by excessive nutrient inputs from treatment plants; the reduction of nitrates to protect waters used as abstraction sources that have or could contain high nitrate levels or of **pathogens** to protect Bathing or Shellfish waters, or ammonia reduction to protect freshwater fisheries. Combinations of the above types of tertiary treatment may be required depending on the uses made of the waters impacted by discharges. Where waters are in need of tertiary treatment they are generally to be designated as 'sensitive areas'.

Designation of sensitive areas

The Directive requires Member States to carry out surveys of their waters to determine where they are adversely impacted by secondary treated discharges and potentially in need of tertiary treatment protection for the purposes of the Directive and/or other water quality directives. Waters are to be designated as sensitive areas where they are:

a) Eutrophic or could become so in the near future without tertiary protection;

b) Abstraction sources that have or could have high nitrate levels without tertiary protection;

c) Other directives' water in need of or already receiving tertiary protection.

The first two criteria relate to tertiary treatment requirements for the purposes of the Directive and the third criterion those of other directives, usually the Bathing Water, Shellfish Waters and the Freshwater Fish Directive, but potentially, any water quality directive whose waters are impacted by secondary treatment discharges.

Sensitive area designations under criteria (a) and (b) would generally arise from four-yearly reviews as required by Article 5.6 of the Directive. The Directive allows a maximum of seven years from the designation date of sensitive areas for the provision of tertiary treatment at treatment plants serving agglomerations of greater than 10,000 p.e. whose discharges are made to or affect sensitive areas identified under these criteria.

Designation of sensitive areas under criterion (c) (other directives' waters) can arise from reviews carried out at four-yearly intervals, or also potentially, annually for Bathing Waters or whenever reviews are conducted of Shellfish Waters to consider the need for new, extended, merged, and even the de-designation of sensitive areas. Waters already designated under other directives not previously qualifying for designation as sensitive areas would qualify for designation wherever they subsequently receive tertiary treatment protection.

As mentioned above excessive nutrients in waste water discharges can lead to problems in the environment and would be tackled by removal of nitrates and/or phosphates from discharges. The panel below presents a brief case study of why such measures are needed and how they can benefit the environment.

Case Study – The River Great Stour sensitive area

Figure 3(a): River Great Stour eutrophic sensitive area at Wye in 2001

Following a survey carried out between 1991 and 1994 by the National Rivers Authority, (the Environment Agency's predecessor body), a stretch of the River Great Stour downstream of Ashford town waste water treatment plant, near Bybrook in Kent, was found to be suffering the effects of eutrophication from phosphate inputs from the plant. Consequently, the affected stretch of the River Great Stour was designated as a sensitive area in May 1994. In 1998 phosphate stripping was introduced at Ashford treatment plant. Following a further survey conducted between 2001 and 2004 a further stretch of the River Great Stour was found to be affected by Ashford treatment plant and the sensitive area was extended in October 2007 to include the additional stretch. The stretch of the river identified as the 'River Great Stour eutrophic sensitive area' now extends approximately 43 kilometres from Ashford treatment plant. The photograph at Figure 3(a), of the River Great Stour at Wye, shows extensive growth of dark filamentous algae along the river bed with minimal growth of a plant within the algal growth seen near the bottom of the picture. The predominance of the filamentous algal growth is typical of waters subject to eutrophication which often exhibit low biodiversity.

It can take a number of years for the benefits of nutrient stripping to be reflected in the environment as illustrated in Figure (3(a) taken in 2001, several years after introduction of phosphate stripping at Ashford treatment plant. Amongst the reasons for this is that lowland waters tend to be naturally nutrient rich, and plant communities can take some time to react to reductions in phosphate levels.

Changes that occur can be quite subtle, however, Figure 3(b) of the same location in 2010, shows a marked general reduction of the dark filamentous algal growth with a greater diversity of plant stands visible along the river bed from the fore to middle ground. Such plant diversity provides a range of food and niche habitats for creatures, such as invertebrates and fish. This in turn attract others animals that feed on them, creating a healthier and appropriately **biodiverse** ecosystems.

Figure 3(b): River Great Stour eutrophic sensitive area at Wye in 2010

Which nutrient to tackle – nitrate or phosphate?

The above case study explained that phosphate stripping was introduced at Ashford treatment plant. Whilst nitrate can also contribute to eutrophication of waters, nitrate removal was not required at Ashford treatment plant. A brief explanation follows of why phosphate only may need to be removed in some cases, or nitrate only in others, or both nutrients. More usually phosphate is the problem nutrient potentially causing eutrophication of freshwaters, with nitrate playing a lesser role in causing freshwater eutrophication. In **saline** coastal waters, nitrate is more generally the problem nutrient potentially causing eutrophication of coastal waters with phosphate having a lesser role. For these reasons phosphate removal only is more usually required for discharges affecting freshwaters and nitrate removal for discharges affecting coastal and more generally saline estuarine waters. The main factor determining whether one nutrient or the other is removed is the **salinity** of the receiving waters. This can mean that in brackish estuarine waters, where freshwaters mix with saline coastal waters, the removal of both phosphate and nitrate may be required. The balance of nitrate to phosphate in environmental waters can also influence eutrophication.

Sensitive areas – recent developments

A further 68 sensitive areas were designated across the United Kingdom in 2011 as detailed below:

- England: 33 eutrophic, four bathing and two shellfish waters (39);
- Northern Ireland: one bathing water;
- Scotland: 13 bathing, 11 eutrophic and four shellfish waters (28);

In Wales a eutrophic water is expected to be designated in the latter half of 2012.

In Scotland the St. Andrews and Fife Shellfish Water sensitive area was de-designated in July 2009, and in England, three Bathing Waters and one Shellfish Water were de-designated in 2011. These sensitive area de-designations followed de-designation of the waters under their parent directives.

Summary sensitive area tables

The UK currently has 588 sensitive areas totalling 19,466 km of river and canal lengths and a surface area of 2,737 km². The following two tables show this information broken down by nation and type of sensitive area.

Table 1: Summary of sensitive areas numbers by UK nation and type

Sensitive area type	England	Northern Ireland	Scotland	Wales	Totals
Bathing Water	181	2	21	24	228
Water	165	14	94	5	278
Freshwater Fish Water	–	–	8	–	8
Abstraction Water	8	–	–	–	8
Shellfish Water	48	1	5	12	66
Totals	**402**	**17**	**128**	**41**	**588**

Table 2: Summary of sensitive area lengths and surface area by UK nation and type

Sensitive area type	Unit	England	Northern Ireland	Scotland	Wales	*Total
Bathing Water	km²	159.06	0.34	11.28	34.82	205
Eutrophic Water	km km²	4,338.47 221.16	12,172.54 583.09	2,246.89 97.04	120.62 12.52	18,879 914
Freshwater Fish Water	km	–	–	123.06	–	123
Abstraction Water	km	464.76	–	–	–	465
Shellfish Water	km²	1,199.20	10.69	91.59	316.15	1,618
***Total length (km)**		**4,803**	**12,173**	**2,370**	**121**	**19,466**
***Total area km²**		**1,579**	**594**	**200**	**363**	**2,737**

*Totals are rounded and values may not sum to totals

The maps in the section '**United Kingdom Urban Waste Water Treatment Directive maps**' show the sensitive areas designated in the UK. The maps also show the location of treatment plants serving agglomerations of above 2,000 p.e., with colour differentiation of those providing secondary or tertiary treatment. Downloadable files containing data on individual sensitive areas are available via the Table section of Defra's sensitive areas webpage at the link below. The Excel file includes links to an interactive map of some of the sensitive areas.

www.defra.gov.uk/environment/quality/water/water-quality/sensitive-areas

Monitoring of waste water discharges to the environment

The Environment Agency, the Northern Ireland Environment Agency and the Scottish Environment Protection Agency and Wales Environment Agency are the UK's environmental regulators. Their regulation role covers continuous discharges from the water industry, other industrial sectors and private discharges as well as intermittent discharges, such as those from combined sewer overflows or emergency overflows. Typically, any discharge to controlled waters requires a **discharge authorisation** which sets out standards for **parameters** monitored in effluent from treatment plants. For intermittent discharges an authorisation may specify the volume of discharges to be made or may include the need to screen discharges to remove sewage litter. Discharge authorisations are referred to as 'Environmental Permits' in England and Wales, 'Water Order Consents' in Northern Ireland and 'Authorisations' in Scotland. Discharge authorisations are designed to minimise the adverse effects of pollution on receiving waters through meeting standards of European Directives or domestic water quality objectives.

Other impacts on environmental water quality

Environmental waters are not only affected by discharges from treatment plants and combined sewer overflows as **point source pollution** only. Waters are also affected by **diffuse pollution** from surface water drainage, urban run-off from brownfield sites, (former industrial sites that often have contaminated, toxic soils that can also leach pollutants to waters), roads, and run-off from land in rural areas. Although notionally clean, surface water drainage introduces diffuse urban pollution to waters, such as petrol, oil, grease and metals from vehicles, and pathogens from misconnections of foul sewerage or from dog-fouling of roads. Misconnections are a particularly difficult problem to deal with, as it entails identifying and addressing misconnections on a site-by-site basis dependent on ownership of the misconnected discharges. These issues are being tackled through initiatives on sustainable drainage systems.

Rainwater run-off from agricultural land can, through poor farming practices, introduce a range of contaminants into water bodies, including fertilisers applied to land and pathogens from farm animals. These contaminants can impact on the quality of waters identified under other Directives such as the Bathing Water and Shellfish Waters Directives.

Addressing the many sources of both point source and diffuse pollution from human activities present a considerable challenge; the **Water Framework Directive**, adopted in October 2000, aims to do that through its promotion of an understanding of the totality of pollution and other impacts on the water environment for the development of an holistic approach to addressing them. This principle is in part implemented through Article 10 of the Water Framework Directive – '*The combined approach for point and diffuse sources*', where along with other water quality directives, the Urban Waste Water Treatment Directive is explicitly cited as a fundamental measure for appropriate implementation of the Water Framework Directive. Section (a) of the Glossary entry **Water quality directives** lists the three fundamental measure directives explicitly cited at Article 10 of the Water Framework Directive.

In England the 'Catchment Based Approach' strategy, launched on World Water Day, 22 March 2011, by Richard Benyon, the Minister for Natural Environment and Fisheries will help with delivery of the aims of Article 10 of the Water Framework Directive. Currently, the strategy is in a pilot phase that will run until December 2012, looking at 10 pilot catchment hosted by the Environment Agency and 15 pilot catchments hosted by other organisations. At conclusion of the pilot findings will be submitted to Defra and an independent evaluation of the 25 pilots is to be undertaken. Beyond 2012 lessons learned from

the pilots are expected to be rolled out for the management of English and Welsh catchments. Further information on the Catchment Based Approach is on Defra's website at: www.defra.gov.uk/environment/quality/water/legislation/catchment-approach

In Northern Ireland, a range of proposals to address diffuse pollution were set out in the Programme of Measures (POM) in Section 7 of the River Basin Management Plans. The POM for each of Northern Ireland's three River Basin Districts can be viewed at the following webpages: www.doeni.gov.uk/niea/nw-pom, www.doeni.gov.uk/niea/ne-pom, and www.doeni.gov.uk/niea/neagh-pom. Each River Basin District has up to nine Local Management Area (LMA) Action Plans either in place or accessible from the above POM pages. The LMA Action Plans contain supplementary measures to protect or improve water body status including, where appropriate, measures to address diffuse pollution.

Improvements to treatment

The tables in the section '**Tables comparing agglomerations, treatment plants and compliance**' compare data submitted to the European Commission for treatment facilities, broken down by size brackets, receiving water and water body types, and compliance in 2008 and 2010. These indicate an overall improvement in the UK's compliance with the Directive's standards since 2008 by 1.7% to 98.5% in 2010.

Bathing water improvements

In 2012 all UK environmental regulators began monitoring against the much tighter standards of the revised Bathing Water Directive with the aim of achieving the new 'sufficient' classification at all designated bathing waters by 2015.

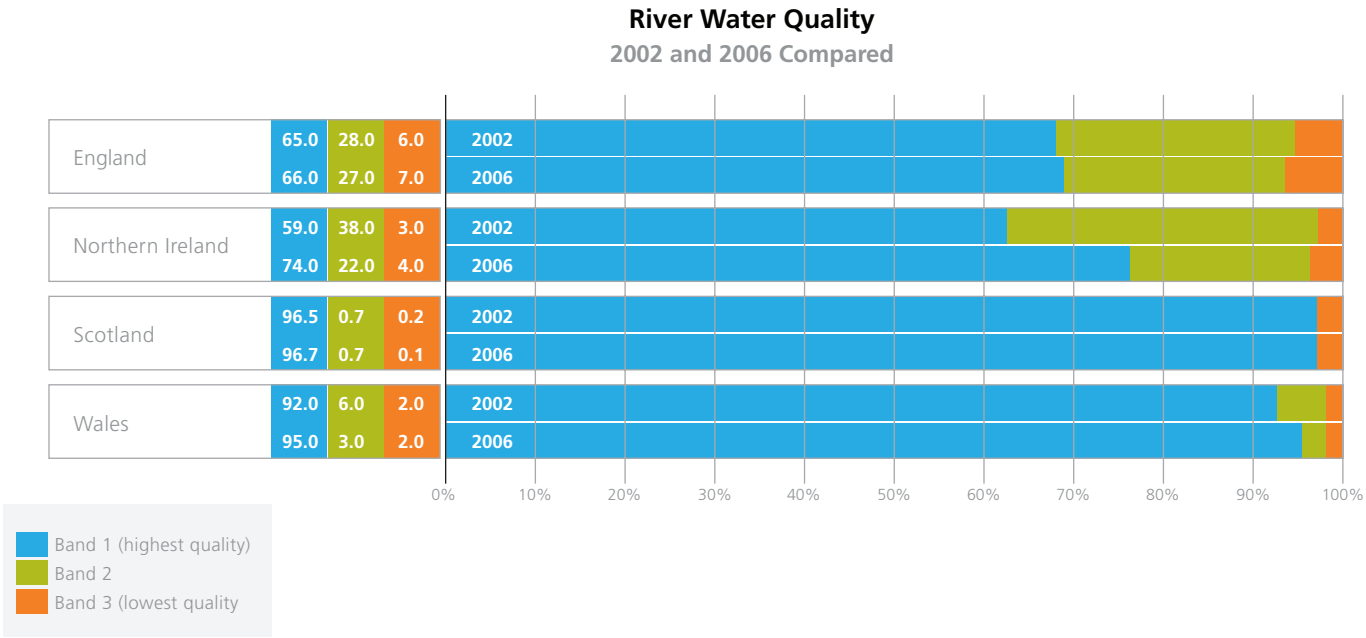
As an example of the scale of investments that can be required to meet standards, in Scotland, which currently has 83 bathing waters, over £100 million has been invested in the period 2002-2010 in waste water treatment and infrastructure to comply with the existing Bathing Water Directive. The need for such investments would not necessarily arise for all designated bathing waters, but only where further measures are needed to secure consistent compliance with Bathing Water Directive standards. This could mean either secondary and/or tertiary UV treatment where these levels are not currently provided or other improvements, such as reducing discharges from combined sewer overflows. Further funding has also been provided in Scotland to study the improvements required to achieve 'sufficient' classification under the revised Directive.

Further information on the Bathing Water Directive is on Defra's Bathing Water Directive webpage: www.defra.gov.uk/environment/quality/water/water-quality/bathing

River quality improvements

Over the last decade, general river quality in England, Northern Ireland, Scotland and Wales has progressively improved. Further improvements arising from on-going additional measures, such as the designation and protection of eutrophic sensitive areas, required under the Directive have begun to take effect. The chart below shows improvements in river quality by UK nation with the years 2002 and 2006 compared. It shows the lower quality categories make up a small proportion of river lengths. England shows a generally unchanged situation, Northern Ireland notable, and Scotland and Wales further improvements over already high quality waters.

Figure 4: Chart of river quality improvements – 2002 and 2006 compared



Quality band classifications used in the chart

Bands 1, 2 and 3 of the chart are generic descriptors for charting purposes only. Band 1 represents the highest quailty bands of the two UK quality classification systems.

- Values for England, Northern Ireland and Wales reflect the *chemical quality* metric of the *General Quality Assessmments (GQA)* system made up of: *Good* (A and B (shown by Band 1)), *Fair* (C and D (shown by Band 2)), *Poor* (class E), and *Bad* (class F), (latter two shown by Band 3).
- Scotland descriptors are: (i) Unpolluted, (ii) Unimpacted by pollution, (iii) Slightly polluted, (iv) Polluted and (v) Severely polluted. The first three, grouped in Band 1 of the chart, have the breakdown :

2002: Unpolluted (81.1), Unimpacted by pollution (10.7) and Slightly polluted (4.7).
2006: Unpolluted (85.2), Unimpacted by pollution (7.9) and Slightly polluted (3.6).
The Scottish data source includes a 'Not calculated 'percentage of 2.6 (rounded) for both the years compared, not included inthe chart.

Sewage sludge utilisation and disposal

The treatment of waste water has the objective of returning much cleaner waste water to the environment. A consequence of sewage treatment is that significant quantities of sewage sludge are generated. Sewage sludge is the residual organic matter and dead bacteria used in the treatment process or biosolids removed from the waste water being treated. In the past around a quarter of sewage sludge was either discharged to surface waters through pipes or disposed from ships at sea. The Directive required the cessation of these practices by 31 December 1998 and since then alternative re-use or disposal routes have had to be used. The higher standards of waste water treatment required by the Directive deadlines of the end of 1998, 2000 and 2005 also resulted in greater quantities of sewage sludge being produced. The changes to re-use and disposal routes are seen in Table 3 where the baseline of 1992 is contrasted with the situation in 2008 and 2010.

Table 3: Sewage sludge re-use and disposal routes – tonnes dry solids

Reuse or Disposal Route	Sludge Discharged to Surface Waters			Sludge Reused		Sludge Disposed			Total
	Pipelines	Ships	Others	Soil & Agriculture	Others	Landfill	Incineration	Others	
1992	8,430	273,158	–	440,137	32,100	129,748	89,800	24,300	997,673
2008	–	–	–	1,241,639	90,845	10,882	185,890	1,523	1,530,779
2010	–	–	–	1,118,159	23,385	8,787	259,642	2,863	1,412,836

Use of sewage sludge as a soil enhancer and fertiliser on agricultural land remains the environmentally favoured option, with around 80% being applied to agricultural land. The reutilisation of sewage sludge to land is regulated under the Sludge (Use in Agriculture) Regulations 1989 (as amended). A voluntary agreement known as the 'Safe Sludge Matrix' ensures that sludge is only recycled to certain crops and vegetation to avoid human health impacts from ingestion of pathogen-contaminated salad crops.

Increasingly the sewage sludge generated from treatment processes has undergone **anaerobic digestion** with around 75% of sewage sludge currently processed this way. Anaerobic digestion reduces the residual sewage solids that needs to be disposed of and generates the by-product of **biogas**, a renewable energy source. For smaller sewage sludge processing facilities the biogas collected is typically used to heat the digesters to improve the digestion process. At larger facilities, economies of scale mean biogas can be conveyed off-site for use in Combined Heat and Power plants to generate electricity for general use by export to the national grid. Technological developments also mean biomethane (processed biogas) can be injected into the national gas grid or used as a fuel for vehicles. Even when incinerated, sewage sludge can be used as fuel to generate energy. More information on sewage sludge reutilisation to agricultural land is available on Defra's website:
http://archive.defra.gov.uk/environment/quality/water/waterquality/sewage/sludge/index.htm

Investments

Waste water treatment, improvements to treatment and the ongoing maintenance of collection systems and waste water treatment plants and other sewerage infrastructure require significant capital construction and ongoing operational costs. The following sections set out investments in treatment provision and enhancements and sewerage infrastructure construction, maintenance and improvements, collectively described as 'sewerage services' in the UK nation tables below.

England

In England investments in sewerage services are determined through the five-yearly periodic review of water industry prices carried out by the Water Services Regulation Authority (Ofwat). Table 4 shows investments in the Directive's treatment enhancements and separately other drivers of treatment enhancements from 1990 to 2015.

Table 4: Investments in sewerage services – England

Period	UWWTD	Others	Total £m
1990-2000	3,600	6,000	9,600
2000-2005	2,600	2,000	4,600
2005-2010	1,300	1,800	3,100
2010-2015*	500	2,600	3,100
2010-2015* – infrastructure maintenance – all categories			5,300
Total			**26,100**

Except for 2010-2015 maintenance, figures are for treatment enhancements

*Forecast investments

As Table 4 does not include investments in network and waste water treatment plants maintenance from 1990 to 2010, actual investments to secure compliance will be higher than shown. The sensitive areas designated in England in 2011 are to be provided with tertiary treatment entailing new one-off capital costs estimated at around £40 million and annual operational costs of £3 million by the end of 2018 and are to be reflected in the 2015-2020 investment period following the periodic review to be conducted in 2014.

Northern Ireland

In Northern Ireland, through Social & Environment Guidance, the Northern Ireland Executive sets out its investment priorities for the water & sewerage industry price control period. These priorities form the basis of the Water Industry Price Control process which determines the level of funding Northern Ireland Water needs to efficiently maintain and enhance its water and sewerage infrastructure. The economic regulator's final determination then informs public expenditure bids for each period. Table 5 sets out investments in Northern Ireland from 1990 to 2013.

Table 5: Investments in sewerage services – Northern Ireland

Period	Treatment Infrastructure		Total £m
1990-1999	currently unavailable	currently unavailable	221
1999-2010	675	435	1,110
2010-2013*	111	65	176
Total			**1,506**

*Forecast investments

Scotland

In Scotland, funding of improvements is achieved through the Water Quality and Standards process. Table 6 sets out investments in sewerage services for the period 1996–2015. The UWWTD investment for 1996-2002 is made up of Public Private Partnership investment of £549 million. Only total investment for 2010-2015 is currently available.

Table 6: Investments in sewerage services – Scotland

Period	UWWTD	Others	Total £m
1996-2002	862	1,298	2,160
2002-2006	286	1,694	1,980
2006-2010	128	2,252	2,380
2010-2015*	currently unavailable	currently unavailable	2,500
Total			**9,020**

*Forecast investments

Wales

The five-yearly price review process conducted by Ofwat described above for England also applies to the Welsh water industry. Table 7 shows expenditure on sewerage services for the Directive and separately other drivers of treatment enhancements.

Table 7: Investments in sewerage services – Wales

Period	UWWTD	Others	Total £m
1990-2000	700	500	1,200
2000-2005	400	100	500
2005-2010	100	200	300
2010-2015*	–	100	100
2010-2015* – infrastructure maintenance – all categories			400
Total			**2,500**

Except for 2010-2015 maintenance, figures are for treatment enhancements

*Forecast investments

As Table 7 does not include investments in network and waste water treatment plants maintenance from 1990 to 2010, actual investments to secure compliance will be higher than shown.

Summary of UK sewerage services investments

Table 8 below summarises investments in sewerage services between 1990 and 2015 across the UK. Differences in the periods presented arise from differing investment planning periods between UK nations or availability of information during compilation of this report. Future editions of this report will seek to generally present investments from 1990, around the time the Directive was adopted, up to the latest available information of planned investments on all other directives requiring sewerage services investments, not just investments relating to the Directive.

Table 8: Summary of UK investments on sewerage services from 1990 to 2015

Summary	Period	£m
England	1990-2015	26,100
Northern Ireland	1990-2013	1,506
Scotland	1996-2015	9,020
Wales	1990-2015	2,500
Total		**39,126**

Sources: Ofwat, Northern Irish and Scottish Governments

Are you doing your bit? What we all can do...

We all contribute to pollution of the water environment, but we can also contribute to its protection by each of us taking responsibility to reduce our impacts. The following sections set out a selection of current initiatives that provide opportunities for us all to do our bit.

England

On 28 March 2012 the 'Love Your River' campaign was launched by Defra in partnership with the Environment Agency and key organisations such as The Wildlife Trusts, The National Trust, Waterwise, Keep Britain Tidy and water companies via the Water Efficiency Network. The campaign aims to raise public awareness of the link between river health and water use, so that people understand and value water and take action to improve their local rivers and the environment around them. There are actions we can take individually, such as having shorter showers, to collective actions through volunteering for local 'clean up' activities and restoration projects that will benefit the water environment. The 'Winnall Moors – Exemplar for the River Itchen' restoration project is a £1.3 million, five-year project that is currently developing the local nature reserve as an example of good practice in areas such as grazing, fishing and the education of local residents on the needs of wildlife. Further information on the 'Love Your River' campaign can be found at: www.defra.gov.uk/loveyourriver.

Northern Ireland

Northern Ireland Water's Education team has a number of Education and Awareness Campaigns, such as its 'Bag It & Bin It' campaign which promotes the disposal of sanitary material such as cotton buds, razors, disposable nappies etc in bins rather than flushing them down the toilet. The 'Bag It & Bin It' campaign is an on-going exercise with Education Officers actively engaging with schools, hospitals, nursing homes, libraries, mother and toddler and other community groups. Furthermore a 'Stop and Think, Not Down the Sink' campaign is targeted at business to highlight responsibilities such as the appropriate disposal of fats, oils and grease covered in more detail in the '**Fats, oils and grease**' section below. Northern Ireland Water is actively engaging with many stakeholders to raise awareness of inappropriate flushing, and participated in a beach cleanup awareness exercise. Further information on the campaign can be obtained from the Northern Ireland Water website: www.niwater.com. In addition Northern Ireland Water's Waterbus 'The Wonderful World of Water' visits primary schools teaching pupils about the water cycle, water for health, water conservation, and water and wastewater treatment.

Scotland

Scottish Water runs a number of customer campaigns to play a positive role in the lives and education of customers now and in future generations. Many Scottish Water campaigns aim to raise awareness of the simple but effective things customers can do in and around their homes to help do their bit to protect Scotland's natural environment. Scottish Water's 'Save your Drains' campaign provides customers with 'Bag It & Bin It' information and advice on how to help prevent blockages in drains through appropriate disposal of waste.

The Scottish Water education programme also helps to educate customers about the water cycle, water and waste water treatment, water and health, and how to help protect the environment by using water wisely and disposing of bathroom and kitchen waste properly. The Scottish Water volunteering programme also allows Scottish Water employees to participate in activities benefitting charities, the environment and communities across Scotland. Further information on Scottish Water customer campaigns and activities are on its website: www.scottishwater.co.uk.

Fats, Oils and Grease

Fats, oils and grease (FOG) disposed to sewers from restaurants, pubs, canteens and residential premises cause significant problems in sewerage infrastructure. FOG readily sticks to pipes and tunnels, where they solidify and build up into hard accretions that can constrict or even block sewers. Accretions of problem FOG need to be removed manually, a task that involves sewerage companies in considerable time, effort and money that is ultimately paid for by sewerage customers. We can each do our bit to help make better use of sewerage companies' resources, by filtering and reusing oils, using kitchen towels to dry-wipe oils and fats from pots, crockery and utensils as appropriate before washing them. Such measures can reduce use of washing up liquid and the potential environmental impact of phosphate used in detergents, which, as we have seen earlier, contributes to **eutrophication**. The UK water industry's umbrella body, Water UK, has produced guidance in collaboration with other organisations for reducing inputs of FOG to sewers from catering establishments, but the general principles apply equally to residential properties: http://www.water.org.uk/home/snap.

UK Urban Waste Water Treatment Directive maps
Figures 5 to 10: English maps

Figure 5: England – Environment Agency Anglian Region map

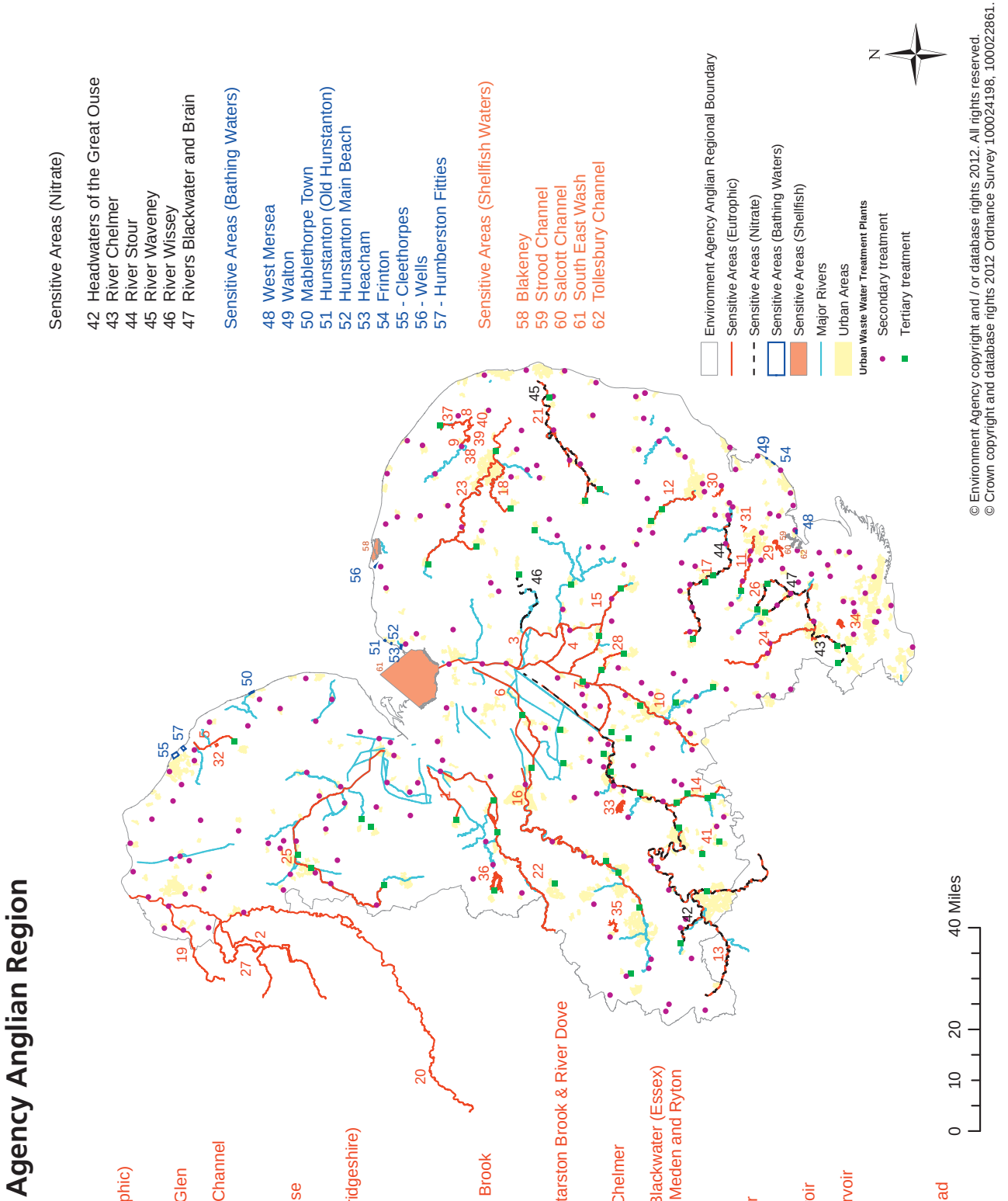


Figure 6: England – Environment Agency Midlands Region

Environment Agency Midlands Region

Sensitive Areas (Eutrophic)

Rivers
1 Badsey Brook
2 Bow Brook
3 Chesterfield Canal
4 Gilwiskaw Brook and River Mease
5 Gloucester and Sharpness Canal
6 Hyde Brook
7 Middle River Derwent
8 Rea Brook
9 River Amber, Westwood & Alfreston Brooks
10 River Anker
11 River Arrow
12 River Avon (Warwickshire)
13 River Blythe
14 River Chelt
15 River Derwent
16 River Devon and Car Dyke
17 River Erewash and Erewash Canal
18 River Itchen
19 River Leadon
20 River Salwarpe
21 River Sence
22 River Soar
23 River Sow and River Penk
24 River Stour & Smestow Brook
25 River Strine/Strine Brook
26 River Swift & Oxford Canal
27 River Teme
28 River Tern
29 River Trent
30 River Wreake
31 River Wye
32 River Wye
33 Rivers Idle, Maun, Meden and Ryton
34 River Cam (Gloucestershire)
35 River Frome

Lakes
36 Aqualete Mere
37 Kingsmill Reservoir
38 Staunton Harold
39 Attenborough Nature Reserve Central Lake
40 Attenborough Nature Reserve West Lake
41 Draycote Water
42 Ogston Reservoir

Sensitive Areas (Nitrate)

43 River Leam
44 Rivers Itchen

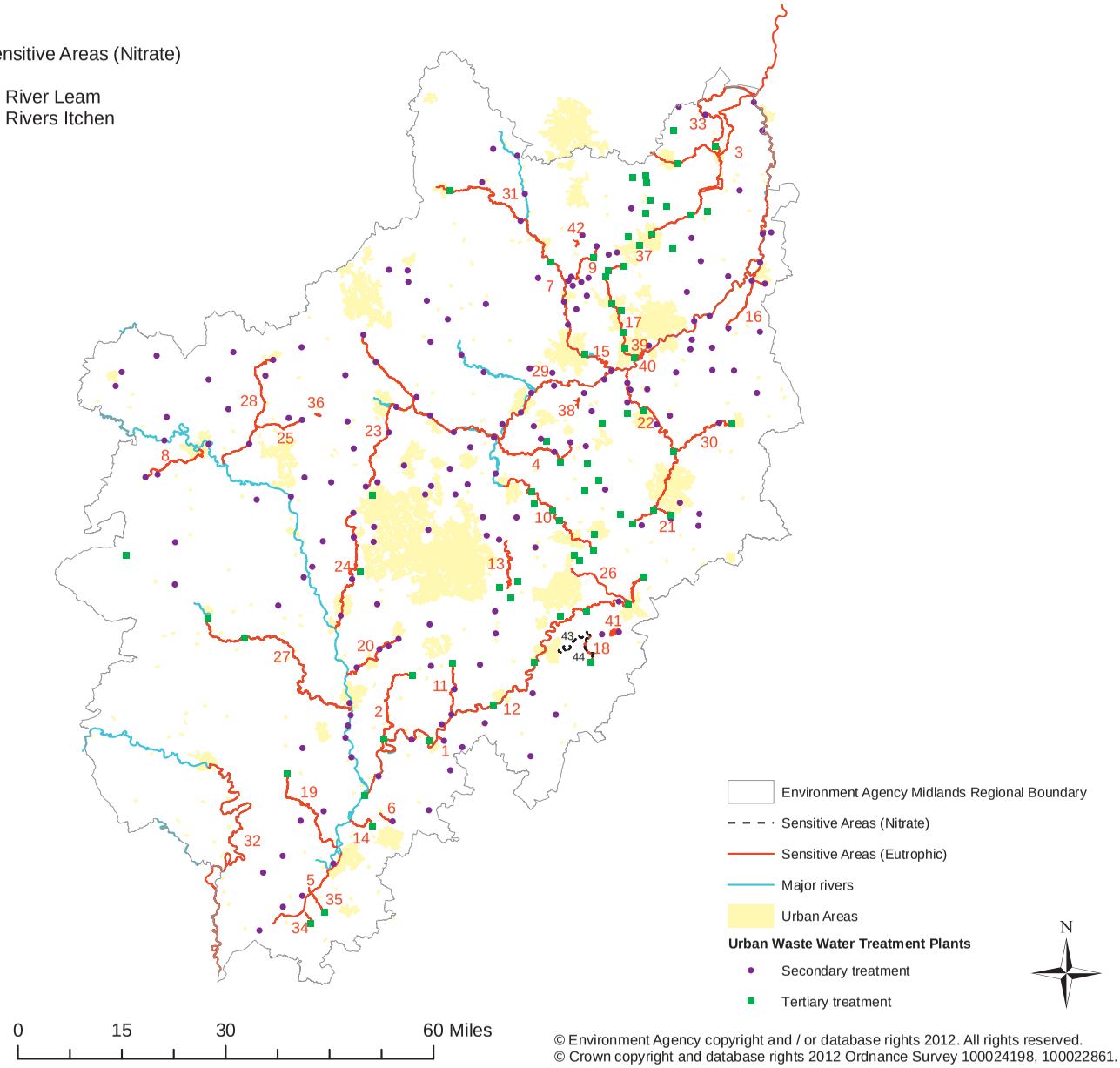


Figure 7: England – Environment Agency – North West Region map

Environment Agency – North West Region map

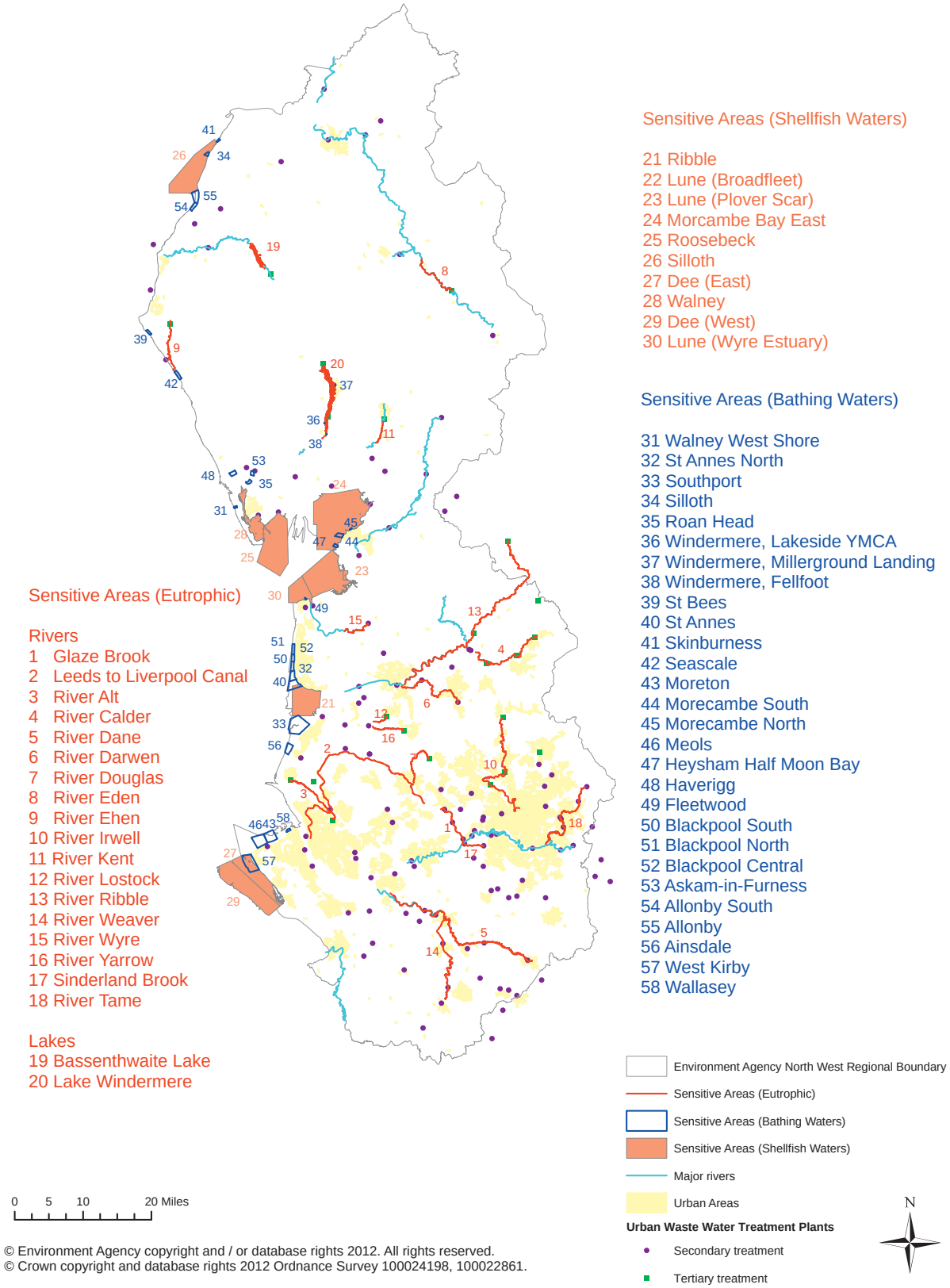


Figure 8: England – Environment Agency South East Region map

Environment Agency South East Region map

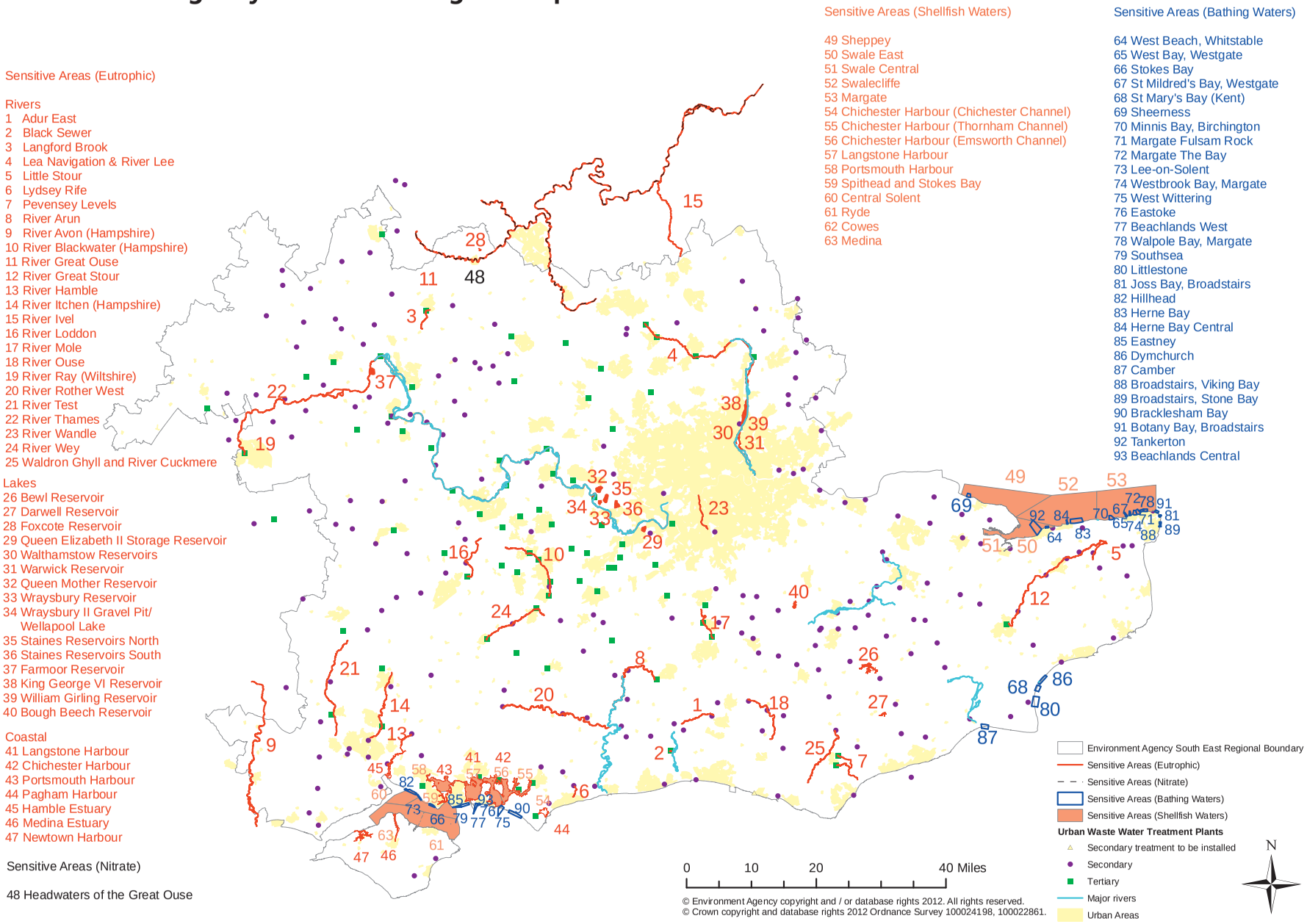


Figure 9: England – Environment Agency South West Region map

Environment Agency South West Region map

Sensitive Areas (Eutrophic)

Rivers
1 Cheddar-Yeo
2 East Looe (Liskeard)
3 River Avon (Bristol)
4 River Avon (Hampshire)
5 River Brue, Sheppey & Alham
6 River Cober and Loe Pool
7 River Creedy
8 River Ray (Wiltshire)
9 River Thames
10 River Tone
11 River Wylye
12 River Yeo
13 St. Austell River
14 Upper Bristol Avon

Coastal
15 Poole Harbour and Holes Bay
16 Truro Tresillian and Fal Estuary
17 Taw Estuary

Sensitive Areas (Shellfish Waters)

18 Poole Bay
19 Poole Harbour North
20 Poole Harbour South
21 Poole Harbour West
22 Dart
23 Salcombe_E
24 Bigbury and Avon
25 Yealm
26 Lynher_E
27 Fowey
28 Tresillian
29 Fal Estuary
30 Carrick Roads
31 Penryn
32 Helford River_E
33 Camel Estuary_E
34 Percuil
35 Exe Estuary_E
36 Fowey (Wisemans Reach)

Sensitive Areas (Bathing Waters)

37 Christchurch Highcliffe Castle
38 Christchurch Friar`s Cliff
39 Christchurch Mudeford Sandbank East
40 Lyme Regis Church Beach
41 Lyme Regis Cobb
42 Dawlish Coryton Cove
43 St Mary's Bay (Devon)
44 Mill Bay
45 Salcombe North Sands
46 Salcombe South Sands
47 Hope Cove
48 Mothecombe
49 Croyde Bay
50 Woolacombe Village
51 Barricane Bay, Woolacombe
52 Ilfracombe Tunnels Beach
53 Ilfracombe Capstone (Wildersmouth)
54 Ilfracombe Hele
55 Combe Martin
56 Plymouth Hoe West
57 Plymouth Hoe East
58 Seaton (Cornwall)
59 East Looe
60 Readymoney
61 Pentewan
62 Gorran Haven Little Perhaver
63 Gorran Haven (Vault)
64 Gyllyngvase
65 Swanpool
66 Maen Porth
67 Porthallow
68 Pollurian Cove
69 Trevaunance Cove
70 Crantock
71 Fistral
72 Towan
73 Mawgan Porth
74 Mother Ivey`s Bay
75 Harlyn Bay
76 Trevone Bay
77 Rock
78 Daymer Bay
79 Polzeath
80 Minehead Terminus
81 Dunster North West
82 Blue Anchor West
83 Burnham Jetty
84 Brean
85 Berrow North of Unity Farm
86 Weston-super-Mare Uphill Slipway
87 Weston Main
88 Swanage Central
89 Seatown
90 Poole Harbour Lake
91 Poole Harbour Rockley Sands
92 Seaton (Devon)
93 Sidmouth Jacobs Ladder
94 Sidmouth Town
95 Ladram Bay
96 Sandy Bay
97 Exmouth
98 Dawlish Town
99 Dawlish Warren
100 Thurlestone South
101 Thurlestone North
102 Bantham
103 Bigbury-on-Sea South
104 Westward Ho!
105 Saunton Sands
106 Instow
107 Lynmouth
108 Clevedon Beach
109 Porthleven West
110 Perranporth Village End
111 Porthtowan
112 Dartmouth Castle and Sugary Cove
113 Christchurch Avon Beach
114 Poole Sandbanks Peninsular
115 Trebarwith Strand
116 Crackington Haven

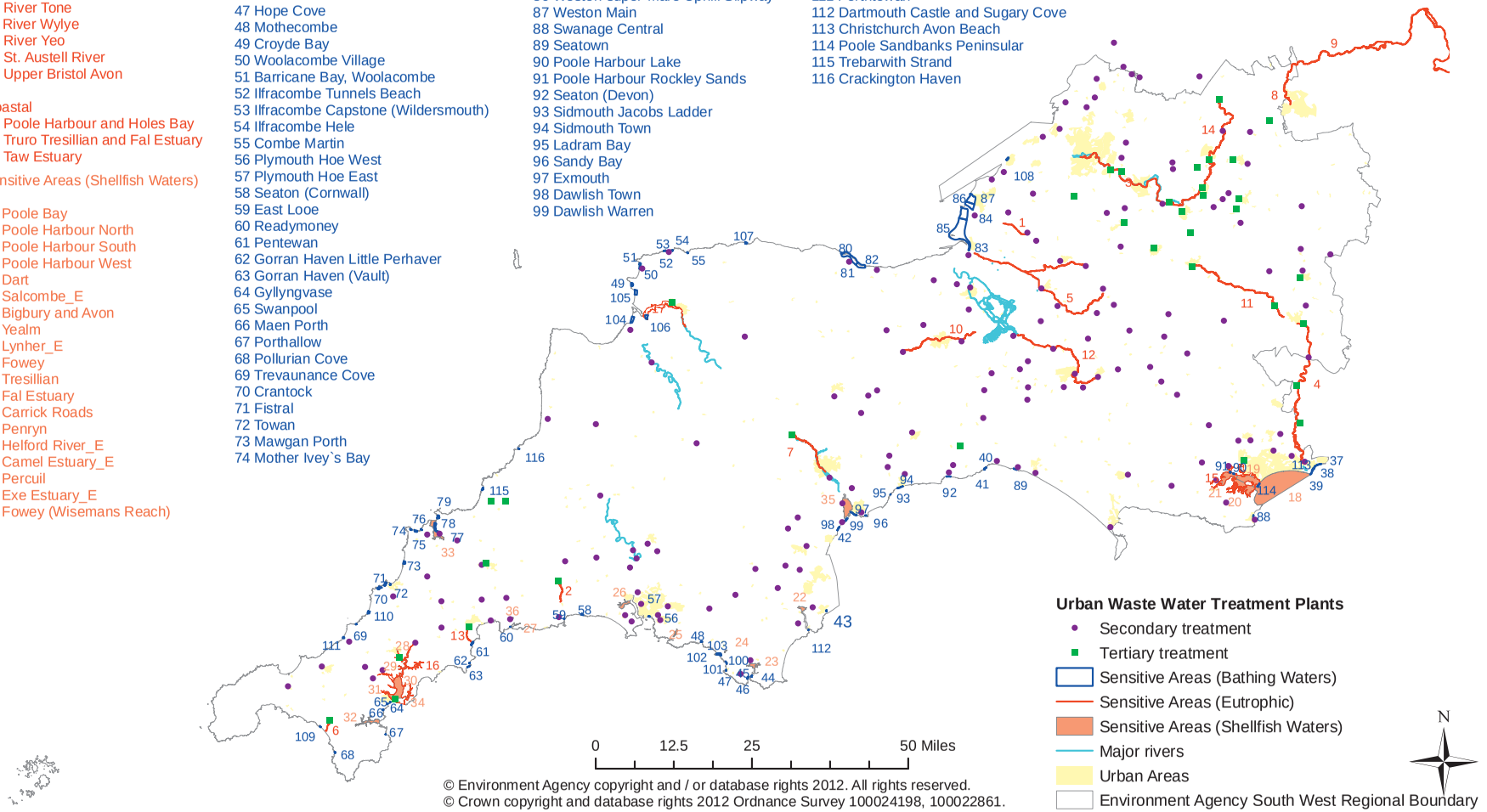


Figure 10: England – Environment Agency Yorkshire and North East Region map

Environment Agency Yorkshire and North East Region map

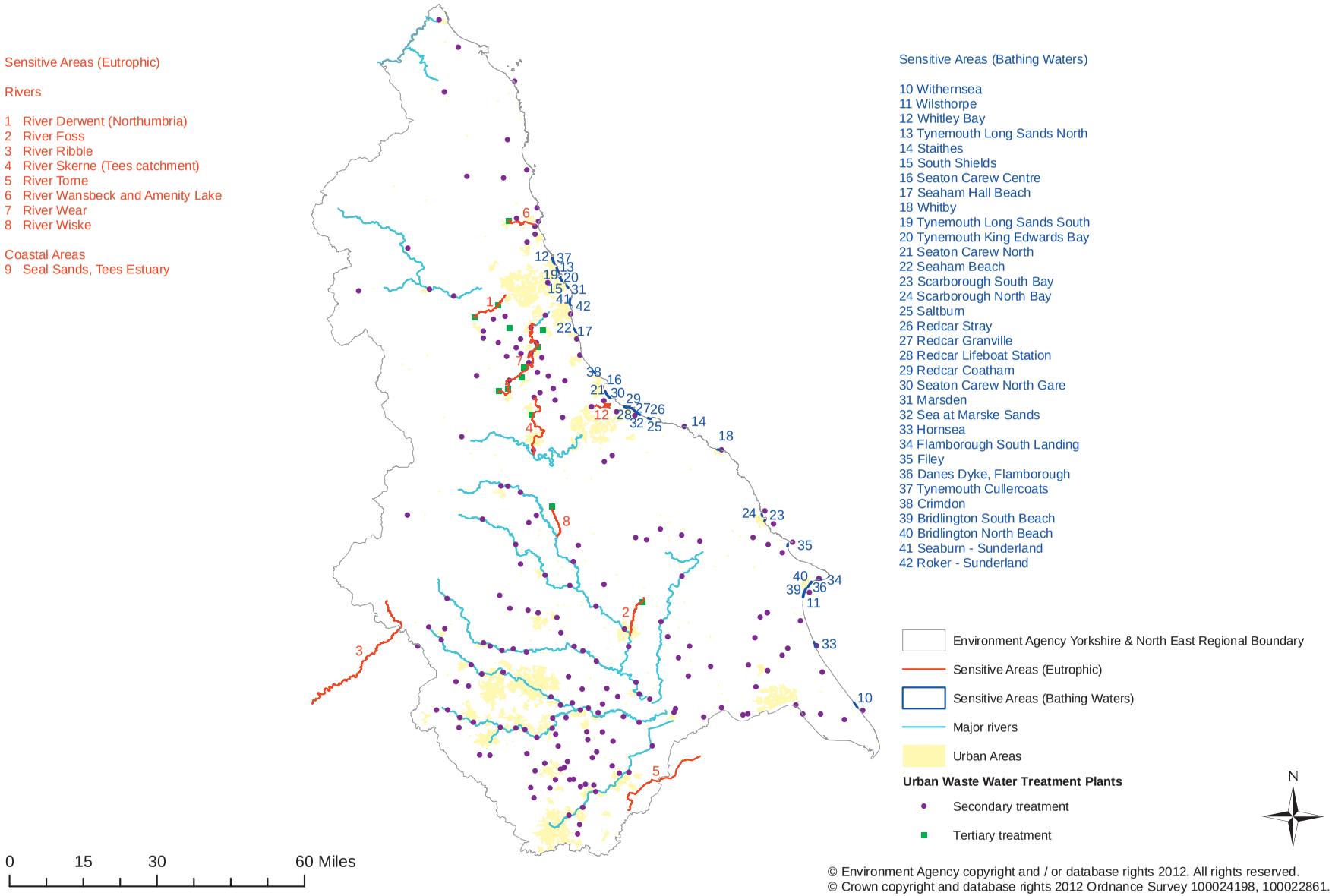
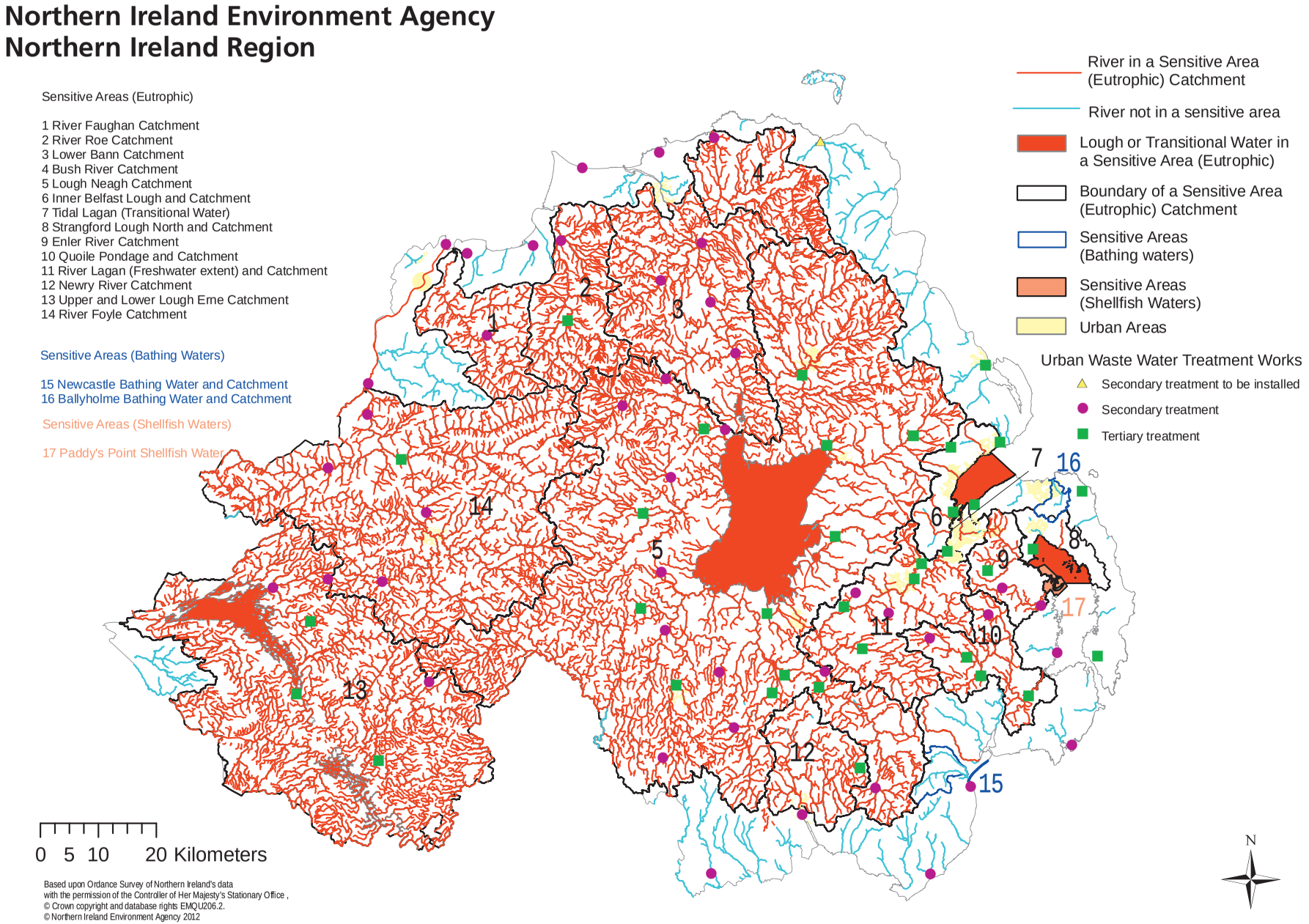


Figure 11: Northern Ireland map

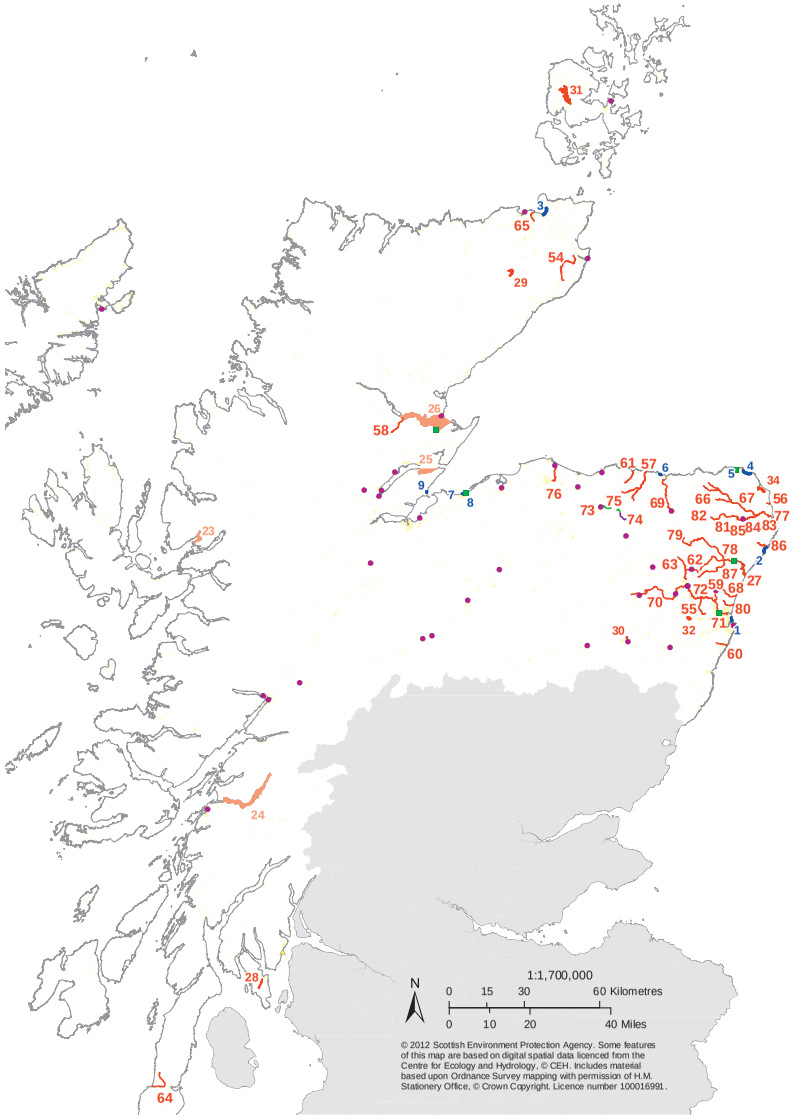


Figures 12 to 14: Scottish maps

NB Scottish maps reflect Article 15 spatial data reporting and submission guidelines rather than legal designations listed in the Direction from Scottish Government to SEPA.

Figure 12: Scotland – Scottish Environment Protection Agency – North Region map

Scottish Environment Protection Agency – North Region



Sensitive Areas (Eutrophic & Freshwater Fish) Rivers

54 Achairn Burn
55 Black Burn
56 Black Water - d/s St Fergus
57 Boyne Burn (including Burn of Corncairn)
58 Easter Fearn Burn
59 Elrick Burn - d/s Newmachar WWTP
60 Findon Burn
61 Fordyce Burn
62 Lochter Burn / Kings Burn
63 Lochter Burn / Kings Burn
64 Machrihanish Water
65 Murkle Burn
66 North Ugie Water - upper catchment
67 North Ugie Water - lower catchment
68 Potterton Burn
69 River Deveron - Turriff to tidal limit
70 River Don - Alford to Inverurie
71 River Don - Dyce to tidal limit
72 River Don - Inverurie to Dyce
73 River Isla - Keith
74 River Isla - d/s Shiel Burn
75 River Isla - d/s Keith to Shiel Burn
76 River Lossie - Waukmill to Arthurs Bridge
77 River Ugie - North/South confl to tidal limit
78 River Ythan - Methlick to Ellon
79 River Ythan - Fyvie to Methlick
80 South Mundurno Burn
81 South Ugie Water - Maud to Stuartfield
82 South Ugie Water - New Deer to Maud
83 South Ugie Water - Longside to Ugie confluence
84 South Ugie Water - Stuartfield to Longside
85 South Ugie Water - Stuartfield to Longside
86 Water Of Cruden
87 Youlie Burn / Bronie Burn

Sensitive Areas (Bathing Waters)

1 Aberdeen
2 Cruden Bay
3 Dunnet Bay
4 Fraserburgh (Philorth)
5 Fraserburgh (Tigerhill)
6 Inverboyndie
7 Nairn (Central)
8 Nairn (East)
9 Rosemarkie

Sensitive Areas (Shellfish Waters)

24 Loch Etive
25 Cromarty Bay
26 Dornoch Firth
23 Loch Kishorn, North West

Sensitive Area (Eutrophic) Estuary

27 Ythan Estuary

Sensitive Areas (Eutrophic) Lochs

28 Loch Fad
29 Loch More
30 Loch of Aboyne
31 Loch of Harray
32 Loch of Skene
33 Loch of Spiggie
34 Loch of Strathbeg

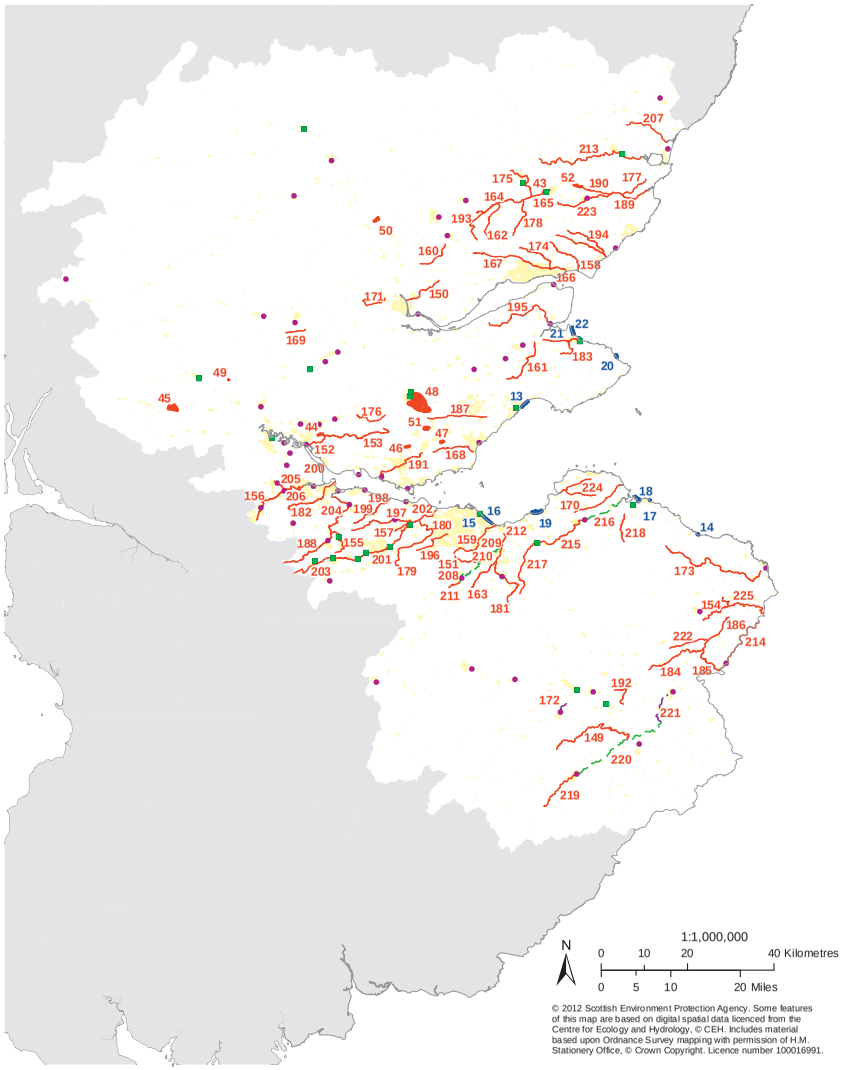
Sensitive Areas (Eutrophic)
Sensitive Areas (Freshwater Fish)
Sensitive Areas (Eutrophic & Freshwater Fish)
Sensitive Areas (Bathing Waters)
Sensitive Areas (Shellfish Waters)
Sensitive Areas (Eutrophic Lochs & Estuary)

Urban Waste Water Treatment Plants

Secondary Treatment to be installed
Secondary
Tertiary
Urban Areas

Figure 13: Scotland – Scottish Environment Protection Agency – South East Region map

Scottish Environment Protection Agency – South East Region



Sensitive Areas (Eutrophic & Freshwater Fish) Rivers

149 Ale Water (Woll Burn confluence to Teviot Water)
150 Annaty Burn
151 Bilston/Boghall Burn
152 Black Devon (Birkhill Plantation to Forth Estuary)
153 Black Devon (Source to Birkhill Plantation)
154 Blackadder Water (Howe Burn confluence to Whiteadder Water)
155 Boghead Burn/Bog Burn/Couston Water
156 Bonny Water/Red Burn
157 Brox Burn (Ryal Burn Confluence to River Almond)
158 Buddon Burn
159 Burdiehouse Burn/Swanston Burn
160 Burrelton Burn
161 Ceres Burn
162 Commerton Burn
163 Dalhousie Burn/Shiel Burn
164 Dean Water
165 Dean Water
166 Dighty Water
167 Dighty Water (Source to Fithie Burn confluence)
168 Dronachy Burn
169 Drummond Burn
170 East Peffer Burn
171 East Pow Burn
172 Ettrick Water
173 Eye Water
174 Fithie Burn
175 Gairie Burn
176 Gairney Burn
177 Gighty Burn
178 Glamis Burn
179 Gogar Burn (Source to Union Canal)
180 Gogar Burn (Union Canal to River Almond)
181 Gore Water/Middleton South Burn
182 Grange Burn
183 Kinness Burn (including Cairnsmill Burn)
184 Lambden Burn
185 Leet Water (Lambden Burn confluence to River Tweed)
186 Leet Water (Source to Lambden Burn confluence)
187 Lochty Burn
188 Logie Water/Barbauchlaw Burn
189 Lunan Water (Friockheim to Estuary)
190 Lunan Water (Rescobie Loch to Friockheim)
191 Lyne Burn
192 Maidenhall Burn
193 Meigle Burn
194 Monikie Burn (including Panlathymill Burn)
195 Motray Water
196 Murray Burn
197 Niddry Burn

Sensitive Areas (Bathing Waters)

13 Leven
14 Pease Bay
15 Portobello (Central)
16 Portobello (West)
17 Dunbar (East)
18 Dunbar (Belhaven)
19 Seton Sands
20 Kingsbarns
21 St. Andrews (East Sands)
22 St. Andrews (West Sands)

Sensitive Areas (Eutrophic) Lochs

35 Castle Semple Loch
43 Forfar Loch
44 Gartmorn Dam
36 Kilbirnie Loch
45 Lake of Menteith
28 Loch Fad
46 Loch Fitty
47 Loch Gelly
48 Loch Leven
37 Loch Lomond (South B

Sensitive Areas (Eutrophic & Freshwater Fish) Rivers

198 Pardovan Burn (d/s Bridgend to estuary)
199 Pardovan Burn/Haugh Burn /Riccarton Burn (Source to d/s Bridgend)
200 Pow Burn (Falkirk)
201 River Almond (Breich Water confluence to Maitland Bridge)
202 River Almond (Maitland Bridge to Cramond)
203 River Almond (Source to Foulshiels Burn confluence)
204 River Avon (Logie Water confluence to Estuary)
205 River Carron (Avon Burn to Bonny Water Confluence)
206 River Carron (Bonny Water confluence to Carron Estuary)
207 River North Esk (Confluence with Cruick Water to Estuary)
208 River North Esk (d/s Lead Burn confluence to Glencorse Burn confluence)
209 River North Esk (Elginhaugh to confluence with South Esk)
210 River North Esk (Glencorse Burn confluence to Elginhaugh)
211 River North Esk (Penicuik House to d/s Lead Burn confluence)
212 River South Esk (Gore Water to N Esk confluences)
213 River South Esk (White Burn confluence to estuary)
214 River Tweed (Coldstream to tidal limit)
215 River Tyne (Birns Water confluence to Haddington)
216 River Tyne (Haddington to Estuary)
217 River Tyne (Source to Birns Water confluence)
218 Sauchet Water
219 Teviot Water
220 Teviot Water
221 Teviot Water (lower)

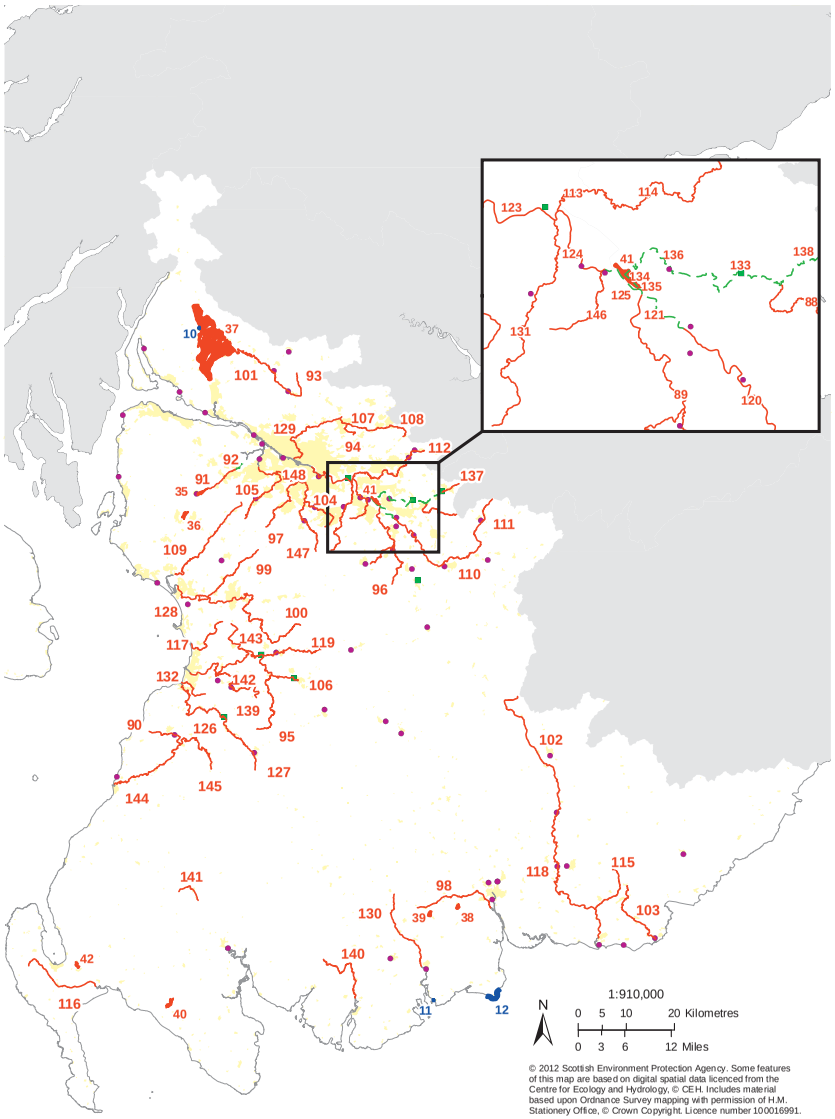
Sensitive Areas (Eutrophic)
Sensitive Areas (Freshwater Fish)
Sensitive Areas (Eutrophic & Freshwater Fish)
Sensitive Areas (Eutrophic Lochs & Estuary)
Sensitive Areas (Bathing Waters)

Urban Waste Water Treatment Plants

Secondary
Tertiary
Urban Areas

Figure 14: Scotland – Scottish Environment Protection Agency – South West Region map

Scottish Environment Protection Agency – South West Region



Sensitive Areas (Bathing Waters)

10 Luss Bay
11 Rockcliffe
12 Southerness

Sensitive Areas (Eutrophic) Lochs

35 Castle Semple Loch
36 Kilbirnie Loch
37 Loch Lomond (South Basin)
38 Lochrutton Loch
39 Milton Loch
40 Mochrum Loch
41 Strathclyde Loch
42 White Loch

Sensitive Areas (Eutrophic)
Sensitive Areas (Eutrophic & Freshwater Fish)
Sensitive Areas (Bathing Waters)
Sensitive Areas (Eutrophic Lochs)

Urban Waste Water Treatment Plants

Secondary
Tertiary

Urban Areas

Sensitive Areas (Eutrophic & Freshwater Fish) Rivers

88 Auchter Water
89 Avon Water (Powmillon Burn to River Clyde)
90 Barlewan Burn
91 Black Cart Water
92 Black Cart Water
93 Blane Water
94 Bothlin Burn (Garnkirk Burn to Luggie confluence)
95 Burnock Water
96 Cander Water/White Corse Burn
97 Capelrig/Auldhouse Burn
98 Cargen Pow /Bogrie Lane
99 Carmel Water
100 Cessnock Water
101 Endrick Water (d/s Blane Water)
102 Evan Water
103 Kirtle Water
104 Kittoch Water
105 Levern Water
106 Lugar Water
107 Luggie Water (Kelvin to Mollins Burn)
108 Luggie Water (u/s Mollins Burn)
109 Lugton Water
110 Mouse Water (Dippool Water to Clyde)
111 Mouse Water (u/s Dippool Water)
112 North Calder Water (d/s Hillend Reservoir to Shotts Burn)
113 North Calder Water (Luggie Burn to Clyde)
114 North Calder Water (Shotts Burn to Luggie Burn)
115 Pennyland Burn/Mein Water
116 Piltanton Burn
117 Pow Burn (Ayrshire)
118 River Annan (Threewaterfoot to Annan)
119 River Ayr (d/s Greenock Water)
120 River Clyde (Mouse Water to Carbans)
121 River Clyde (Mouse Water to Strathclyde Loch outflow)
123 River Clyde (North Calder to Tidal Weir)
124 River Clyde (Strathclyde Loch outflow to North Calder)
125 River Clyde (Strathclyde Loch outflow to North Calder)
126 River Doon (d/s Muck Water)
127 River Doon (u/s Muck Water)
128 River Irvine (Cessnock confluence to Tidal Weir)
129 River Kelvin (Glazert Water to Tidal Limit)
130 River Urr
131 Rotten Calder Water
132 Slaphouse Burn
133 South Calder Water (Auchter Water to Tillan Burn)
134 South Calder Water (Strathclyde Loch centreline)
135 South Calder Water (Strathclyde Loch outflow to River Clyde)
136 South Calder Water (Tillan Burn to Strathclyde Park)
137 South Calder Water (u/s Auchter Water)
138 South Calder Water (u/s Auchter Water)
139 Taiglum Burn
140 Tarff Water
141 Upper Cree
142 Water of Coyle (d/s Taiglum Burn)
143 Water of Fail
144 Water of Girvan (d/s Dailly)
145 Water of Girvan (Lindsayston Burn to Palmullan Burn)
146 Wellshaw /Earnock Burn
147 White Cart Water (above Kittoch conf)
148 White Cart Water (Kittoch Water to Hamills Weir)

Figure 15: Wales – Environment Agency Wales map

Environment Agency Wales

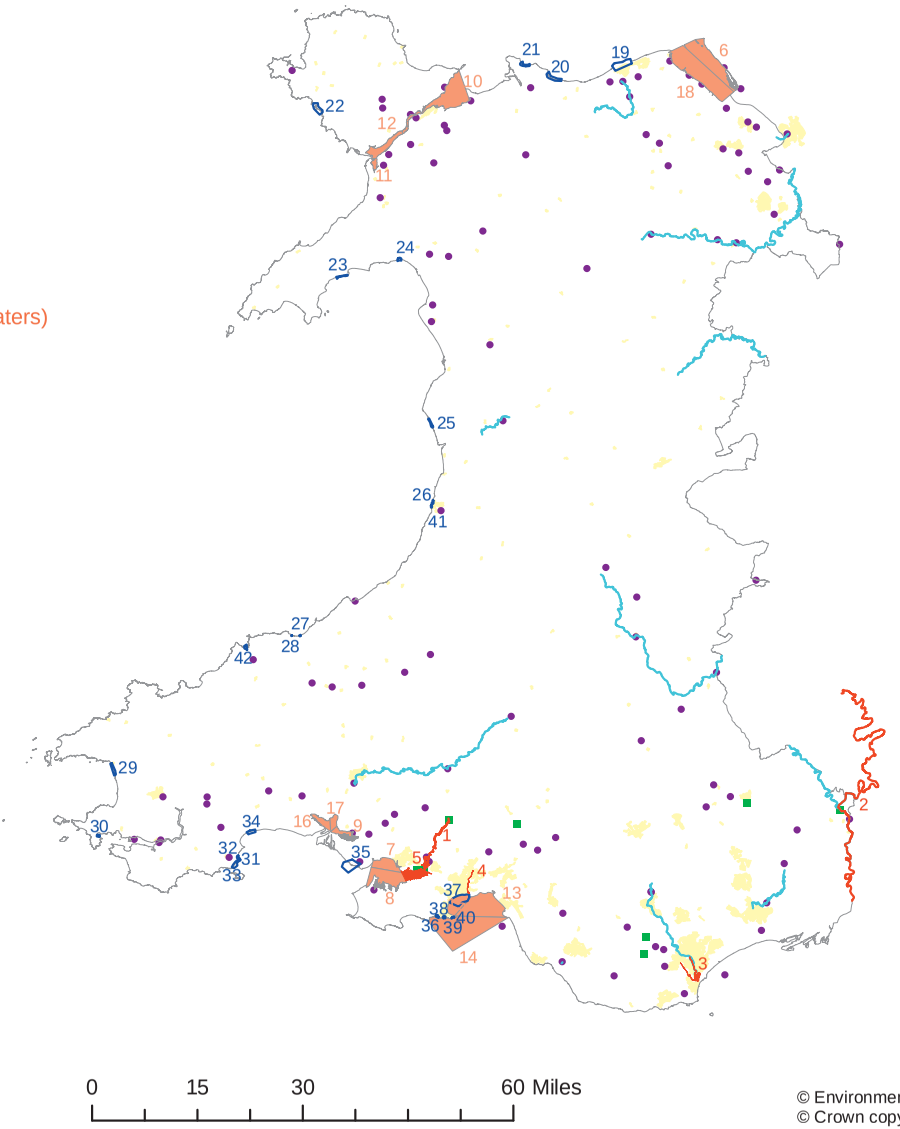
Sensitive Areas (Eutrophic)

Rivers
1 River Loughor
2 River Wye

Coastal
3 Cardiff Bay
4 Tawe Estuary
5 Lougher Estuary

Sensitive Areas (Shellfish Waters)

6 Dee (East)
7 Burry Inlet (North)
8 Burry Inlet (South)
9 Gwendraeth
10 Menai Strait (East)
11 Menai Strait (Foryd Bay)
12 Menai Strait (West)
13 Swansea Bay (East)
14 Swansea Bay (South)
15 Swansea Bay (West)
16 Taf
17 Tywi
18 Dee (West)



Sensitive Areas (Bathing Waters)

19 Rhyl
20 Colwyn Bay
21 Llandudno North Shore
22 Rhosneigr
23 Pwllheli
24 Criccieth
25 Tywyn
26 Aberystwyth North
27 Tresaith
28 Aberporth
29 Newgale
30 Dale
31 Castle Beach, Tenby
32 Tenby North
33 Tenby South
34 Amroth Central
35 Pembrey
36 Caswell Bay
37 Swansea Bay
38 Langland Bay
39 Limeslade Bay
40 Bracelet Bay
41 Aberystwyth South
42 Poppit West

Sensitive Areas (Eutrophic)
Sensitive Areas (Bathing Waters)
Sensitive Areas (Shellfish Waters)
Major rivers
Environment Agency Wales Boundary

Urban Waste Water Treatment Plants

Secondary treatment
Tertiary treatment
Urban Areas

N

Figure 16: Sewage treatment stages and sewage sludge re-use and disposal routes

Treatment	Process	Discharge Area	
	Waste water from domestic, commercial,and municipal properties and certain industries (generally food and drinks industries) carried by sewers to waste water treatment plants		
		Water body type	**From agglomerations of**
Preliminary	Grit removal by flow attenuation, screening of large solids	**'Appropriate treatment'**	
		Freshwater, Estuarine	<2,000 p.e.
		Coastal	<10,000 p.e.
		'Appropriate treatment' can be no treatment, or preliminary through to tertiary treatment depending on uses of receivng water and associated standards	
Primary	Settlement of suspended solids	**'less sensitive areas'**	
		Estuarine	between 2,000 and 10,000 p.e.
		Coastal	>10,000p.e.
Secondary	**Biological treatment** (bacterial breakdown) **(a)** activated sludge process (aerated, agitated bacterial culture liquor) **(b)** filter beds (waste water trickled over bacteria-coated aggregate)	**'normal areas'**	
		Freshwater, Estuarine	> 2,000 p.e.
		Coastal	>10,000 p.e.
Tertiary	Various types of tertiary treatment can be applied individually or combined to meet emission or water quality standards. Main types are: phosphate removal, nitrate removal (by chemical processes), disinfection (by UV irradiation or filter membranes). *Designation of 'eutrophic' and 'abstraction source protection' sensitive areas applies where discharges from >10,000 agglomerations affect the receiving waters. Other directives' waters identified as sensitive areas have no associated lower agglomeration size threshold; tertiary treatment protection alone qualifies them as sensitive areas.	**Discharges affecting 'sensitive areas'**	
		Freshwater, Estuarine, Coastal	>10,000 p.e. *

Sewage sludge from treatment processes
Re-use and disposal routes percentages

	2008	2010
Reuse	Agriculture **81.1**% Others **5.9**%	Agriculture **79.1**% Others **1.7**%
Disposal	Incineration **12.1%** Landfill **0.7**% Others **0.1**%	Incineration **18.4**% Landfill **0.6**% Others **0.2**%

Tables comparing agglomerations, treatment plants and compliance

Tables 9(a) to 11(b) compare agglomerations, treatment plants and compliance of plants for 2008 and 2010 and are based on data submitted to the European Commission under Article 15 of the Directive, which is largely concerned with reporting compliance of treatment plants with the Directive's emission standards. Submitted data are on the EC's website at the following links: **2008 data** | **2010 data**.

1. The tables are for active agglomerations and plants.
2. Tables include more than one agglomeration generating, and plant catering for, organic loads of less than 2,000 p.e. reported in 2008 or 2010.
3. Agglomeration discharges reported as discharging to the 'catchment of a sensitive area" are included under the 'sensitive areas' columns.
4. 't.p.e.' means 'total population equivalent' – see Glossary entry **1 population equivalent**.
5. Tabular and geographical data reported under Article 15 are required to conform to data submission formats. Submission format requirements mean that not all legally designated sensitive areas can currently be reported, with the consequence that agglomerations and treatment plants associated with the omitted designations are grouped under the 'normal' rather than the 'sensitive areas' heading in the tables below.

Table 9(a): Agglomerations as at end of 2008

Discharge area	Normal areas				Sensitive areas				Less sensitive areas				Totals all areas	
	Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters			
Size brackets (p.e.)	N°	t.p.e.	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e
2,000 10,000	399	1,797,059	17	106,236	612	2,759,254	2	11,154	–	–	–	–	**1,030**	**4,673,703**
10,001 15,000	59	723,447	17	205,417	103	1,265,224	0	0	–	–	–	–	**179**	**2,194,088**
15,001 150,000	185	9,139,704	61	3,635,654	315	13,935,018	6	321,722	–	–	–	–	**567**	**27,032,098**
150,001 and above	35	19,534,100	10	3,100,164	36	12,782,197	3	947,483	–	–	–	–	**84**	**36,363,944**
Totals for categories	**678**	**31,194,310**	**105**	**7,047,471**	**1,066**	**30,741,693**	**11**	**1,280,359**	**0**	**0**	**0**	**0**	**1,860**	**70,263,833**

Table 9(b): Agglomerations as at end of 2010

Discharge area	Normal areas				Sensitive areas				Less sensitive areas				Totals all areas	
	Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters			
Size brackets (p.e.)	N°	t.p.e.	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e
2,000 10,000	410	1,799,785	16	108,597	616	2,734,329	1	4,743	–	–	–	–	**1,043**	**4,647,455**
10,001 15,000	63	770,394	15	182,068	111	1,354,960	0	0	–	–	–	–	**189**	**2,307,422**
15,001 150,000	184	9,064,922	62	3,606,746	312	13,722,297	6	338,839	–	–	–	–	**564**	**26,732,804**
150,001 and above	34	19,169,205	10	3,002,867	35	12,475,968	3	990,968	–	–	–	–	**82**	**35,639,008**
Totals for categories	**691**	**30,804,305**	**103**	**6,900,278**	**1,074**	**30,287,555**	**10**	**1,334,550**	**0**	**0**	**0**	**0**	**1,878**	**69,326,689**

Table 10(a): Treatment plants at end of 2008

Discharge area	Normal areas				Sensitive areas				Less sensitive areas				Totals all areas	
	Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters			
Size brackets (p.e.)	N°	t.p.e.	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e
2,000 10,000	415	1,882,863	17	93,928	601	2,687,618	0	0	–	–	–	–	**1,033**	**4,664,409**
10,001 15,000	59	723,447	18	215,933	102	1,254,708	0	0	–	–	–	–	**179**	**2,194,088**
15,001 150,000	194	9,509,542	63	3,831,173	306	13,429,766	5	261,617	–	–	–	–	**568**	**27,032,098**
150,001 and above	34	19,008,689	10	3,100,164	36	12,973,608	2	680,993	–	–	–	–	**82**	**35,763,454**
Totals for categories	**702**	**31,124,541**	**108**	**7,241,198**	**1,045**	**30,345,700**	**7**	**942,610**	**0**	**0**	**0**	**0**	**1,862**	**69,654,049**

Table 10(b): Treatment plants at end of 2010

Discharge area		Normal areas				Sensitive areas				Less sensitive areas				Totals all areas	
		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters			
Size brackets (p.e.)		N°	t.p.e.	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e
2,000	10,000	422	1,864,711	26	127,998	594	2,633,252	1	0	–	–	–	–	**1,043**	**4,625,961**
10,001	15,000	65	802,656	16	194,730	110	1,337,733	0	0	–	–	–	–	**191**	**2,335,119**
15,001	150,000	190	9,288,321	65	3,833,156	302	13,323,442	5	272,237	–	–	–	–	**562**	**26,717,156**
150,001	and above	33	18,695,462	10	2,993,388	36	12,987,085	2	724,478	–	–	–	–	**81**	**35,400,413**
Totals for categories		**710**	**30,651,150**	**117**	**7,149,272**	**1,042**	**30,281,512**	**8**	**996,715**	**0**	**0**	**0**	**0**	**1,877**	**69,078,649**

11(a): Compliant plants at end of 2008

Discharge area		Normal areas				Sensitive areas				Less sensitive areas				Totals all areas	
		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters			
Size brackets (p.e.)		N°	t.p.e.	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e
2,000	10,000	396	1,781,301	15	90,545	590	2,637,017	0	0	–	–	–	–	**1,001**	**4,508,863**
10,001	15,000	58	710,022	13	155,224	101	1,243,923	0	0	–	–	–	–	**172**	**2,109,169**
15,001	150,000	191	9,365,054	57	3,321,572	298	13,044,975	5	261,617	–	–	–	–	**551**	**25,993,218**
150,001	and above	30	16,789,042	10	3,100,164	36	12,973,608	2	680,993	–	–	–	–	**78**	**33,543,807**
Totals for categories		**675**	**28,645,419**	**95**	**6,667,505**	**1,025**	**29,899,523**	**7**	**942,610**	**0**	**0**	**0**	**0**	**1,802**	**66,155,057**
														Compliant plant numbers and p.e. as % of Table 10(a) for 2008	**96.8%**	**95.0%**

11(b): Compliant plants at end of 2010

Discharge area		Normal areas				Sensitive areas				Less sensitive areas				Totals all areas	
		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters		Fresh and estuarine waters		Coastal waters			
Size brackets (p.e.)		N°	t.p.e.	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e	N°	t.p.e
2,000	10,000	418	1,834,130	23	122,661	589	2,612,915	1	0	–	–	–	–	**1,031**	**4,569,706**
10,001	15,000	65	802,656	12	145,314	109	1,326,615	0	0	–	–	–	–	**186**	**2,274,585**
15,001	150,000	186	9,049,976	60	3,448,909	300	13,220,818	5	272,237	–	–	–	–	**551**	**25,991,941**
150,001	and above	32	18,070,084	10	2,993,388	36	12,987,085	2	724,478	–	–	–	–	**80**	**34,775,035**
Totals for categories		**701**	**29,756,845**	**105**	**6,710,273**	**1,034**	**30,147,434**	**8**	**996,715**	**0**	**0**	**0**	**0**	**1,848**	**67,611,267**
														Compliant plant numbers and p.e. as % of Table 10(b) for 2010	**98.5%**	**97.9%**

Key organisations and information links

Government Departments

- Department for Environment, Food and Rural Affairs — www.defra.gov.uk
- Department of the Environment for Northern Ireland — www.doeni.gov.uk
- Scottish Government — www.scotland.gov.uk
- Welsh Government — www.wales.gov.uk

Environmental Regulators

- Environment Agency for England — www.environment-agency.gov.uk
- Northern Ireland Environment Agency — www.doeni.gov.uk/niea
- Scottish Environment Protection Agency — www.sepa.org.uk
- Environment Agency Wales — www.environment-agency.gov.uk/cy

Umbrella body for UK water supply and sewerage services providers

- Water UK — www.water.org.uk*

* includes links to all UK sewerage undertaker websites

Link to European Union website page of the Directive

- http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31991L0271:EN:NOT

Links to UK legislation transposing the Directive on Defra's website

- www.defra.gov.uk/environment/quality/water/sewage/sewage-treatment

Glossary

Except where indicated 'the Directive', 'Articles', 'Annexes' and 'Table(s)' refer to the Urban Waste Water Treatment Directive	
1 population equivalent	'1 Population Equivalent' is the unit of measure employed in the Directive for assessing the polluting potential of waste water discharges. 'Population' does not refer to a population headcount of communities. It is defined in the Directive as: *'1 p.e. (population equivalent)' means the organic biodegradable load having a five-day biochemical oxygen demand (BOD5) of 60 g of oxygen per day.* This means the oxygen used, largely by bacterial organisms, in breaking down the organic matter in waste water. The use of 'equivalent' is therefore a proxy for any organic matter, not just that arising from human metabolism, that when broken down by bacterial cultures utilises dissolved oxygen. The p.e. of discharges, sensitivity of receiving waters to discharges, and whether discharges are made to fresh, estuarine or coastal waters are used to determine the treatment to be provided, as in general, confined freshwaters provide less dilution than either estuarine or coastal waters, and estuarine waters provide less dilution than coastal waters. The sensitivity of waters to discharges, such as if they are impacted by excess nutrients in discharges, may also need to be considered. See Article 2(6).
Agglomeration	An agglomeration is a community of homes, shops, hospitals, offices etc, and generally food and drinks industries which are sufficiently concentrated for their waste water to be collected and conveyed for treatment at a waste water treatment works. See Article 2(4).
Anaerobic digestion	'Anaerobic' means 'without oxygen'. Processing of sewage sludge using this process refers to the use of bacterial cultures in the absence of oxygen to break down organic matter.
Appropriate treatment	The term used in the Directive to refer to the waste water treatment applicable to smaller communities. It can be involve processes* and/or disposal systems that ensure receiving waters meet water quality objectives set by environmental regulators can potentially mean no treatment to tertiary treatment. See Articles 2(9) and 7. **Septic tanks, rotating biological contactors, trickle filters, reed beds etc.*
Bathing Water Directive	Introduced in 1975 to help protect bathers (in identified waters) from the harmful bacteria and viruses arising from sewage discharges largely. It sets microbiological and physico-chemical quality requirements for identified bathing waters. A revised Bathing Water Directive was adopted in March 2006 requiring higher water quality standards than the 1975 Bathing Water Directive.
Biochemical oxygen demand (BOD)	A widely used measure of polluting potential – BOD is a measure of oxygen use or 'demand' of bacteria and other organisms breaking down the biodegradable load present in waste water. BOD is the basis for deriving a community's **population equivalent**. See Article 2(6) and Annex I, Table 1.
Biodegradation	The chemical deconstruction of organic matter by largely by bacteria, fungi and other organisms. When biodegradation occurs in the water environment dissolved oxygen is utilised generally through bacterial action. If acting on significant amounts of organic matter, such as that present in untreated waste water, the process rapidly deoxygenates waters and can lead to fish and invertebrate deaths.

Biodiverse, biodiversity,	Biodiverse generally refers to the normal diversity of plants and/or animals inhabiting an ecosystem unimpacted by human activities or other external factors detrimentally affecting it. It may not always mean that ecosystems contain a large number of species and numbers within species as some ecosystems can naturally contain few species and individuals, such as naturally nutrient poor upland lakes. See **Eutrophication** for nutrient status classifications.
Biogas	Biogas is the gas that is produced from the decay or bio-degradation of organic matter in the absence of oxygen. An important constituent of biogas is methane which is a renewable energy source that can be burned for direct use of the heat energy or to generate electricity.
Diffuse pollution	Pollution not arising from a specific, identifiable point. Agricultural land and brownfield sites are often cited as sources of diffuse pollution. Contrasts with **Point source pollution**.
Discharge authorisation	A generic term to refer to documentary authorisation issued by environmental regulators allowing emissions to be made to the environment. It is the regulatory, or legal, mechanism for controlling polluting emissions to the environment. Emissions are discharges of continuous treated discharges from waste water treatment plants, or, lesser treated or untreated intermittent discharges from trunk sewerage combined sewer overflows, treatment plant storm tanks, or pumping station emergency overflows. Different terms are used to refer to these documents in the UK: *Environmental Permits* in England and Wales; *Water Order Consents* in Northern Ireland; *Authorisations* in Scotland. Authorisations for treatment plant discharges typically identify the discharge (or outfall) location, concentration limits (standards) for controlled **parameters**, such as **biochemical oxygen demand**, suspended solids, ammonia, toxic metals and hazardous substances.
Ecosystem	A system made up of living organisms (bacteria, fungi, plants and animals), and the non-living physical characteristics of the environment (water, soil, latitude, elevation, water depth, light and temperature regimes), within, and with which, the living organisms interact.
Effluent	Generally, the treated waste water discharged from a sewerage system. Effluent from treatment plants is typically sampled and analysed to ensure discharged water complies with standards set in **discharge authorisations**. Where percentage reduction standards for parameters are to be achieved, effluent is sampled in conjunction with **influent** to enable reductions to be measured.
Environmental regulator	A generic term referring to the organisations responsible for controlling polluting emissions to the environment and monitoring of environmental waters to meet water quality standards or objectives. These are the: *Environment Agency* in England; *Northern Ireland Environment Agency, Scottish Environment Protection Agency; Wales Environment Agency.*
Estuarine	Refers to estuaries. The term 'transitional waters' was introduced in the Water Framework Directive to refer to waters transitioning between fully fresh to fully saline waters.

Eutrophication	Naturally occurring eutrophication is usually the beneficial enrichment of the environment by various mechanisms such as animal and plant decay, mineral and nutrient deposition from rock weathering and soil erosion, nitrogen-fixing by bacteria or lightning. The natural state of environments with low to high nutrient levels (their trophic status) are classed as: oligotrophic (low), mesotrophic (medium), eutrophic (high). Ecosystems associated with these naturally arising trophic states can be adversely impacted by nutrient inputs from human activities. For example, small inputs of nutrients to oligotrophic ecosystems can cause more damage than larger inputs to a mesotrophic environment and so on. Undesirable eutrophication can arise from human activities. In the context of the Directive eutrophication is the process to which waters are subject when excessive inputs of nutrients, specifically nitrogen and/or phosphorus compounds in waste water discharges, cause accelerated growth of algal and higher forms of plant life and a degradation of water quality, resulting in an imbalance in the range of plant and animal species expected for pristine ecosystems. 'Eutrophic' describes the status of waters chronically impacted by excessive nutrient inputs (for that ecosystem) from human activities. Eutrophic waters may usually be populated by plant and algal species that are better able to utilise excess nutrients and that are more tolerant of poor quality water arising from eutrophication, (such as low oxygen or light levels), and so outcompete other species. See Article 5 and Annex II (A)(a).
Hydromorphological type	Hydromorphology is a term introduced for implementation of the Water Framework Directive to refer to the geomorphological characteristics and processes that distinguish and are associated with different water body types. At its most basic level of description riverine, **lacustrine**, estuarine and coastal waters represent four hydromorphological water body types. Sub-categories of these four basic morphologies may be used to differentiate between for example, clear, nutrient poor and generally pollution free upland rivers and lakes as against turbid, nutrient enriched and generally more polluted lowland waters.
Influent	Untreated waste water entering a waste water treatment plant. Various measurements of influent can be undertaken such as volume, concentrations of controlled substances that help with management of waste water flows through plants and control of treatment processes needed to achieve percentage reduction standards for parameters in discharges.
Lacustrine	Is a term that refers to lakes, much as estuarine refers to estuaries.
Less sensitive area	A 'less sensitive area' can be an estuarine, or coastal water, (or both) designated for the purposes of the Directive as having characteristics of good water and oxygen exchange and not subject to eutrophication or low oxygen levels. Discharges of a size that would receive secondary treatment if made to **normal waters** can receive a minimum of primary treatment, if (i) they are made to less sensitive areas, and (ii) comprehensive studies demonstrate there would be no adverse environmental impacts on the receiving waters from such discharges. See Articles 6, 8(5) and Annex II (B).
Mandatory standards	Generally, the minimum standards for emissions or environmental water quality required to comply with legislation.
More stringent treatment	Term used in Article 5(2): "… *more stringent treatment than that described in Article 4*". As Article 4 covers secondary treatment, more stringent in effect means tertiary treatment. Annex II (A)(c) of the Directive uses the term '*further treatment*…' to refer to tertiary treatment.

Normal waters	Waters not designated as either 'less sensitive areas' or 'sensitive areas' are by default, 'normal waters", and can be inland, estuarine (transitional) or coastal waters. Large discharges to normal waters receive secondary treatment. See also **less sensitive areas** and **sensitive areas**.
Parameter	In the context of waste water treatment and a **discharge authorisation** a parameter is a pollutant present in waste water that is to be controlled through relevant treatment, such as UV light irradiation to destroy bacterial or viral contaminants. Examples of other parameters that may need to be controlled are: **BOD**, named toxic metals or nutrients or sewage litter.
Pathogen	Disease causing agent, more generally referring to viruses, bacteria and protozoa, but can include microscopic invertebrates, fungi and alga.
Point source pollution	Pollution arising from specific identifiable points, such as the end of pipes discharging waste water. Contrasts with **Diffuse pollution**.
Preliminary treatment	The simplest treatment that waste water arriving at treatment plants can have. It generally involves removal of grit and gravel by slowing flows down so such matter is deposited in grit traps. After de-gritting waste water is often screened to remove rags and other large solids, and less commonly, maceration, to reduce the size of remaining solids.
Primary treatment	Primary treatment involves the passive and/or chemically-enhanced process of settlement of suspended solids not removed by preliminary treatment. The Directive sets percentage reduction figures for biochemical oxygen demand of the influent by at least 20% and a reduction in total suspended solids in the influent by at least 50% before discharge to receiving waters. Discharges from agglomerations to inland and estuarine waters above 2,000 p.e and coastal discharges above 10,000 p.e. to **normal waters** receive secondary treatment with more stringent **BOD** standards. Primary treatment standards are therefore generally intended to apply to discharges made to **less sensitive areas** provided comprehensive studies demonstrate a minimum of primary treatment would not impact the environment. See Article 2(7).
Pumping station	Sewerage systems usually rely on gravity to convey sewage to treatment plants, and sewers are constructed with gradients to achieve that. However, to avoid very deep sewers pumping stations are used to pump waste water to sewers nearer the surface so it can to continue its journey to treatment plants. They may also be used to pump waste water past low-lying regions such as valleys, depressions etc.
Saline	When applied to environmental waters a term that means waters with high concentrations of salt generally coastal and marine waters.
Salinity	Refers to the 'saltiness' or salt content of waters, where 'low salinity' or 'high salinity' indicating low and high salt concentrations. The term 'salinity gradient' is typically used to describe the degree (rapidity) of change in the concentration of salt between freshwaters and saline coastal or marine waters.
Secondary treatment	Secondary treatment is the biological treatment of waste water. It generally involves use of bacterial cultures to break down biodegradable matter in waste water. The objective of secondary treatment is to reduce the **BOD** of waste water to avoid chronic oxygen depletion in receiving waters, the immediate and most damaging effect of untreated sewage discharges to the environment. Various processes are used to achieve BOD reductions, such as: aeration of waste water with bacterial culture sludges to accelerate biodegradation of organic matter, often used for larger communities; trickle filter beds containing aggregate covered with bacterial cultures to maximise the surface area over which waste water is trickled, used for small to medium size communities. See Article 4 and Annex I, Table 1.

Sensitive area	A 'sensitive area' is a legally designated body of water. There are three criteria for their designation with the objective of (a) protecting water ecosystems from excessive nutrients; (b) protecting abstraction source waters from high nitrate levels and (c) 'flagging' other directives' waters that require tertiary treatment to achieve their parent directives' quality requirements. The common thread is that whatever the criterion, sensitive areas receive tertiary treatment protection from impacting discharges. See Article 5 and Annex II (A) (a), (b) and (c).
Sewage	The more commonly used term to refer to '*urban waste water*'. In general this report uses the term '*waste water*'. See also the 'Sewerage' entry below.
Sewage litter	The artificial, manufactured, solid matter present in waste water, such as cotton-buds, condoms, sanitary-ware, disposable nappies, razors, safety-pins and many other items that have been flushed down toilets or put down drains and manholes. Sewerage systems were never designed to deal with such matter which can affect the performance of treatment systems and end up in environmental waters.
Sewage solids	A term which includes sewage litter but also, usually, visible faecal matter, vegetable and animal matter flushed to sewers from domestic and commercial premises or from surface drainage.
Sewerage	Generally, a term to describe the network, or system, of pipes, and for larger systems, also tunnels, that collect waste water; their receiving drains, manholes, pumping stations, combined sewer or emergency overflows, screening chambers and waste water treatment plants. Sewerage ends at the point of discharge of treated or untreated waste water to the environment. In technical UK usage 'sewage' and 'sewerage' are distinctly different, but is sometimes erroneously used interchangeably. In correct UK usage, sewage *flows through* sewerage.
Sewerage undertakers	A generic term used to describe the organisations responsible for the collection and treatment of waste water, and for the construction and maintenance of associated sewerage infrastructure.
Suspended solids	This is a term used to describe the matter, both organic and artificial, such as **sewage litter**, suspended in water. See **Sewage solids** also.
Tertiary treatment	Treatment provided after preliminary, primary and secondary treatment. It is provided to address a variety of polluting agents so can take a variety of forms such as ultra-violet light irradiation (UV treatment), microfiltration or chemical dosing. The Directive uses the term **more stringent treatment** (then secondary treatment) to refer to tertiary treatment. The Directive does not set (environmental) quality standards for other directives' waters identified as sensitive areas – the Directive only sets emission standards. See Annex I, Table, 2 for tertiary treatment emission standards required by the Directive.
Water Framework Directive	The Water Framework Directive (WFD), 2000/60/EC, was adopted on 23 October 2000. It is designed to improve and integrate the way water bodies are managed throughout Europe. Further information on the WFD is on Defra's website at: www.defra.gov.uk/environment/quality/water/legislation/water-framework-directive.

Water Quality Directives	**Section (a):** Directives explicitly cited at Article 10 of the Water Framework Directive (WFD) and considered to be fundamental measures under the Water Framework Directive are: • Integrated Pollution Prevention and Control Directive (96/61/EC)[2] • Urban Waste Water Treatment Directive (91/271/EEC) • Nitrates Directive (91/676/EEC) **Section (b):** WFD Annex IX Directives – referenced via Article 10 of WFD: • The Mercury Discharges Directive (82/176/EEC) • The Cadmium Discharges Directive (83/513/EEC) • The Mercury Directive (84/156/EEC) • The Hexachlorocyclohexane Discharges Directive (84/491/EEC) • The Dangerous Substance Discharges Directive (86/280/EEC) **Section (c):** Directives with waters qualifying as sensitive areas: • Bathing Water Directive • Freshwater Fish Directive[2] • Shellfish Waters Directive[2] 1. Codified (consolidation of amendments) by Directive 2008/1/EC, which is replaced by Directive 2010/75/EU that takes effect on 7 January 2014. 2. To be repealed in 2013 with relevant standards adopted under WFD as appropriate.

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