

Have your say on improving the quality of our water environment

Tay
Draft Area Management Plan
2009–2015

SEPA has coordinated the development
of this document with the Tay Area Advisory Group

Terms that will help you use this plan

Welcome to the Tay area Management Plan. This section provides a summary of the key terms, specific to the river basin planning process used to produce this draft plan which will help you understand this document. A further list of technical terms is provided in the glossary.


River basin planning is the process used to manage the water environment. It aims to avoid deterioration and improve, where necessary, the ecological condition of rivers, lochs, estuaries, coastal and ground waters. The key objective of river basin planning is to achieve good ecological status by 2015. If more time is necessary then by the longer timescales of 2021 or 2027. The draft river basin management plan (draft RBMP) for the Scotland river basin district (RBD) and the supplementary area management plans (AMPs) outline how we are going to work towards this over the next six years (2009–2015). After the first six year cycle, the plan will be reviewed and the next cycle of river basin planning begins.

River basin district – a river basin district (RBD) could be a single very large catchment or, as in the case of the Scotland RBD, a natural geographical area that occurs within the landscape and is based on a group of catchments. River basin districts are not administrative boundaries relating to unitary or other authorities, but areas relating to the natural environment. A management plan must be produced for each river basin district.

Catchment – the land area from which water drains into an individual river or loch.

Water body – a management unit of a river, burn, loch, estuary, coastal water or groundwater. Every type of water must be managed in the river basin planning process, but sometimes they are too large for effective management. Dividing the water environment into smaller units enables us to manage and report more effectively. A water body may be a single burn or loch, or it could be a stretch of river or an area of ground water. All water bodies reported here are above a certain size (rivers have a catchment area of more than 10km² and lochs have a surface area bigger than 0.5km²).

Good ecological status – rivers, lochs, estuaries and coastal waters and must achieve the same health and diversity of plants and animals as would be expected in a state that is only slightly altered from their natural state. 'Ecological status' is a combined measure of the plants and animals present, the quantity of water available to sustain species, the physical structure of the water body which provides habitat for animals and plants and the chemical water quality. The emphasis is on the health and diversity of plants and animals that the water environment supports.

Geographic information system (GIS) – this is a digital map system that can hold several layers of information all related to particular points on an Ordnance Survey map. We have created a new layer that holds information on individual water bodies and which can be accessed through our website. When we refer to this GIS in the plan, we use this symbol .

Measures – a measure is an action taken to improve or maintain the condition of a water body. Measures can be part of regulations such as issuing a licence to allow or restrict an industrial discharge to a water body or non-regulatory measures such as partnership projects to reduce nutrient inputs to surface and ground waters. This plan provides an overview of draft measures and the improvements they are expected to lead to by 2015 and beyond. More detailed information is held in the GIS.

Executive summary

The Tay area has a high quality environment supporting a diverse range of nationally and internationally important habitats and species, including salmon, otter and freshwater pearl mussel. We rely on the quality of its rivers, lochs, estuaries, coastal waters and groundwaters for drinking water supply, recreation, tourism, energy, farming and industry. We must therefore ensure that the health of this water environment is protected.

The purpose of this plan is to set out the ways in which we are seeking to protect our high quality waters and where necessary implement improvements. It provides you with a chance to see what is proposed and our ambitions for the waters of the Tay area for the next six years (2009-2015). This plan is a consultation document which seeks your views on the water environment of the Tay area. It is one of eight area management plans that are supplementary plans to the draft Scotland River Basin Management Plan. These plans have been produced as part of Scotland's work to deliver the Water Framework Directive – European legislation introduced to protect and enhance our water environment.

For the purposes of the river basin planning process, the water environment in the Tay area has been divided into 354 water bodies (rivers, lochs, estuaries, coastal waters and groundwater). Many are currently in good condition, with almost 50% considered to be currently achieving an overall status of good or high. By 2015 we anticipate that almost 60% of the water bodies in the Tay area will be reaching high or good ecological status or potential.

The key issues we need to address in the Tay area are:

- nutrient enrichment in our rivers and lochs and high levels of nitrates in groundwater;
- changes to the physical habitat of rivers and burns (including artificial barriers to fish passage);
- changes to river flow and water levels in rivers and groundwater

The Tay area management plan has been developed under the advice and guidance of the Tay Area Advisory Group, which has members from statutory agencies, the agricultural sector, conservation organisations, the forestry sector and local fisheries boards. The plan focuses on local issues and highlights the opportunities for partnership working to ensure we all benefit from improvements to our water quality. It is therefore relevant to all those who manage or use the water environment.

We are seeking your views on this draft plan. You can help to shape the future of the water environment in the Tay area by letting us know what you think of this plan. Your feedback will be used to contribute to the final version to be published in December 2009.

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List of abbreviations

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

Section 1 About the Tay Area Management Plan

In 2000 a new piece of European legislation called the Water Framework Directive (WFD) was introduced. The WFD aims to improve the condition and integrate the management of the water environment across Europe. The Water Environment and Water Service Act (Scotland) translated this directive into Scottish legislation in 2003.

The main goal of the WFD is for all rivers, lochs, estuaries and coastal waters to be of good ecological and chemical status by 2015. Groundwater should also achieve good status for both water quality and quantity. In some cases achieving this by 2015 would be disproportionately costly, so there is the potential to set a later deadline of either 2021 or 2027. At the same time, we must ensure that we maintain water quality where they already meet these levels. We must also avoid any deterioration in all water bodies.

To do this we have implemented a new planning process, which is supported by the production of a draft river basin management plan for the Scotland river basin district (RBD) together with a series of annexes. To make this process more locally relevant, eight area management plans have been produced to focus and expand upon a different geographical area of the Scotland RBD.

This plan provides an overview of the waters in the Tay area (Map 1) and was drawn up with the help of members of the Tay Area Advisory Group (AAG) whose members come from statutory agencies, the agricultural sector, conservation organisations, the forestry sector and local fisheries boards. The plan focuses on local issues and highlights the opportunities for partnership working to ensure we all benefit from improvements to our water quality. It is therefore relevant to all those who manage or use the water environment.

If you would like to know more about the quality of individual rivers, lochs, estuaries or coasts you can find more detailed information on the web-based interactive GIS map www.sepa.org.uk/water/river_basin_planning.aspx

1.1 How can you contribute to the river basin planning process in the Tay area?

This is a consultation document, so you can help to shape the future of the Tay area water environment by letting us know what you think of this plan. We are seeking your comments on it. We need your local knowledge and would like to know what you or your organisation could do to help improve the water environment. We also want to know what you think of the process we have used to develop the plan and the way in which we have presented information.

We welcome your responses on the consultation questions throughout this plan and have listed them below. Where you are able to, we would be grateful if you would provide information to support the comments you make in your responses. We will take your responses into consideration when finalising the Tay area management plan.

This draft area management plan is available for six months public consultation. This period closes on 22 June 2009. Where possible, please respond by 22 March 2009 either in full or at least in the form of a summary setting out your principal comments and suggestions. This will help us plan the work we need to do to finalise the plan during the spring and summer next year.

We would particularly like your feedback on the detailed questions listed below. Feedback would be helpful for either the Tay area or for an individual river, loch, estuary, coastal water or ground water.

Question 1: Do you agree with our assessment of the ecological status/potential (condition) of the water environment in the Tay advisory group area? Please provide any information you have to support your view.

Question 2: Do you agree with the objectives set out in this plan (and detailed in the GIS for individual water bodies www.sepa.org.uk/water/river_basin_planning.aspx) to improve the water environment? If you think objectives are not ambitious enough or set too high, please let us know. Please give any information you have to support your view.

Question 3: As this is a draft plan, it is likely that we have not identified all measures which could lead to improvements in ecological status of the Tay advisory group area's water environment. Please let us know any measures we have missed.

Question 4: Could you or your organisation, potentially working in partnership with others, help deliver any of the following:

- A. Existing measures?
- B. Potential measures as set out on the SEPA website www.sepa.org.uk/water/river_basin_planning.aspx ?
- C. Completely new measures?

- Question 5:** Are there any other remaining or future issues which should be included in the plan?
- Question 6:** Are there any other particular plans, strategies or processes which could lead to improvements in the Tay advisory group area's water environment and which should be included in this plan?
- Question 7:** Which measures do you feel it is important to monitor? How can we collectively monitor and report progress on achieving the goals in this area management plan?
- Question 8:** Overall, do you think we have identified the best methods for measuring our success in implementing the RBMP for the Scotland RBD? Can you suggest additional methods?

We will be running a series of events throughout the six month consultation period to help raise awareness and gather comments about this plan.

You can also request a copy on CD. For more details please visit the SEPA website www.sepa.org.uk/water/river_basin_planning.aspx

If you have any comments please submit them to SEPA either:

- by email to rbmp@sepa.org.uk
- online at www.sepa.org.uk
- contacting your River Basin Management Planning co-ordinator

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Section 2 Why is the water environment of the Tay area so important?

The Tay area covers an area approximately 9000km², with a diverse landscape rising from the east coast of Scotland to the Grampian Mountains in the north-west and dropping into its southern boundary of Lowland Perthshire and north-east Fife. It includes notable areas of interest including eastern expanses of the Loch Lomond and The Trossachs National park, South Eastern extremes of the Cairngorms National Park around Glen Clova and Glen Prosen, and the length of Britain's largest flowing river, the River Tay.

The landscape is dominated by rural land use with the large river systems and coastal and estuarine waters an important aspect of the natural environment. There are 7 major river catchments within the Tay:

- River North Esk
- River South Esk
- Lunan Water
- Dighty water
- River Eden
- River Tay
- River Earn

The waters of many of these catchments are generally of the highest quality and with large areas of gravel beds, shallows, fast flowing water and deep pools, they provide a wide range of habitat supporting a high salmon population. Estimates from catch returns indicate that the Tay catchment is consistently one of the top three salmon rivers in Scotland. The area is also important for river lamprey, with widespread distribution throughout the rivers Dochart, Tilt and the Tay.

The habitats and condition of the freshwater catchments within the area are recognised for their importance in supporting a diverse range of flora and fauna, resulting in a significant number of nationally and internationally designated sites. Of note here are the River Tay system special area of conservation (SAC) and the River South Esk SAC, both designated for Atlantic salmon and the River South Esk for fresh water pearl mussels. The diversity of habitat including riverine features, wet woodlands, oxbow lakes and wetlands also provides ideal breeding and feeding grounds for otters.

The high quality of the coastal and estuarine waters of the Tay area make them important for a wide variety of interests and help to promote the important and valuable tourism industry both within the area and within Scotland. Many of these waters are protected areas, with many coastal waters designated as bathing waters (eg Carnoustie, St Andrews) and our estuaries designated as Special Protection Areas (eg the Firth of Tay, Eden Estuary and the Montrose Basin). The Tay area has four national scenic areas:

- Loch Rannoch and Glen Lyon;
- Loch Tummel;
- the River Earn east of Loch Earn;
- the River Tay at Dunkeld,

It also has the southern extremes of a fifth at Glen Doll of Deeside and Lochnagar.

The rivers in the Tay area rise in the northern and western parts of the area where the significant higher relief receives rainfall totalling over 2000mm per year in the upper parts. This translates to mean flows of over 170m³/second in the lower Tay. Further south and east towards the coastal areas, precipitation is less than 800mm per year; combined with higher demands for water, rivers can experience low flows in summer.

Industries within the Tay area are varied and wide ranging determined by climate, geography and landscape. The area supports a high level of agricultural activity and much of the landscape is dominated by agriculture;

- arable farming along the east coast;
- the growing of potatoes and soft fruit in Angus and north east Fife;
- sheep farming in the uplands.

Upland areas are also managed for forestry and as sporting estates for deer stalking and grouse shooting, while the rivers support important fisheries and angling and canoeing interests. These activities attract visitors from all over the world which in turn creates employment in the area. In Perthshire, Angus and Fife 19,800 people were employed in the tourism industry in 2006 when, according to Visit Scotland a total of over £460million was spent by domestic and international tourists to the areas.

The potential for hydro-electricity generation in the Tay area was recognised as early as the 1920s. There are a number of large scale hydropower schemes in the Tay and Earn catchments (Breadalbane, Finlarig, Tummel and Earn schemes) - all managed by Scottish and Southern Electricity (SSE), as well as smaller schemes in catchments such as the River Lyon.

The Tummel Valley scheme has nine power stations and includes the rivers Garry, Tummel, Errochty and Lochs Rannoch, Tummel and Ericht. The Breadalbane scheme develops the water resources of the mountainous region around Lochs Lyon, Tay. The Finlarig scheme utilises high altitude catchments around Ben Lawers on the north shore of Loch Tay and the Earn scheme takes water from catchments to the south of Loch Tay down to Loch Earn and Loch Lednock. These four schemes have a total of 16 main power stations with an installed capacity of 342 MW. They generate around 1,100 GWhrs/year on average which is about 3- 3.5% of Scotland's annual electricity demand.

This largely rural area covers all or part of six local authority areas (Perth and Kinross, Angus, Fife, Stirling, Aberdeen and Dundee City Council), with the largest settlements being the cities of Perth and Dundee. The provision of drinking water to these cities and other urban areas has led to the designation of around 74 Drinking Water Protection Areas in the Tay area. A small part of the Tay area also falls within the Loch and the Trossachs National Park and the Cairngorms National Park.

In summary, the environment of the Tay area contains a diverse mix of landscapes and features. Any plan for this area needs to consider these varied uses of the water environment, while at the same time preventing its degradation and addressing any negative impacts of human activity to date.

Section 3 **How good is our water environment and what are we aiming for?**

The Water Framework Directive sets out a common approach to measuring a wide range of impacts in a similar way across Europe. This new approach takes account of water abstractions, impoundments, engineering works and invasive non-native species, all of which may impact on the condition of the water environment in ways not measured by the previous water quality classification schemes used by SEPA.

This section of the plan describes our assessment of the current condition of the water environment and the environmental improvement objectives set for the next three planning cycles for the Water Framework Directive (WFD) in the Tay area. A summary of the condition of protected areas and objectives for compliance with the standards relevant to legislation under which they were designated is also presented.

3.1 **Background**

Our water environment has been divided into smaller units to enable us to report on them more effectively and to ensure they are managed efficiently. These units are called water bodies; they can be individual burns, stretches of river, estuary or coastal water, or whole or parts of a loch. SEPA focuses on river and loch water bodies of a certain size (rivers with a catchment area not less than 10km² and lochs with a surface area of at least 0.5km²). All estuaries and coastal waters are assessed. Rivers and lochs below these threshold sizes are defined as 'small water bodies' and are not reported on here.

The health of the water environment is monitored each year and its condition is assessed. Each water body has been assigned one of five quality classes – high, good, moderate, poor or bad. This combines information on the health of the ecology (eg plants and insects) with information on the quality of the physical habitat that is provided by each river, loch, estuary and coastal water.

Groundwater bodies have also been monitored and classified. Groundwater must be protected so that it can fulfil two functions:

- supplying water for human use;
- supporting those wetlands and other surface water ecosystems that rely on it.

The classification scheme is designed to assess groundwater against its ability to perform these key functions, by establishing both a chemical status and quantitative (i.e. the amount of water present) status for each groundwater body.

For some of the pressures affecting the water environment monitoring and assessment are well established but for others this type of assessment is new for Scotland. There are still gaps in our knowledge, and monitoring tools will continue to be developed and refined, but this first set of results gives a much wider picture of the condition of our rivers, lochs, estuaries, coastal waters and groundwaters than we had before. More information on how we assess the water environment can be found on the SEPA website. Scotland's Water Environment Review 2000-2006 provides more information on SEPA's previous classification scheme and recent improvements in water quality.

Some of our rivers and lochs have been changed dramatically so we can use them for specific purposes (eg electricity generation and drinking water supply). The WFD recognises that such uses will have changed water bodies so that they can no longer be restored to their original condition without threatening current use. It refers to these rivers and lochs as heavily modified water bodies (HMWBs). For these water bodies best practice measures to improve the water levels and flows and/or physical habitat must be put in place to allow the water body to meet good ecological potential rather than good ecological status. Where a water body is classified as moderate, poor or bad ecological potential then either the operator has not applied best practice or there is another problem (eg high levels of phosphorus) affecting the water body.

Other water bodies (eg canals) are completely man-made and do not have the same physical features as natural water bodies; they are defined by the WFD as artificial water bodies (AWBs). There is only one AWB in the Tay area – the Stormontford Lade (4km).

3.2 **Current condition of the surface waters and ground waters in the Tay area**

Table 1 and Figure 1 summarise the classification results for the water environment in the Tay area. Overall the assessment of our water environment shows that 170 of our water bodies are of good status or better. This accounts for almost 50% of the water bodies in the Tay area. The distribution of the different quality of our rivers, lochs, estuaries and coasts within the Tay area is shown on Map 2. Information on the condition of individual water bodies can be found on the GIS layer.

The assessment of good ecological potential for heavily modified and artificial water bodies will be reviewed before publication of the final Tay area management plan.

In this section all percentages are based on length or area of water body, as opposed to number of water bodies. This gives a more accurate reflection of the extent of problems within the Tay area.

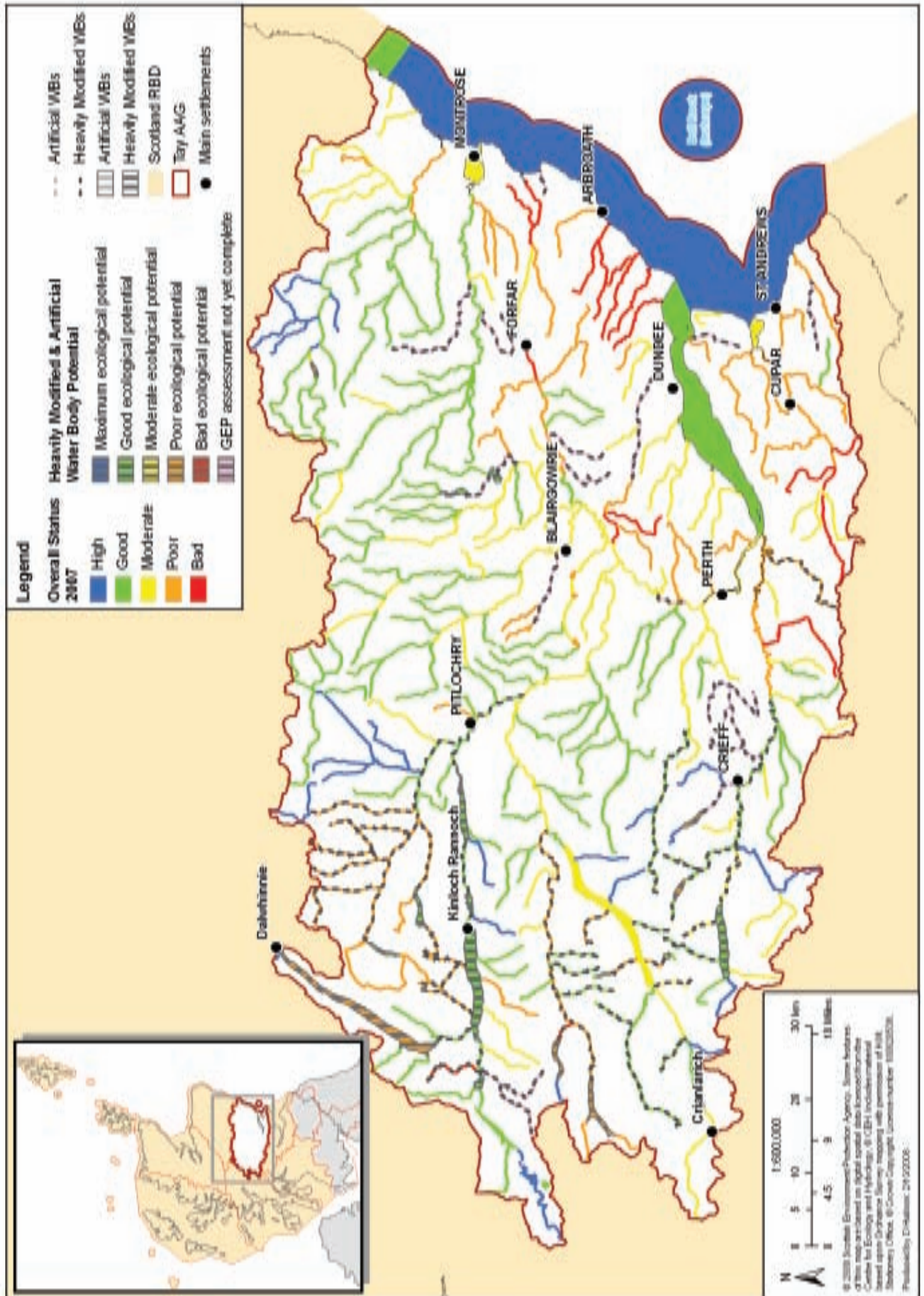
Table 1: Summary of the ecological status of water bodies in the Tay area in 2007

Water body category	Total length/area (no. of water bodies)	High status	Good status	Moderate status	Poor status	Bad status	Not yet assessed
Rivers	2556km (215)	208km (23)	1055km (85)	686km (60)	436km (35)	170km (12)	0
Lochs	39km ² (10)	3km ² (2)	7km ² (3)	27km ² (2)	2km ² (3)	0	0
Estuaries	117km ² (5)	0	103km ² (2)	14km ² (3)	0	0	0
Coastal	640km ² (6)	616km ² (5)	24km ² (1)	0	0	0	0
Groundwater	8960km ² (46)		6628km ² (19)		2333km ² (27)		0
Total	282	30	110	65	65	12	0
% total		11%	39%	23%	23%	4%	0
HMWBs and AWBs (rivers)**	665km (54)	0	205km (19)	23km (3)	216km (14)	14km (2)	206km (16)
HMWBs (lochs)	81km ² (18)	0	46km ² (11)	0	34km ² (6)	0	1km ² (1)
Total	354	30	140	68	85	14	17
% of total		8%	40%	19%	24%	4%	5%

* Grey shading denotes that the status category is not relevant to this water body category.

** There is only one AWB in the Tay area – Stormontford Lade (4km).

Map 2: The condition of the surface waters in the Tay area



3.2.1 Rivers

Overall almost 50% (1250km) of our rivers are of good status or better. Over 200km of river in the Tay area, specifically within the catchments of the river Earn (41km), North Esk (42km) and Tay (125km) have been assessed as high status based on the habitats they provide and the ecology they support. Rivers at good status are found in these catchments along with rivers in the South Esk catchment and the Craighall burn (7km) in the River Eden catchment. However, not all rivers in these catchments are at good status. The rivers within the Lunan Water, Dighty Water and River Eden catchments (apart from the Craighall Burn) and those draining into the coastal areas of Perth, Angus, Dundee and North Fife all fail to reach good status.

In addition to these rivers there are 53 rivers (660km) that have been significantly modified by human activity for use for hydropower and/or drinking water supply and one artificial water body. Of the 53 heavily modified rivers 19 (205km²) have been assessed as reaching good ecological potential and 19 (253km) as failing to meet good ecological potential. Although there has been some discussion with operators regarding some of the remaining 15 heavily modified rivers the assessment of good ecological potential for these has not been finalised.

3.2.2 Lochs

In the Tay area 25% of the loch area meets good status. The river Tay catchment supports the highest quality lochs, with Loch Ba (2.5km²) and Loch Lubhair (0.5km²) both reaching high status. A further three lochs (7km²) are of good quality whilst four lochs (28.5km²) in this catchment are less than good quality. Rescobie loch (0.6km²) in the Lunan Water catchment is at moderate status.

The remaining 18 classified lochs (81km²) in the Tay area have been significantly modified by human activity and are therefore designated as heavily modified water bodies (HMWBs). Current assessments indicate that 11 (46km²) of these HMWBs meet good ecological potential and six (34km²) are at poor ecological potential. Loch Benachally (0.6km²) in the River Tay catchment is still to be assessed in terms of ecological potential.

3.2.3 Estuaries and Coasts

Our coasts are all of good quality with five of the six coastal waters meeting high status.

The quality of our estuaries is more of a concern as three of the five - the Montrose basin (8.5km²), Eden estuary (5km²) and Barry Links lagoon in the Firth of Tay (<0.5km²) - are all at moderate status and the remaining two, the lower and upper Tay estuary (103km²) at good status.

No estuaries or coastal waters have been designated as heavily modified in the Tay area.

3.2.4 Groundwaters

Groundwaters in the Tay area are affected by poor chemical quality and reduced levels of water. As shown in Table 2 2332km² of the 8960km² groundwater area (26%) fails to meet the chemical quality standards set for good status. In addition, 1601km² (18%) fail due to a reduction in the quantity of water.

Table 2: Summary of the quality of our ground waters in the Tay area in 2007

	Total	Chemical tests		Quantity of water	
		Good	<Good	Good	<Good
Area of water (No. of water bodies)	8960km ² (46)	6628km ² (19)	2332km ² (27)	7359km ² (34)	1601km ² (12)
% of total area		74%	26%	82%	18%

It is important to remember that groundwater bodies usually cover several tens or hundreds of square kilometres. SEPA has a strategy for identifying appropriate locations for groundwater monitoring and information can be found on the SEPA website. It is therefore inevitable that there will be a range of localised pressures across all but the most remote groundwater bodies. It is quite possible for a groundwater body to be at good status but for there to be some localised pollution.

3.2.5 Derogations

Table 3 summarises four applications that SEPA has assessed under the Water Environment (Controlled Activities) (Scotland) Regulations 2005 (CAR) within the Tay area which are likely to result in a deterioration of ecological status or potential of a water body. These activities have been assessed against the criteria set out in the WFD and the benefits to human health, human safety or sustainable development outweigh the benefits of preventing the deterioration in ecological status or potential.

Table 3: Summary of derogations

Name	Activity	Water body identification number*
Kinnaird	Hydro	7348
Innerwick hydro	Hydro	6646
Invervar hydro	Hydro	6643
Keltneyburn	Hydro	6641

* This number can be used to identify the water body on the GIS map

3.3 Why are some of our waters less than good quality?

The three main reasons that the waters in the Tay area are not at good status are:

- nutrient enrichment in rivers and lochs and high levels of nitrates in groundwater
- changes to the physical habitat in rivers and barriers to fish migration
- changes to water flow and water levels in rivers and groundwater

3.3.1 Nutrient enrichment and high nitrate levels in groundwater

Almost 30km² (77%) of the area of our lochs and around 600km (>20%) of our rivers have high levels of phosphorus located predominantly in the east of the area (Map 3). A number of heavily modified water bodies are also affected by high levels of phosphorus - five of the 18 loch HMWBs (33km²) and six of the 53 river HMWBs (75km). Nutrient enrichment is also affecting the conditions of both the Dunkeld-Blairgowrie lochs SAC and the River South Esk SAC, impacting on populations of slender naiad (an aquatic plant) and freshwater pearl mussel.

Although nitrogen levels exceed the standard required by the WFD in 12% of our estuaries there is no evidence to suggest that this has led to enhanced plant (algal) growth as these water bodies are classified as good or high status for phytoplankton (microscopic algae).

The majority of ground water in the Tay area that is not achieving good chemical status is failing due to the presence of high levels of nitrates in the groundwater. Nitrate in groundwater is a naturally occurring substance, but the impact of human activities such as excessive application of fertilisers and animal slurries can artificially increase levels. An important element of the nitrates classification in the Tay area is the impact of groundwater, at a catchment scale, affecting the Dundee coastal area as well as Angus and North Fife.

3.3.2 Changes to the physical habitat and artificial barriers to fish migration

In the Tay area, the condition of 30% of the river habitat (800km) is less than good status, with all catchments within the area affected by changes to the physical habitat. These changes are also having an impact on the River South Esk SAC, affecting populations of freshwater pearl mussel.

It should also be noted that 115km of heavily modified rivers (18%) do not meet good ecological potential for morphology and therefore potentially require further mitigation measures to improve habitat quality and passage to fish. A further 15 HMWBs require further assessment for good ecological potential (GEP) and these may also require additional measures.

Barriers to fish affect around 300km of river length, almost half of which is water designated as heavily modified and approximately 10km² of loch area in the Tay area, all of which is designated as heavily modified.

3.3.3 Changes to water flows and water levels

Alterations to flow and water levels are seen across the Tay area, with a high proportion of rivers being affected in the Fife coastal regions and River Eden catchment the Angus coastal regions and Lunan Water catchment (Map 4). Almost 700km (>25%) of the rivers in these areas are affected by changes in flow and water levels.

It should also be noted that 100km of heavily modified rivers (15%) do not meet good ecological potential for hydrology and therefore potentially require further mitigation measures to improve flow conditions and water levels. A further 15 HMWBs require further assessment for good ecological potential (GEP) and these may also require additional measures.

Almost one fifth (1601km²) of groundwaters in the Tay area do not meet good status as a result of reduced levels. These reduced groundwater levels are affecting river flows in Fife and Angus. In the Eden valley, Fife, the reduction in groundwater levels may in the long term reduce the chemical quality still further.

3.4 What quality are we aiming for?

We have set objectives for each water body to show the improvements in the quality of our water environment that we expect to achieve by 2015. There are two target objectives in terms of the WFD:

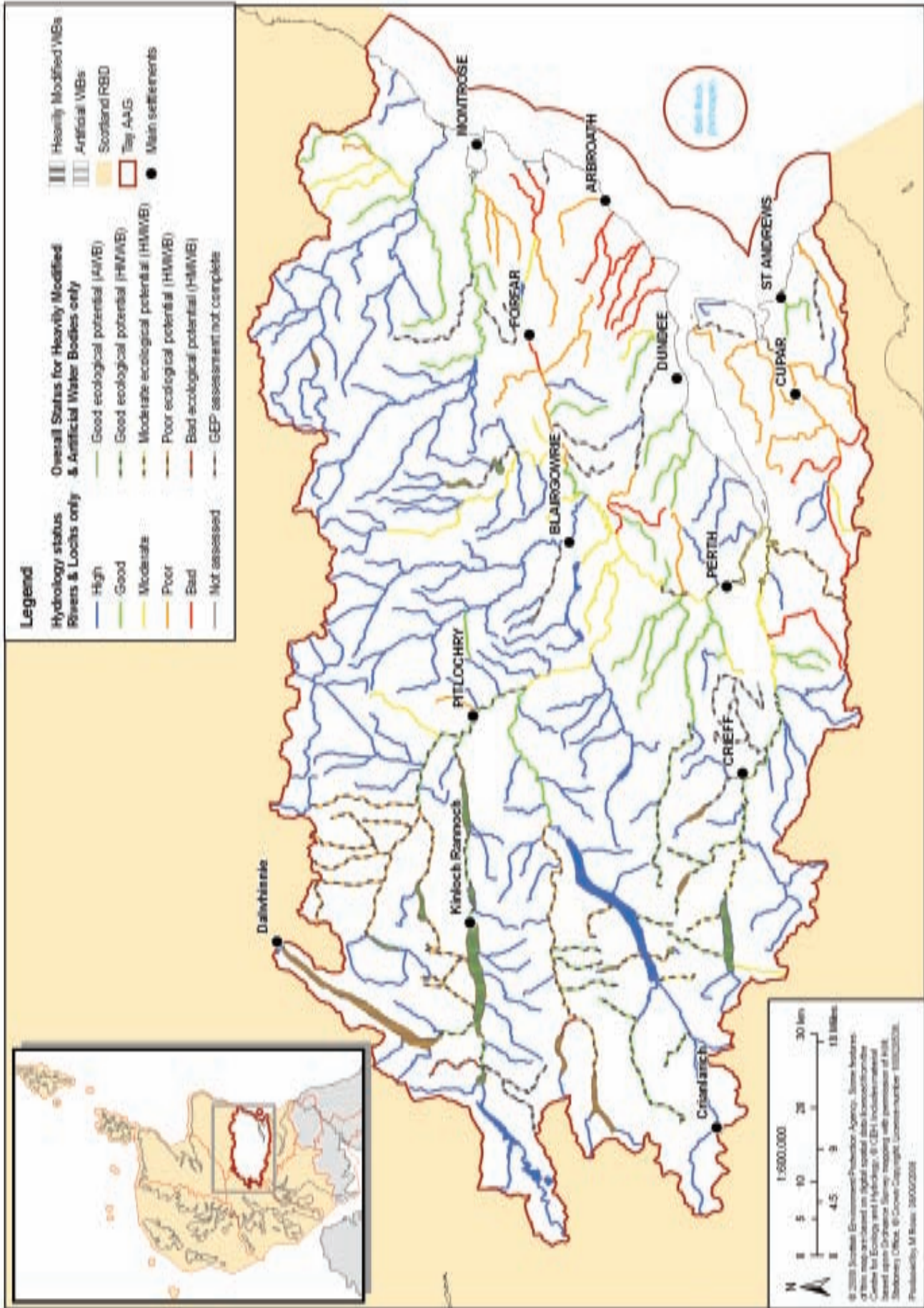
- to avoid deterioration in the current status and
- to aim to achieve at least good status by 2015.

However this may not always be possible. For example, it may be too costly to restore some water bodies or it may just take more time for some to recover - even following restoration or a reduction in impacts. We have therefore also set objectives for the subsequent cycles of river basin planning (2021 and 2027) where it is a longer term problem that is going to take many years to resolve. Plans produced during the second and third cycles of river basin planning will need to ensure that these later objectives are met. More information on this process can be found in the draft RBMP for the Scotland RBD Annex 3 www.sepa.org.uk/water/river_basin_planning.aspx

In exceptional circumstances, the WFD permits deterioration in the status of a water body because of the importance of a proposed development. Any deterioration in status which is permitted after 2008 will be reported in the next river basin management plan.

We describe below how we expect the overall status of the water environment in the Tay area to change. However, there will be improvements in some aspects of their ecological quality which do not change the overall status by 2015. For instance, for a river water body even though we expect a lowering in nutrient enrichment there will be no improvement in the condition of the physical habitat so the overall classification will not change by 2015.

Map 4: Water flows and water levels in the Tay area



3.5 Improvements between 2007 and 2015

Table 3 and Figure 1 summarise our objectives for the water environment in the Tay area. Overall we expect a 10% improvement in the number of water bodies meeting good status or better between 2007 and 2015, compared to an overall improvement of 7% in the Scotland river basin district. In the Tay area the improvement means a reduction in the number of moderate and poor status water bodies.

Further information can be found on Map 5 which shows the environmental objectives for 2015. Improvements on individual water bodies can be found on the interactive GIS [map](http://www.sepa.org.uk/water/river_basin_planning.aspx) www.sepa.org.uk/water/river_basin_planning.aspx

Table 3: Ambitions for the quality of the waters in the Tay area by 2015*

Water body category	Total length/area (no. of water bodies)	High status	Good status	Moderate status	Poor status	Bad status	Not yet assessed
Rivers	2556km (215)	213km (24)	1215km (97)	571km (51)	387km (31)	170km (12)	0
Lochs	39km ² (10)	30km ² (3)	7km ² (3)	1km ² (2)	2km ² (2)	0	0
Estuaries	117km ² (5)	0	103km ² (2)	14km ² (2)	0	<1km ² (1)	0
Coastal	640km ² (6)	616km ² (5)	24km ² (1)	0	0	0	0
Groundwater	8960km ² (46)		7074km ² (30)		1886km ² (16)		0
Total excluding HMWBs	282	32	133	55	49	13	0
% of total		11%	47%	20%	17%	5%	0
HMWBs and AWBs (rivers)**	665km (54)	0	367km (27)	23km (3)	65km (7)	4km (1)	206km (16)
HMWBs (lochs)	81km ² (18)	0	78km ² (15)	1km ² (1)	2km ² (1)	0	1km ² (1)
Total including HMWBs	354	32	175	59	57	14	17
% of total		9%	49%	17%	16%	4%	5%
% change from 2007		+1%	+9%	-2%	-8%	0%	0%

* Grey shading denotes that the status category is not relevant to this water body category.

** There is only one AWB in the Tay area – Stormontford Lade (4km).

3.5.1 Rivers and lochs

The main improvements can be seen in our lochs where we expect the area of loch at good or high status to improve by 27km² (69%) between 2007 and 2015. The length of river at good or high status is expected to improve by 165km (6%). These anticipated improvements assume the actions in this plan are carried out.

We also anticipate the length of heavily modified river at high or good status to improve by 162km (24%) and the area of heavily modified loch to improve by 32km² (40%) by 2015, following the implementation of mitigation measures.

3.5.2 Estuaries and coastal waters

The objectives for the estuaries will remain the same with the exception of one small water body the Barry Links Lagoon (part of the Firth of Tay) where deterioration from moderate to bad status is indicated. This predicted deterioration is currently under review.

The coastal waters of the Tay area will remain at the same high quality and are not expected to deteriorate.

3.5.3 Groundwaters

The groundwater objectives indicate that there will be a 24% improvement in the chemical quality and a 2% improvement in water quantity between 2007 and 2015 (Table 4 and Figure 2).

Table 4: Ambitions for the quality of our ground waters in the Tay area by 2015

	Total	Chemical tests		Impact of abstraction	
		Good	<Good	Good	<Good
Area of groundwater (No. of water bodies)	8960km ² (46)	7074km ² (30)	1186km ² (16)	7385km ² (35)	1575km ² (11)
% of total area		79%	21%	82%	18%
% change 2007 - 2015		+24%	-24%	+2%	-2%

3.6 Improvements expected beyond 2015

Longer term targets have been set for improvements in the status of some water bodies in the Tay area. We anticipate the following improvements between 2015 and 2027:

- 59km of river (four water bodies) improve from moderate to good status;
- 2km² of heavily modified loch (Loch Turret reservoir) improve from poor to good status
- 2km² of loch (Loch of Drumelie and Loch of Lowes) also improve from poor to moderate status.

It is expected that further improvements will be realised with the development of additional measures over the next two river basin planning cycles.

Map 5: Environmental objectives for the Tay area for 2015

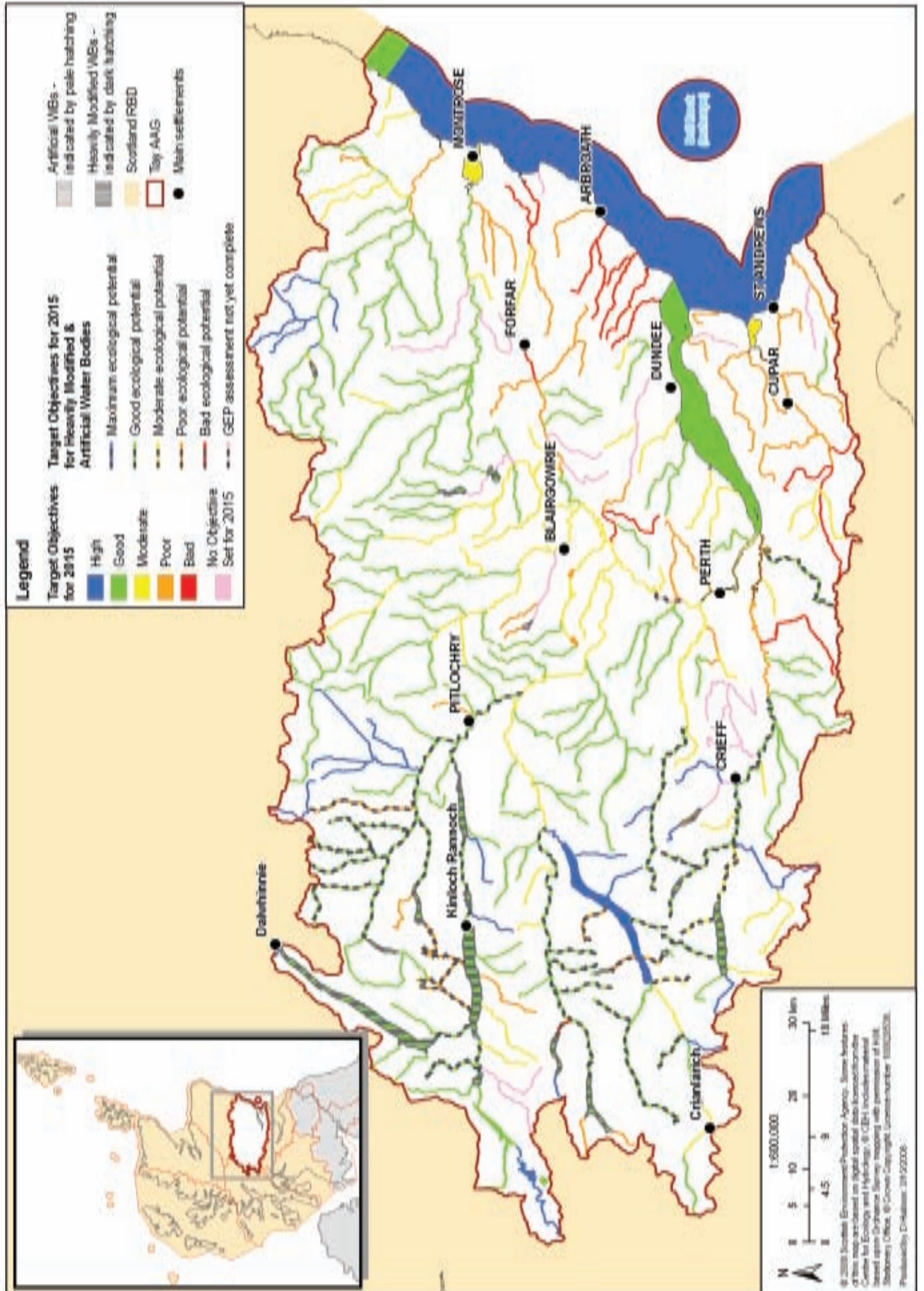


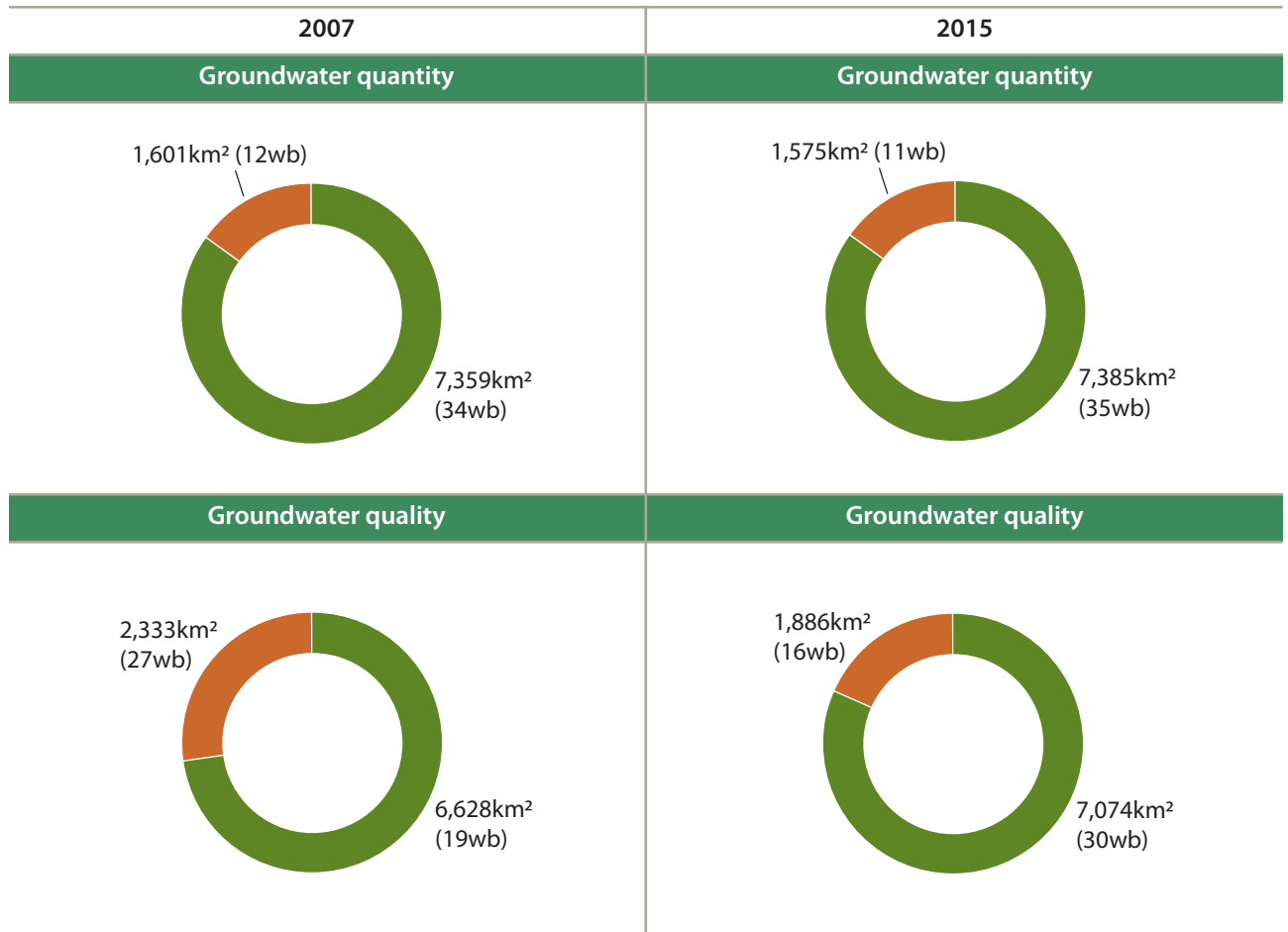
Figure 1: Expected changes in the ecological status of surface waters in the Tay area between 2007 and 2015 by length or area



Wb = water body
*does not include HMWBs

Legend High Good Moderate Poor Bad Not yet set

Figure 2: Expected changes in the condition of our ground water environment 2007–2015



Wb = water body

Legend



3.7 Protected areas

A number of protected areas in the Tay area require special protection under other national or European legislation. These include Natura 2000 sites (Special Protection Areas designated under the Birds Directive and Special Areas of Conservation designated under the Habitats and Species Directive), shellfish growing waters, freshwater fish (FWF) waters, bathing waters and drinking water protected areas. These may be part of a larger water body (eg bathing waters) or a group of water bodies (eg freshwater fish waters).

The quality of the protected areas is assessed against the standards under European legislation to protect the features for which they are designated. Further information on the assessment of protected areas can be found in the draft RBMP for the Scotland RBD annex 5 on the SEPA website www.sepa.org.uk/water/river_basin_planning.aspx. The register of protected areas required by the WFD can be found on the SEPA website www.sepa.org.uk

Further information on protected areas can be found below and in Map 6.

3.7.1 Protected areas for bathing

The 7 bathing waters in the Tay area all achieved good or excellent status in 2007, as required by the terms of the Bathing Waters Directive. They are:

- Montrose
- Carnoustie
- St Andrews (West Sands)
- Kingsbarns
- Arbroath
- Broughty Ferry
- St Andrews (East Sands)

How good is our water environment and what are we aiming for?

Although the revised Bathing Water Directive does not come into force until 2015, one bathing water would be classified as sufficient when assessed against its more stringent standards, with the rest good or excellent. This assessment reflects the overall high quality of these waters.

By 2010 we expect all bathing waters to meet the mandatory standards during all but exceptionally wet periods in an average summer. We also expect a significant improvement in the number of waters achieving guide standards.

3.7.2 Protected areas for important shellfish

The three areas designated as shellfish growing areas in the Tay area meet the mandatory standards for faecal coliforms required under the Shellfish Growing Waters Directive but fail the stricter guide standards due to the presence of faecal bacteria. One of these waters (Fife Ness to Elie) is almost exclusively within the Forth AAG area.

For 2015 we will aim to maintain this level of compliance while striving to significantly increase the number of waters achieving guide standards.


3.7.3 Protected areas for economically important freshwater fish

There are 14 protected areas designated for the protection of salmonid fish (salmon and trout). All pass the guide environmental standards of the Freshwater Fish Directive.

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

3.7.4 Protected areas for species or habitat of international conservation importance

There are 18 water-dependent areas of international importance for conservation in the Tay area - nine are Special Areas of Conservation (SACs) and nine are Special Protection Areas. Five of the nine SACs and all SPAs are in favourable conditions. The reasons for unfavourable conditions include diffuse and point source pollution, alterations to the physical habitat and the presence of alien species. The conservation objectives for these Natura sites developed by Scottish Natural Heritage are available on its website www.snh.gov.uk

For water-dependent SACs and SPAs the water quality parameters used for site condition monitoring provide a useful basis for determining whether the conservation objectives will be met. These monitoring results can be viewed on the GIS  map www.sepa.org.uk/water/river_basin_planning.aspx

The Scottish Government has set an ambitious target of getting 95% of special features on protected nature conservation sites into favourable condition, or unfavourable recovering, by March 2010.

3.7.5 Protected areas for water supplies intended for human consumption

There are 74 drinking water protected areas in the Tay area. Risk assessments are not yet available so it is not possible to identify measures and set objectives at this stage. An assumption is being made that all will meet the required standards by 2015.

3.7.6 Nutrient sensitive areas

In the Tay area there are 16 nutrient sensitive areas designated under the Urban Waste Water Treatment Directive (UWWTD).

The groundwaters of the Tay area play a significant role in the provision of drinking water. In order to protect these waters from land use activities which may cause pollution, particularly from nitrates, parts of the area are designated as nitrate vulnerable zones. In the Tay area, there is just one designated nitrate vulnerable zone, the Strathmore/Fife area.

Nutrient sensitive areas under UWWTD and nitrate vulnerable zones are not assessed against an environmental standard. Instead, compliance is measured in terms of measures taken.

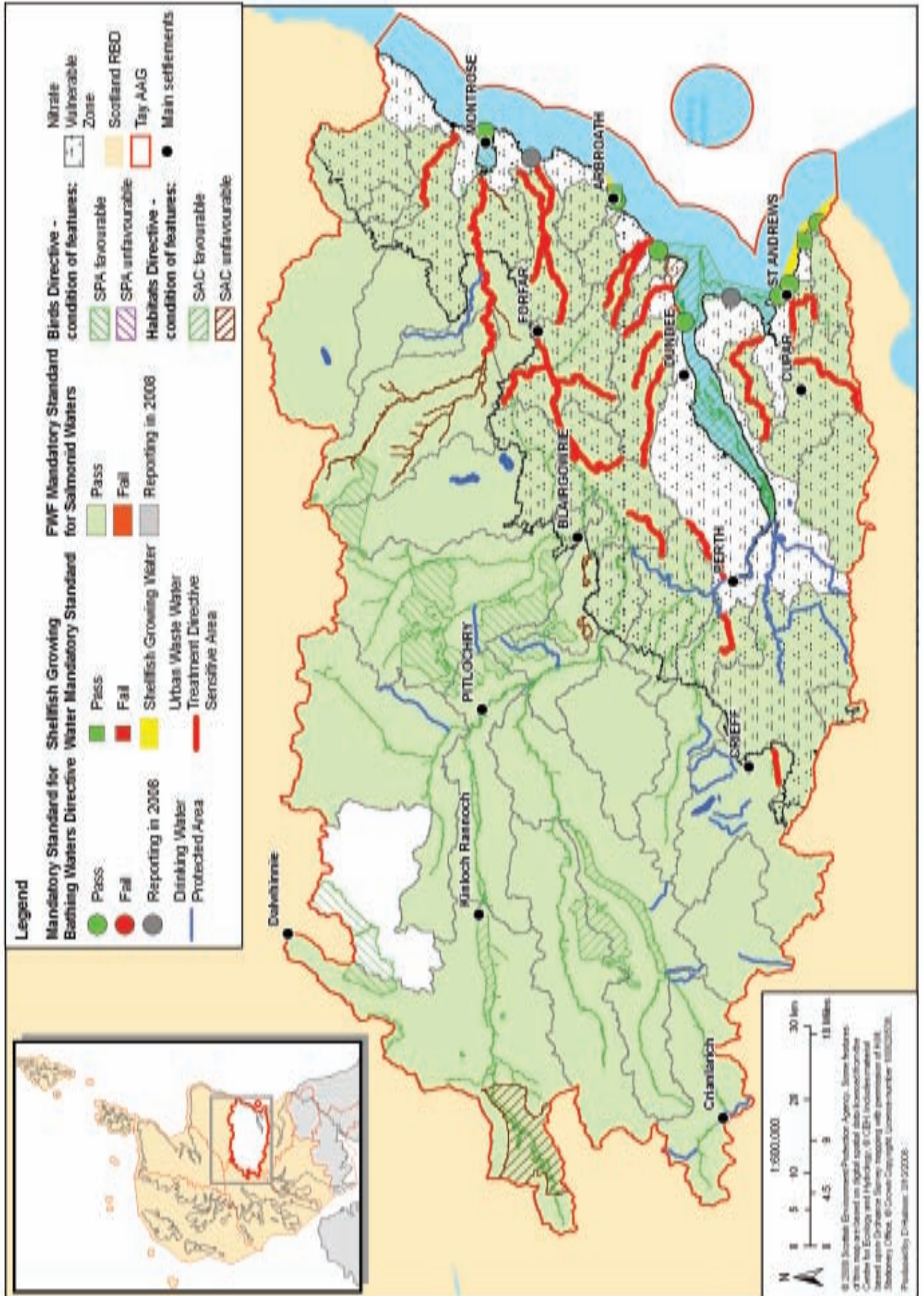
3.8 What do you think?

How good is our water environment and what are we aiming for?

Question 1: Do you agree with our assessment of the ecological status (condition) of the water environment in the Tay advisory group area? Please provide any information you have to support your view.

Question 2: Do you agree with the objectives set out in this plan (and detailed in the GIS for individual water bodies www.sepa.org.uk/water/river_basin_planning.aspx) to improve the water environment? If you think objectives are not ambitious enough or set too high, please let us know. Please give any information you have to support your view.

Map 6: Protected areas in the Tay area



Section 4 What are our priorities for action in the Tay area?

During the development of the draft Scotland RBMP we identified a wide variety of issues affecting the water environment. This section focuses on those considered particularly significant in the Tay area. These were identified by looking at the current state of the water environment (section 3).

The issues considered in more detail in this section are:

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

There are other activities causing smaller or more localised impacts in the water environment in the Tay area but these are not discussed here. The draft Scotland RBMP includes information on the significant water management issues and what we plan to do about them at a river basin district scale.

4.1 Nutrient enrichment and high levels of nitrates in groundwater

In the Tay area more than 60km² of the lochs and heavily modified lochs and around 700km of rivers and heavily modified rivers have raised phosphorus levels. The increase of nutrients such as phosphorus in surface waters can result in the excessive growth of aquatic plants and algae which can affect light penetration and oxygen levels. This can lead to adverse effects on the aquatic wildlife and habitat.

There are a number of potential sources of these nutrients. The most likely causes of high levels of phosphorus and nitrogen in our rivers, lochs, estuaries and groundwaters are:

- Diffuse pollution from agriculture
- Point source pollution from sewage treatment

In 2007 almost 600km of the 700km of rivers (including 75km HMWBs) with elevated nutrient levels were affected by diffuse pollution from agriculture and over 300km were affected by point source pollution from sewage treatment. A number of these rivers were affected by both pressures.

High levels of nitrates potentially affect over a quarter of the groundwater area; 2172km² (93%) of the 2332km² in the Tay area at poor chemical status are thought to be affected by diffuse pollution from agriculture.

The conditions of both the Dunkeld-Blairgowrie lochs SAC and the River South Esk SAC, are also thought to be affected by diffuse pollution from agriculture.

4.1.1 Diffuse pollution from agriculture

The management of the surrounding land can have a significant impact on water quality. Diffuse agricultural pollution can arise from a range of land use activities although much of the pollution resulting from these activities is unintentional. Potential agricultural activities that can cause diffuse pollution leading to nutrient enrichment in the Tay area include:

- inappropriate fertiliser application – if nutrient management does not take into account the current nutrient content of soil or previous applications of manure and slurry, they may result in excess nutrients being washed out of the soil.
- water run-off from farm steadings can contain sediment and nutrients which can be washed directly into watercourses
- soil erosion resulting from cultivation on steep slopes, winter cropping, preparation of seedbeds and livestock poaching can all cause soil particles to enter adjacent water courses. These soil particles may bring nutrients, particularly phosphorus, with them.

What action are we taking?

Tackling diffuse pollution will require a combination of voluntary, economic and regulatory measures. Some of these measures are listed below:

- The Water Environment (Diffuse Pollution) (Scotland) Regulations 2008 are based on widely accepted standards of good practice such as the Prevention of Environmental Pollution from Agricultural Activity (PEPFAA) Code. They will provide a statutory baseline of good practice. Under the new Scotland Environmental and Rural Services (SEARS) programme, diffuse pollution will be one of the areas incorporated into the routine farm visits by Scottish Government and Scottish Natural Heritage staff. This will provide a major opportunity to raise awareness of the new regulations.

- The Nitrate Vulnerable Zone Action Programme Regulations aim to reduce leaching of nitrates through a variety of measures. These include:
 - o closed periods when chemical fertilisers cannot be spread;
 - o a requirement to ensure nitrogen inputs are matched to the crop requirements;
 - o avoiding high risk periods for the spreading of slurries (eg on frozen ground).
- The new Scotland Rural Development Programme (SRDP) contains a number of measures to improve water quality such as constructed farm wetlands, buffer strips and nutrient management. Land managers will need to apply to the scheme for funding for these measures and applications will be prioritised on a regional basis by the Tay Regional Proposal Assessment Committee. Improving water quality and reducing diffuse pollution are priorities within the scheme and advice will be provided in areas of concern (including Natura 2000 sites).
- Since 2005, farmers have had to comply with certain environmental conditions in order to receive support payments. These include the requirement to ensure that the land is maintained in Good Agricultural and Environmental Condition (GAEC). GAEC is potentially very relevant to diffuse pollution control and could have a beneficial impact on the loss of soil, in particular.

Other local actions have included a number of catchment projects aimed at reducing diffuse pollution from agriculture. Examples include

- the Environmental Focus Farms project;
- the Lunan Lochs project;
- the Forfar Lochs project;
- Conservation of Atlantic salmon in Scotland (EU Life III project);

New catchment management projects, such as the River South Esk catchment management plans will also be developed during this first river basin planning cycle. Further information on the demonstration element of these projects is included in the case studies below on the Environmental focus farm; Mains of Balgavies, and the Lunan Lochs.

Case study: **Lunan Lochs Scottish Natural Heritage Natural Care Scheme**

The Lunan Lochs in Perthshire comprise a chain of five lochs (Craiglush, Lowes, Butterstone, Clunie and Marlee) along the Lunan Burn (see map). Together they form the Dunkeld-Blairgowrie Lochs Special Area of Conservation (SAC), which is designated for its populations of two European protected species (slender naiad and otter), clearwater lochs, and transition mires and quaking bogs. The SAC comprises two Sites of Special Scientific Interest (SSSIs) – Lochs Butterstone, Craiglush and Lowes SSSI and Lochs Clunie and Marlee SSSI. These SSSIs are important for a variety of features, including swamp vegetation fringing the margins of the lochs, mesotrophic open water, mesotrophic river/stream, wintering birds (principally greylag geese), assemblage of breeding birds, including osprey, and vascular plants.

The species and habitats of the lochs are under threat from nutrient enrichment from phosphorus due to a combination of soil erosion, and animal and human waste (i.e. septic tanks and washing detergents). Phosphates from agriculture were considered to be the largest contribution. Therefore, in 2003 SNH commissioned farm pollution audits on all farms within the catchment to help identify the source of the problem. The results of the audits identified a range of opportunities to reduce soil erosion and nutrient enrichment through changes to stock management, fertiliser applications and cropping patterns. Many farmers were able to make savings immediately due to the results of the pollutions audits identifying that excessive amounts of manure and inorganic fertiliser were being added to the land. By adjusting the fertiliser application a total saving of £24,000 across the catchment per annum could be made.

The pollution audits formed the basis for the Lunan Lochs Project Natural Care Scheme, which SNH launched in March 2004. The Scheme aimed to restore the water quality of the lochs by reducing phosphate pollution from farms in the surrounding catchment through working in partnership with local land managers.

There are 20 agricultural units in the scheme area, which covers a catchment of 5877 ha, of which 430ha is SSSI/SAC land. The target was for 80% of the catchment to be in assured management by the end of 2005. Although the last agreement was not signed until March 2007, this brought the total area of the catchment in assured management to 95%. In addition, we are also aware that at least one of the farmers who did not enter the Scheme has adapted his farming practices to take account of the advice provided in the pollution audit.

A joint monitoring strategy has been agreed between SNH and SEPA, including SNH's Site Condition Monitoring programme, detailed monitoring of the slender naiad population, and water quality monitoring of the lochs. MLURI have also undertaken projects, which have considered the effectiveness of best management practices (BMPs).

When the project was launched the target was for all the lochs to attain a trophic status of ≤ 25 g/litre. Three of the lochs (Craiglush, Butterstone and Marlee) were below this threshold. Although there has been a slight improvement in water quality in the Lochs of Lowes and Clunie it could be several years before there is a sustained improvement in the water quality of the Lunan Lochs.

Case Study: **Environmental Focus Farms project at Mains of Balgavies Farm in Angus**

The Scottish Agricultural College (SAC) Environmental Focus Farms project aims to recommend practical, effective and affordable ways to help to reduce the likelihood of pollutants reaching waterways and groundwater from farming operations. The project, which will run till 2011, will implement appropriate measures on Mains of Balgavies Focus Farm near Balgavies Loch in Angus. Such measures will be applicable more widely throughout the farms' neighbouring areas as well as in similar settings in Scotland as a whole.

Tom Sampson (farmer at Mains of Balgavies) is working with SAC, SEPA and The Macaulay Institute to identify and evaluate best management practices (BMPs) to help reduce the effects of diffuse pollution from agriculture. The project is currently focusing on gathering baseline data (eg surface and groundwater monitoring, aquatic ecology and channel morphology monitoring) helping to determine the effectiveness of measures put in place. The monitoring will help determine the effectiveness of the measures put in place. Measures which have already been implemented include a nutrient budget which will inform future fertiliser planning and liming and a soil erosion risk assessment.

An important aspect of the project is partnership working which includes farmers in the area forming a focus group. The Angus farmers' focus group has approximately 20 members who meet regularly to share information on the causes and effects of diffuse pollution and learn how they may apply some of the measures on their own farms.

4.1.2 Nutrient input to surface waters from sewage treatment works

Treated final effluent from sewage treatment works contains a mixture of substances, including nutrients, which are not removed from the wastewater by most secondary treatment methods. The problems in the Tay area are associated with wastewater treatment plants and private sewage works and septic tanks from the rural catchments of this area.

A strategic and long-term approach is required to ensure that there is adequate capacity in the sewerage system to accommodate expected levels of development. This will add increasing pressure on the environment and we must ensure that the Water Framework Directive objective of no deterioration in status is achieved.

What action are we taking?

The main mechanism to address pollution caused by sewage discharges is to invest in the public sewerage network and sewage treatment works. This investment is delivered via a public planning process known as the Quality and Standards (Q&S). The measures for the period 2006 to 2010 have been agreed by ministers and are now being delivered by Scottish Water.

Provisional measures for the period 2010 to 2014 are included in the draft river basin management plan. These are subject to further consideration and ministerial approval (due in 2009), but in the Tay area investment is expected to result in:

- improved treatment to reduce nutrient loads, oxygen demand and ammonia at eight sewage works by 2014;
- upgrading to reduce pollution incidents at one sewage works by 2010 and at four sewage works by 2014;

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

The rate at which Scotland can deliver environmental improvements depends on the charges we are prepared to pay. These are determined by the Water Industry Commission for Scotland and approved by ministers. These charges are standardised across Scotland and are similar to charges in England and Wales.

4.1.3 What benefits will these actions bring?

These actions will bring about an improvement in the quality of the rivers, lochs and estuaries in the Tay area. We expect to see a reduction in phosphorus levels in almost 200km of river length and over 50km² of loch area.

Through a reduction in nutrient enrichment and the control of soil runoff we should see:

- a reduction in the erosion and loss of soil from valuable agricultural land;
- reduced smothering of fish spawning gravels;
- improved protection for drinking water sources and a resultant reduction in the cost of water treatment;
- improved quality of water supporting a greater diversity of plants and animals.

4.2 Changes to the physical habitat in rivers and barriers to fish migration

Changes to the physical habitat of our water environment can result in:

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

Changes to physical habitat that have been made to our rivers can:

- result from the damming of lochs providing storage for power generation and water supply;
- lead to a loss of natural bankside vegetation resulting in reduced shading and greater erosion;
- result from the straightening and deepening of rivers for flood defence and land drainage;
- create artificial barriers which restrict the ability of migratory fish to access habitat upstream of the structure.

The changes to physical habitat are not only affecting the quality of our rivers, but are also having an impact on the River South Esk SAC, affecting populations of freshwater pearl mussel.

Of the 900km of our river habitat (including HMWBs) failing to achieve good status or ecological potential for physical habitat, 325km are affected by hydropower and 108km are affected by public water supply. Many of the rivers are affected by multiple pressures that are still to be defined but include agricultural activities, historical engineering activities and flood defence, as well as hydropower and drinking water supply.

4.2.1 What actions are we taking?

Regulated activities

A number of actions are being taken to minimise the changes in physical habitat and to prevent the blockage of fish passage. When new engineering structures or engineering works are designed, SEPA can use the Controlled Activity Regulations (CAR) to ensure that appropriate mitigation measures are included and that in-stream engineering works only take place when the benefits clearly outweigh the ecological impacts.

Where a structure that is blocking fish passage is owned and operated by an individual or an organisation, it now needs to be licensed under the CAR. When these licences are reviewed, SEPA can ask for appropriate mitigation measures to be installed to ensure fish can pass through or around the structure.

In some cases, SEPA can take regulatory action to require the removal or modification of some redundant structures where an owner/responsible person can be identified. This particularly applies to redundant weirs where SEPA can require the provision of fish passage or the removal of the weir to improve downstream habitat and allow fish passage.

SEPA is in discussions with the hydropower industry and Scottish Water on how to deliver benefits for the water environment.

4.2.2 Actions by others

For those structures with no clear owner or operator, mitigation works will also need to be undertaken. The Fishery Boards and Trusts have worked for many years to remove or mitigate barriers to fish migration. This process has been constrained by financial and access problems and the scale of the work varies across the country. Many of the Boards are currently developing Fishery Management Plans, which are likely to prioritise the removal of fish barriers in their areas.

In many cases it is sufficient to give rivers more space by fencing or by creating buffer strips. This enables natural processes to allow rivers to recover their natural habitat diversity and structure. Because this type of restoration work is so closely related to the way land is managed, these actions will also reduce diffuse pollution impacts. The provision of best practice guidance to land managers, the implementation of the Water Environment (Diffuse Pollution) (Scotland) Regulations 2008 and support from the Scotland Rural Development Programme will contribute to minimising the impact from agricultural activities.

SEPA has secured funding of £1.1 million from the Scottish Government to support actions to restore the physical water environment over a three year period between 2008 and 2011. This funding will cover a wide range of restoration projects which will deliver multiple benefits. During the period leading up to the development of the final river basin management plan, SEPA will work with Area Advisory Groups to develop a wider range of proposals for restoration.

4.2.3 What benefits will these actions bring?

These actions will bring about a reduction in the number of artificial barriers to fish migration and an overall improvement in the physical habitat of our rivers in the Tay area. The measures undertaken within our area will contribute to an improvement in river habitat of around 4000km across Scotland.

Through a reduction in fish barriers and an improvement in physical habitat we should:

- improve the populations and distribution of fish;
- improve the amenity value of our rivers;
- prevent further deterioration of the physical habitat of our rivers.

4.3 Changes to water flow and water levels in rivers

Many of our rivers and lochs in the Tay area are affected by changes in water flow and water levels. Changes in water flows and water levels in rivers and lochs due to the abstraction of water or the damming of rivers can have impacts on the habitat and wildlife. A large reduction in water levels can lead to a bare zone that is unsuitable for plants or fish spawning. Rapid changes to river flows downstream of dams can lead to stranding of fish and temperature fluctuations. In contrast, stable flows below some dams may lead to sedimentation of fish spawning areas which are no longer cleaned out by spates. At a catchment scale lack of water can lead to problems for other water users.

There are a number of sources of abstraction. Of the 800km of rivers failing to meet environmental standards in 2007 due to changes to water levels and flows, approximately 700km are affected by abstraction for agriculture, more than 200km are affected by abstraction for drinking water supplies and 275km affected by abstraction for hydropower.

SEPA is working with hydropower and drinking water supply operators to identify areas where operations could be changed to deliver environmental improvements.

4.3.1 Abstraction for agriculture

In the Tay area the main use of water for agriculture is for irrigation to support the economically important production of fruit, vegetables and root crops (mainly potatoes). The main focus of this activity is in Angus and north east Fife, although other areas are affected. Although irrigation has increased substantially over the past 10 years regulatory controls have only recently been introduced. These controls will help to manage abstraction levels but there is much that farmers can do themselves to reduce the impact of their abstractions.

What action are we taking?

Scotland's Environmental and Rural Services (SEARS) partners will work to provide information to farmers in catchments affected by abstraction on how to minimise environmental impacts. The effectiveness of this work will be enhanced by support from the industry associations such as the Scottish Rural Property and Business Association (SRPBA) and the National Farmers Union of Scotland (NFUS).

Abstraction for farming is now licensed and this licence information provides the basis upon which SEPA assesses environmental impacts.

The cumulative impact of small scale abstraction is also of concern. Therefore it is vital that farmers consider:

- whether or not they have applied to abstract more water than they need;
- options for using water more efficiently by balancing irrigation with crop needs (this will reduce pumping costs and protect the environment);
- a catchment approach to abstraction to ensure over-abstraction does not occur from multiple users abstracting at the same time;
- whether alternative sources of water may be more appropriate and have less environmental impact;
- whether a storage pond may provide benefit.

Less water is available during dry periods when irrigation is required. Efficient use of our water is essential to ensure water is available not just for wildlife but for use by others downstream and to protect groundwaters.

4.3.2 What benefits will these actions bring?

The actions outlined for agricultural activity along with improvements that will be made through the regulation of abstraction for hydropower and drinking water supplies will contribute to an improvement in the water levels and flows of almost 200km of river length in the Tay area. Further measures are required to reduce the impact of abstraction on groundwater levels by 2015.

The consequences of these improvements will be:

- consistency of flows and levels, providing improved habitat for wildlife;
- improved fishery habitat increasing opportunities for recreational activities;
- greater security for all farmers within a catchment, particularly during dry periods.

4.4 Local measures

The Area Advisory Group has collated a list of projects and measures being implemented locally to help improve the condition of the water environment. During discussions on key issues and specific catchments in the Tay area, the AAG also identified further opportunities for possible projects to improve or protect the water environment provided the resources can be secured. AAG members will develop these proposals further during the next year for inclusion in the final area management plan.

A number of projects have already been agreed. Details of those directed at a specific water body are given on the GIS layer www.sepa.org.uk/water/river_basin_planning.aspx

New measures will need to be developed where existing measures will not deliver the level of protection, or the scale of improvement required by the WFD. Information on relevant measures and local partnership projects is presented in Table 5.

Table 5: Summary of measures and local partnership projects for the Tay area

Environmental improvement	Measure/action/project/partnership	Lead sector/organisation	Other partners
Reduce nutrient enrichment and high levels of nitrates in groundwater	Implementation of good agricultural and environmental conditions	Land managers	SEARS partners FWAG, SAC
	Nitrate vulnerable zones action programme	Land managers	Scottish Government
	SRDP	Land managers and Scottish Government	SEARS partners FWAG, SAC
	Environmental Focus Farms project	Land managers and SAC	SEPA, MLURI, Scottish Government
	Lunan Lochs project	Land managers and SNH	SEPA, MLURI
	Conservation of Atlantic salmon in Scotland (EU Life III project)	SNH	Esk and Tay DSFBs, FRS, FC, Scottish Government, SSE, the Crown Estate and others
	Improve treatment at 18 sewage works by 2014*	Scottish Water	
	Upgrade 1 sewage works by 2010 and 4 sewage works by 2014*	Scottish Water	
Improve the condition of the physical habitat of rivers and reduce barriers to fish migration	Mitigation measures required for new engineering works under the Controlled Activity Regulations (CAR)	SEPA	Drinking water supply and hydropower operators, land managers, developers, local authorities
	Removal or modification of redundant structures (eg mill of Keithwick weir)	SEPA	Tay DSFB, Drinking water supply and hydropower operators
Improve water levels and flows	Mitigation measures required for abstractions used for agriculture, drinking water supply and hydropower under the Controlled Activity Regulations (CAR)	SEPA	Land managers, drinking water supply and hydropower operators

* subject to further consideration and ministerial approval

FC – Forestry Commission FRS – Fisheries Research Service FWAG – Farming Wildlife Advisory Group DSFB – District Salmon Fisheries Board
MLURI – Macaulay Land Use Institute SEARS – Scotland’s Environmental and Rural Services SNH – Scottish Natural Heritage SAC – Scottish Agricultural College

4.5 What do you think?

This draft area management plan, as well as the detail held in the interactive GIS map, contains information on measures needed to improve the ecology of these water bodies. We need to ensure we have these actions right and that we have not missed any. Please bear this in mind when responding to the following questions.

Our work on measures will continue to develop during the consultation period; more information is available on the SEPA website www.sepa.org.uk/water/river_basin_planning.aspx

Question 3: As this is a draft plan, it is likely that we have not identified all measures which could lead to improvements in ecological status of the Tay advisory group area's water environment. Please let us know any measures we have missed.

Question 4: Could you or your organisation, potentially working in partnership with others, help deliver any of the following:

- A. Existing measures?
- B. Potential measures as set out on the SEPA website?
- C. Completely new measures?

Section 5 What priority issues will remain if we implement this plan?

This area management plan seeks to address a number of issues affecting the water environment of the Tay area. However, it is the first plan in a long-term process and it will be followed at six yearly intervals by subsequent plans that will build on the actions suggested here. We therefore have the opportunity to plan further ahead than the first planning round. As the process develops we will be able to build on what we have learnt from monitoring both the environment and the success of the actions we implement.

5.1 Potential additional measures

Production of the draft river basin management plan and area management plans has identified significant progress towards meeting the WFD's environmental objectives. However, preparation of these plans has also identified where there are gaps in measures to manage key pressures likely to have an impact in future planning cycles.

The process of setting objectives across the Scotland river basin district indicates that the following environmental problems in particular need additional measures to reduce their impacts:

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

The Scottish Government recognises the need to explore how we might fill these gaps and is considering a limited set of potential additional measures. These will be set out in a proposed Scottish Government consultation on continued improvements.

5.2 Invasive non-native species

The classification results identify the presence of North American signal crayfish in the Tay and South Esk catchments. The control of this species is considered a high priority for the local area.

There are other non-native and invasive species in the area (eg giant hogweed and Japanese knotweed) that impact on the water environment and more information on these will be captured in future plans. Some AAG member organisations have invested considerable time and funding in eradication programmes for these species which will help prevent their further spread. These efforts will be reflected in the final plan.

5.3 Future issues

Some issues are likely to become increasingly important in the future and need to be considered during the plan's implementation and in future river basin planning cycles. The list below is not exhaustive and we would welcome any views on similar issues.

5.3.1 Climate change

Climate change is evident in Scotland from observed trends in temperature, rainfall and snow cover. It is causing changes in the growing, breeding and migration seasons, shifts in species abundance and diversity, higher rainfall intensity and river flows leading to flood risk, and sea level rise causing flood risk and erosion. Left unchecked, climate change will accelerate causing damaging effects on physical, biological and chemical processes with significant consequences for Scotland's environment, economy and society. Climate change is different from the other issues discussed previously in that it affects all aspects of managing the water environment.

More information on the implications of climate changes on river basin management planning can be found in the draft RBMP for the Scotland river basin district.

5.3.2 EC Floods Directive and the Flood Risk Management (Scotland) Bill

The Flood Risk Management (Scotland) Bill, which was introduced on 29 September 2008, identifies SEPA as the lead authority for producing flood risk assessments, maps and river basin district flood risk management plans. In preparing these plans, SEPA will be responsible for agreeing and setting national objectives and measures to manage flood risk, and for prioritising these objectives and measures within and across planning cycles. This will also include linking directly into the WFD river basin planning process under the WEWS Act (2003).

Local authorities and other responsible authorities will be responsible for translating the district flood risk management plans produced by SEPA into implementation plans that identify and coordinate projects and schemes to manage flood risks at a catchment level where required. There will also be a requirement at this level to coordinate proposals with river basin planning.

5.4 What do you think?

Question 5: Are there any other remaining or future issues which should be included in the plan?

Section 6 What is the role of the Tay Area Advisory Group?

We all use water in our daily lives and we can all have an impact on our water environment with the actions we take. This is particularly the case for island communities, who often have a strong interaction with the water around them. It is therefore crucial that as many people as possible are involved in this planning process. To help facilitate this, SEPA established a network of eight Area Advisory Groups in the Scotland river basin district overseen and co-ordinated by a National Advisory Group.

6.1 National Advisory Group

The National Advisory Group is made up of representatives from responsible authorities, national stakeholders and key deliverers and has strong links with Scottish Ministers. The role of the group is to:

- oversee the river basin management planning process in Scotland;
- contribute to the preparation of the River Basin Management Plan; and
- coordinate the work of the AAGs.

6.2 The work and members of the Tay AAG

An AAG was established in the Tay area in mid-2006. Its members are listed below. The group has met regularly during the development of this plan, helping to interpret the Water Framework Directive at a local level and to those they represent on the group. The results of those meetings have fed into the actions for this plan.

As well as the involvement of AAG members in developing the area management plan, opportunities were taken to allow consultation with a wider group of stakeholders and interested parties. Consultation was carried out at the Tay Estuary Forum in April 2007 and through presentations to groups such as the Perth Access Forum.

Members of the Tay Area Advisory Group

- Angus Council
- Dundee City Council
- Fife Council
- Perth and Kinross Council
- Forestry Commission Scotland
- National Farmers Union Scotland
- Royal Society for the Protection of Birds (representing environmental Non Government Organisations)
- Scottish Environment Protection Agency
- Scottish Government Rural Payments and Inspections Department
- Scottish Natural Heritage
- Scottish and Southern Energy
- Scottish Rural Properties and Business Association
- Scottish Water
- Tay District Salmon Fishery Board (representing District Salmon Fishery Boards)
- Tay Estuary Forum
- British Ports Authority
- Loch Lomond and the Trossachs National Park (corresponding member)
- Cairngorms National Park (corresponding member)
- Stirling Council (corresponding member)

6.3 The future role of the Tay AAG

The proposed future role of the Tay AAG has three elements, which are summarised below. The role and remit of the Area Advisory Groups will be reviewed at the end of 2009 (ie after the final area management plans are published).

6.3.1 Refining objectives and classification for the final plan

The Tay AAG will be consulted on the process and priorities for reviewing and refining the classification and objectives results for the final plan. For some aspects information provided by the Tay AAG and sectors they represent may contribute to improving the assessments.

6.3.2 Developing and implementing measures

The Tay AAG will continue to identify local actions, both existing and planned, that are - or will be - implemented by individual land managers, voluntary organisations (eg catchment management groups), local authorities and national organisations working at a local level (eg RSPB Scotland).

Where existing measures will not deliver the level of protection, or the scale of improvement, required by the Water Framework Directive new measures will need to be developed. Area Advisory Groups will work on a wide range of voluntary actions.

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

6.3.3 Providing local knowledge and input to help SEPA deliver improvements

The group is also responsible for providing local knowledge and input to help SEPA deliver improvements:

- Drinking Water Safety Plans identify where action is required to reduce the risk of pollution which could affect public drinking water sources and which could require expensive new treatment provision. SEPA and Scottish Water will take this information to the Tay AAG over the next year with the intention of developing new measures for the final plan.
- The Tay AAG will provide input into directing a more targeted approach to tackling diffuse pollution as part of the national process of identifying 'priority catchments' for farm visits to identify hotspots, target measures and deliver one-to-one advice. These catchments will be identified on the basis of effectiveness of measures assessments, multiple benefits and Area Advisory Group priorities.
- The Tay AAG will work with SEPA and Scottish Water to provide the basis of identifying indicative Water Framework Directive objectives for 2021 and 2027 investment. These lists will prioritise wastewater treatment on the basis of the scale of the environmental, social and economic benefits that can be delivered. The output from this process will be the basis of SEPA's submission to the next Scottish Water investment round (Quality and Standards IV)¹.

¹Subject to Ministerial approval

Section 7 Working effectively together to target action in the Tay area: our implementation plan

Many of the measures required for the delivery of this plan are linked to other planning processes. To help ensure river basin management planning is integrated better with other planning processes in the future, a summary of the main plans and planning processes that are relevant has been collated for the draft RBMP for the Scotland RBD. Table 6 lists a summary of the key plans and planning processes and local examples.

Improving understanding and changing attitudes through public education and motivation has an important role to play in delivering improvement in the water environment. Changing existing plans, processes and regulation will be more effective in promoting improved water environment and achieving long-term success when delivered alongside education.

Table 6: Key plans and planning processes in the Tay area

Relevant plan and planning processes	Local examples
Town and country planning	<ul style="list-style-type: none"> • Development plans (structure and local plans) from 6 councils and also the Cairngorms and the Loch Lomond and Trossachs National Park plans set out the development context linked to the aims of river basin planning.
Community planning	<ul style="list-style-type: none"> • SEPA has been asked to contribute environmental objectives to a single outcome agreement between Local Councils and the Scottish Government.
Coastal planning	<ul style="list-style-type: none"> • The Tay estuary forum (a coastal partnership is developing the Tay estuary management plan • Angus Council shoreline management plan • Inner Tay Estuary local Nature Reserve management plan • Fife Shoreline management plan
Local Biodiversity Action Plans (LBAPs)	<ul style="list-style-type: none"> • Fife LBAP • Tayside LBAP • Loch Lomond and the Trossachs National Park BAP • Cairngorms National Park BAP
SNH 'Natural Heritage Futures'	<ul style="list-style-type: none"> • These publications link to a wide range of national and local strategies and initiatives including the WFD and the Habitats Directive and Birds Directive.
Management of Natura 2000 sites	<ul style="list-style-type: none"> • SNH produces site management statements for each site.
Scotland Rural Development Programme	<ul style="list-style-type: none"> • The rural priorities grant scheme in the Tay area assists land managers to implement actions that benefit the water environment in predominantly agricultural areas.
Flood Management Plans	<ul style="list-style-type: none"> • Under the new Floods Directive, flood management plans will need to be prepared by 2015. These will need to link to future versions of the river basin management plan.
Scottish Water Quality and Standards III Planning	<ul style="list-style-type: none"> • Provisional measures for the period 2010–2014 are included in the draft RBMP for the Scotland RBD though they are subject to further consideration and ministerial approval (due 2009).
Catchment Management Plans	<ul style="list-style-type: none"> • Lunan Lochs project • River South Esk catchment management plan • Forfar Lochs project • Conservation of Atlantic salmon in Scotland (EU Life III project); • Montrose basin management plan

7.1 What do you think?

The involvement of so many stakeholders in the AAGs will hopefully encourage future actions to be co-ordinated and ensure that, when other plans are reviewed, they take into account the aims of river basin planning.

Question 6: Are there any other particular plans, strategies or processes which could lead to improvements in the water environment of the Tay area and which should be included in this plan?

Section 8 How we will measure our success

Having developed this plan we must assess how successful the process has been, both in terms of environmental improvement and effective partnership working. There will be an opportunity to review the first cycle of the river basin planning process and we can then build on the lessons learnt for future planning cycles.

8.1 Monitoring

This plan sets goals for the water environment. It also sets out how we wish to achieve them and how quickly we expect to see changes. It will also influence where or how new activities which may impact on the water environment can happen. It is important to deliver this plan as efficiently as we can.

To understand whether we are meeting these goals and how we are doing it we propose monitoring:

- environmental outcomes;
- measuring implementation;
- how we are working together.

8.1.1 Environmental outcomes

We will assess improvements to the water environment itself through on-going biological and chemical monitoring. This monitoring is a requirement of the WFD. The monitoring strategy for the Scotland RBD can be found in the WFD aquatic monitoring strategy available on the SEPA website. We will also use monitoring undertaken by other organisations (eg Scottish Natural Heritage) to assess environmental improvements, and progress reporting for sector specific plans such as fishery management plans etc. Investigative monitoring during and after local projects have been undertaken will also indicate environmental change in response to pressures. Objectives for each water body will be revised in the next river basin management plan, following the monitoring results.

The Strategic Environmental Assessment for the Scotland River Basin District sets out a monitoring plan to assess the environmental impact of the river basin planning process. Further information can be found on the SEPA website www.sepa.org.uk/water/river_basin_planning.aspx

8.1.2 Measuring implementation

We are currently considering how and at what scale it is appropriate to monitor how this plan is being implemented and what it is influencing. We welcome your views on those actions you feel it is important to measure and how collectively we can monitor and report progress on achieving the goals in this area management plan.

The programme of measures will be reviewed to ensure that actions are happening to deliver this plan's objectives.

We will monitor the uptake of funding in this area from the SRDP and restoration funding.

In some cases measures may have been successfully implemented but we may need to wait before we see changes in ecological status. Alternatively we may still require additional measures to achieve good ecological status for the water body.

8.1.3 How we are working together

The effectiveness of partnership working will be measurable to some extent through the improvements to the environment. However, partnership working is generally harder to assess as it is less tangible than many of the other parameters that will be monitored for the water environment.

During the consultation process for this plan, we need to consider how we can effectively assess the impact of partnership working on the success of the river basin planning process. This may include assessing how the process has increased knowledge, trust and understanding for different stakeholders.

The impact of this plan on the work of others can also be assessed through the number of links and references to this area management plan in other plans and processes throughout the area.

We would like your views on how we can monitor whether we are working together well and how efficient it is. We suggest the following as indicators:

- links between plans and processes
- links to RBMP in corporate plans

We will also be able to assess wider public interest in the river basin planning process through:

- attendance at forum and other events;
- the extent to which the wider public respond to this consultation.

We are due to review the role of the Area Advisory Groups at the end of 2009. We propose to further review how we are working through the AAG and local partnerships during the implementation period for this plan. This will help to ensure we are learning from best practice and that we alter the way we work together where it is not delivering outcomes for this area.

8.2 Reporting

Each year we will publish our assessment of the classification of water bodies updated with monitoring data from the previous year.

8.3 What do you think?

We welcome your views on which measures you feel it is important to monitor and how we can collectively monitor and report progress on achieving the goals in this area management plan.

Question 7: Which measures do you feel it is important to monitor? How can we collectively monitor and report progress on achieving the goals in the Tay area management plan?

Question 8: Overall, do you think we have identified the best methods for measuring our success in implementing the RBMP for the Scotland RBD? Can you suggest additional methods?

Glossary

Term	Definition
Algae	A general term for a group of photosynthetic organisms (microscopic or very large such as seaweeds), which may have bacteria-like cell structures or ones like all other organisms, containing chlorophyll a and a variety of other pigments that give the organisms a range of characteristic colours.
Algal bloom	An algal bloom is a rapid increase in the population of algae (microscopic and macroalgae) in an aquatic system. Algal blooms may occur in freshwater as well as marine environments. Some blooms may be recognised by discoloration of the water resulting from the high density of pigmented cells. Some algal blooms are the result of an excess of nutrients (particularly phosphorus and nitrogen). As the algae die off this dead organic matter becomes food for bacteria that degrade it using oxygen. When the dissolved oxygen content decreases, many fish and aquatic insects cannot survive. Algal blooms may also produce neurotoxins.
Biodiversity	The richness and complexity of plant and animal communities.
Buffer strip	A 1–5 metre strip of agricultural land left uncultivated alongside watercourses to minimise erosion.
Catchment	An area from which surface run-off is drained away into a river.
Culvert	A culvert is a conduit used to enclose a flowing body of water. It may be used to allow water to pass underneath a road, railway or embankment for example.
Cyprinid	Family of freshwater fish including carps, true minnows and their relatives (e.g. barbs)
Diffuse pollution	Pollution arising from land use activities (urban and rural) dispersed across a catchment or sub-catchment, and which does not arise as a result of the discharge of an industrial, domestic sewage, deep mine or farm effluent (this is point source pollution).
Ecological	From ecology which is the scientific study of systems of living organisms and the interactions among organisms their environment.
Ecosystem	Living organisms (species, populations and communities of plants and animals), their physical environment (habitat) and their inter-relationship within a particular system.
Estuary	Area at the mouth of a river where it broadens into the sea and where fresh and sea water mix to produce brackish water.
Faecal coliforms	A specific type of coliform bacteria found only in the gut, where they can aid the digestion of food, and consequently can be found in waters suffering recent contamination with human sewage or animal faeces. The number of faecal coliform bacteria found in 100 millilitres (ml) of water is used as an indicator of pollution by faecal material.
General binding rule (GBR)	A level of authorisation under the Controlled Activities Regulations
Groundwater	The term groundwater refers to all water that is below the surface of the ground in the saturated zone and which is in direct contact with the ground or subsoil.
Habitat	Place where an organism (e.g. human, animal, plant, microorganism) or population of organisms live, characterised by its surroundings, both living and non-living.
Inorganic	Composed of material other than plant or animal matter.
Invasive non-native species	Invasive species which are not native but which have successfully established themselves in our aquatic ecosystems, resulting in damage to our natural biodiversity and creating potentially significant impacts.
Macroalgae	Also referred to as algae or seaweed. Large aquatic plants found in freshwater and marine waters.
Measure	A measure is an action taken to improve or maintain the condition of a water body.

Morphology	Physical attributes that describe the shape, form and texture of river or loch environments, e.g. bars, sediment, riffles.
Nitrate	Soluble nitrate is an important limiting factor in the growth of certain bacteria in ocean waters. In many places in the world, artificial fertilisers applied to crop lands to increase yields result in run-off delivery of soluble nitrogen to oceans at river mouths. This process can result in eutrophication of the water, as nitrogen-driven bacterial growth depletes water oxygen.
Nitrate Vulnerable Zone (NVZ)	An area designated in accordance with the requirements of the Nitrate Directive 91/676/EEC, which aims to reduce water pollution caused by nitrates from agricultural sources. For more information see http://www.scotland.gov.uk/Topics/Agriculture/Environment/NVZintro
Nutrient	A nutrient is either a chemical element or compound used in an organism's metabolism or physiology. Oversupply of plant nutrients in the environment can cause excessive plant and algae growth.
Pesticide	Any substance, preparation or organism prepared or used (among other uses) to: protect plants or wood or other plant products from harmful organisms; regulate the growth of plants; give protection against harmful creatures; or render such creatures harmless.
Phosphate Phosphorus	Phosphorus is an essential component of living systems and is found in nervous tissue, bones and cell protoplasm. Phosphates are the naturally occurring form of the element phosphorus and are found in many phosphate minerals. In ecological terms, phosphate is often a limiting reagent in environments, and its availability may govern the rate of growth of organisms. Addition of high levels of phosphate to the environment can have significant ecological consequences (e.g. algal blooms).
Phytobenthos	Microscopic plants attached to the bottom of ponds, lakes, rivers and seas. This includes some diatoms which are particularly sensitive to nutrient enrichment.
Phytoplankton	A community of largely microscopic algae, adapted to suspension in waters, and maintained in suspension by wind-generated water currents.
Point source pollution	Pollution caused by a discharge from a fixed installation such as the end of a pipe, stack or drain.
Programme of Measures	The combination of national, regional and local measures being taken to improve or maintain the condition of water bodies in the river basin district.
Riparian	Relating to a river bank
Run-off	Portion of rainfall, melted snow or irrigation water that flows across the ground's surface and is eventually returned to streams. Run-off can pick up pollutants from air or land and carry them to receiving waters.
Saline	Water with a salt concentration greater than 18 parts per thousand (ppt)
Salmonids	Freshwater fish of the salmonid family (e.g. salmon, trout)
Saltmarsh	Comprise the upper, vegetated portions of intertidal mudflats, lying approximately between mean high water neap tides and mean high water spring tides.
Septic tank	A septic tank is a small-scale sewage treatment system common in areas with no connection to main sewerage pipes. The term 'septic' refers to the anaerobic bacterial environment that develops in the tank and which decomposes or mineralises the waste discharged into the tank. Periodic maintenance is required to remove the irreducible solids which settle and gradually fill the tank, reducing its efficiency. A properly cared for system can last for decades and possibly a lifetime.
Sewage	The waterborne wastes of a community. Domestic sewage is derived from a residential area. An industrial sewage is from a mixed residential and industrial area. Storm sewage is that flowing to a treatment works in wet weather or discharged from storm overflows, when the sewage is diluted to a greater or lesser extent with rain water.

Sewerage	A system of pipes and appurtenances for the collection and transportation of domestic and industrial waste waters.
Sheep dip	The term sheep dip refers to a liquid formulation of insecticide and fungicide which shepherds and farmers may use to protect their sheep from infestation against external parasites. The sheep are completely immersed in the preparation. Sheep dips have been found to contaminate surrounding soil, creating environmental problems.
Silage	Silage is fermented, high-moisture forage that can be fed to ruminants (cud-chewing animals such as cattle and sheep). Silage must be firmly packed to minimise the oxygen content or it will spoil.
Sustainable urban drainage system (SUDS)	SUDS are designed to reduce the potential of flooding on new and existing urban developments. Unlike traditional urban stormwater drainage systems, they also help to protect and enhance ground water quality.
Turbidity	Hazy or cloudy condition of water due to the presence of suspended particles, such as fine solids.
Water table	The water table is the surface where the water pressure is equal to atmospheric pressure. In undeveloped regions or areas with high amounts of precipitation, the water table roughly follows the contour of the overlying land surface, and rises and falls with increases or decreases in infiltration.
Wetlands	Areas that are inundated by surface water or groundwater at a frequency sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth or reproduction.

