The river basin management plan for the Solway Tweed river basin district 2009–2015

Chapter 4:
Heavily modified and artificial water bodies

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1. Introduction

This chapter summarises:

- the process used to designate water bodies as heavily modified or artificial;
- the agencies' assessment of the condition of these water bodies;
- the environmental objectives that have been set for these water bodies.

Some surface water bodies have been substantially altered in character for purposes such as navigation, power generation, public water supply provision, recreation, land drainage and other important human sustainable development activities.

The alterations to the water bodies' physical characteristics may have been caused by:

- direct engineering modifications to the structure and condition of the bodies' beds, banks and shores - or morphological characteristics - (eg engineered concrete flood defence walls, etc);
- substantial changes to water flows and levels (eg the disruption of water flows and levels caused by large dams) that have consequent impacts on the structure and condition of the beds, banks and shores of water bodies.

Where their physical characteristics cannot be restored without significant adverse impacts on the uses served by the alterations or on the wider environment, the agencies have identified the water bodies for designation as heavily modified.

The ecological quality of heavily modified water bodies (HMWBs) is described by their "ecological potential". This is a measure of how the ecological quality of such a water body compares with the maximum quality achievable without significant adverse impacts on:

- the purposes served by the physical alterations (eg flood defence or hydropower generation);
- the wider environment.

Water bodies have been designated as artificial water bodies (AWBs) if they were created where no water body previously existed (eg most canals and some reservoirs). As for HMWBs, the ecological quality of AWBs is described by their ecological potential.

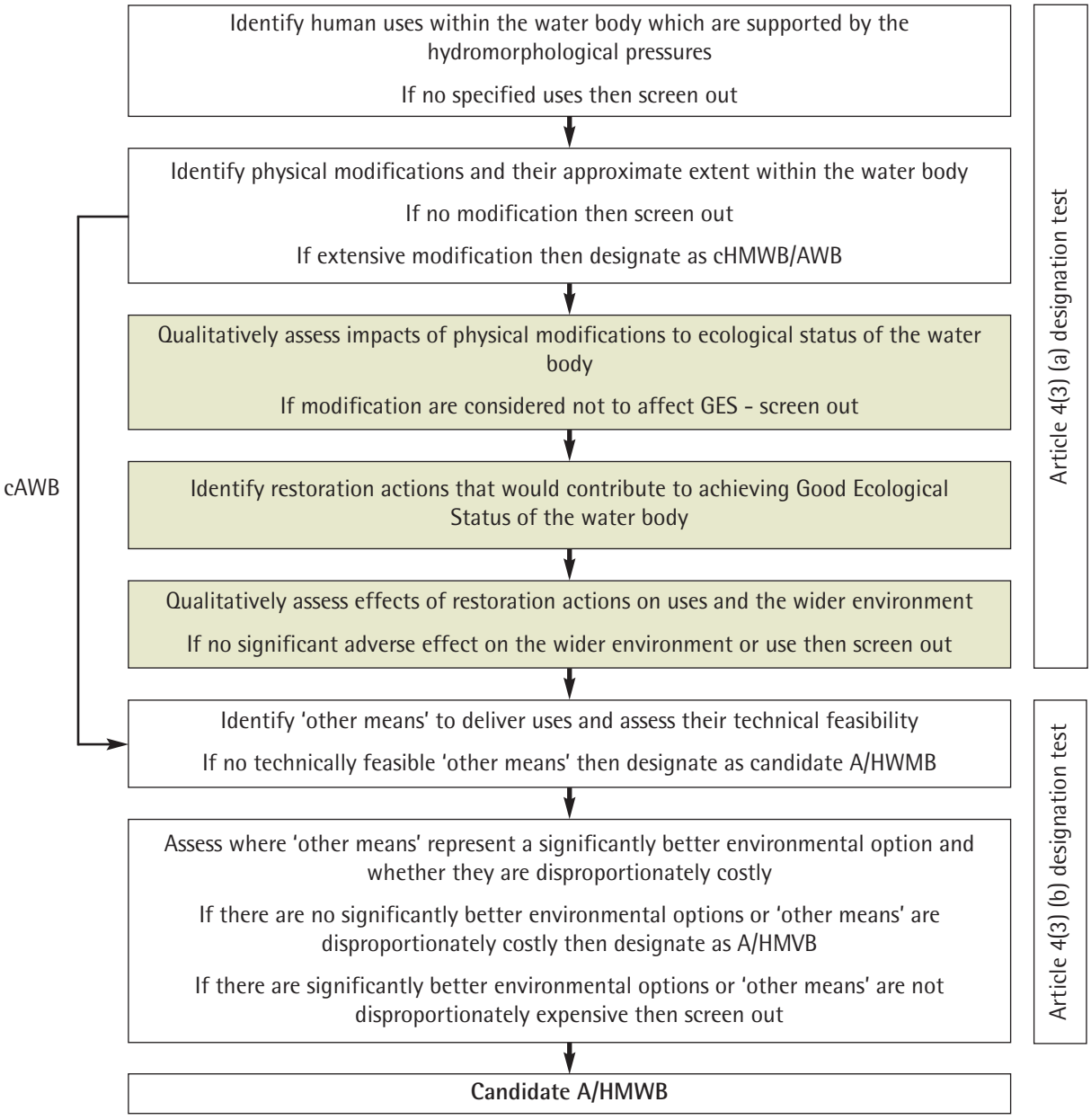
Except where so doing is technically infeasible or disproportionately expensive, the objective for a HMWB or AWB that is not at maximum or good ecological potential is to achieve good ecological potential by 2015. Longer timescales, for example by 2021 or 2027, may be set if improvement is possible but it is technically infeasible or disproportionately expensive to do by 2015.

2. Designation of heavily modified or artificial water bodies

As part of the initial characterisation of the Solway Tweed river basin district[1], which was completed in 2004 and reported in 2005[2], SEPA and the Environment Agency provisionally identified water bodies as heavily modified or artificial. These 'candidate' HMWBs were then screened to identify those that clearly met the criteria for designation.

Figure 1 below shows how individual water bodies were assessed to see if they met the criteria for designation as artificial or heavily modified.

Figure 1: Heavily modified and artificial water bodies assessment process



[1] www.sepa.org.uk/water/river_basin_planning/significant_issues.aspx
[2] www.sepa.org.uk/water/river_basin_planning/significant_issues.aspx

The approach to designating water bodies is set out in European guidance[3]. If you want to find information about a particular water body, please use the interactive map on SEPA's website: www.sepa.org.uk/water/river_basin_planning.aspx

Following the initial characterisation work, SEPA and the Environment Agency gathered additional information to help refine the risk assessments. This resulted in a small number of additional candidate HMWBs being identified. The initial results of this work were published in 2007 in our report on the significant water management issues in the Solway Tweed river basin district[4].

Since the publication of the significant water management issues report[5] and the draft river basin management plans, SEPA and the Environment Agency gathered further information and worked with our key stakeholders on the designation process. This resulted in the identification of a number of additional heavily modified and artificial water bodies and led to some candidate HMWBs/AWBs being de-designated.

Table 1 shows the numbers and lengths/areas respectively of heavily modified and artificial water bodies by water body category designated for different purposes in the Solway Tweed river basin district. Note that some water bodies are designated for more than one purpose and, as such, are counted more than once in the tables throughout this chapter.

Table 1: Number of HMWBs/AWBs in the Solway Tweed river basin district

		River	Loch/lake	Estuary	Coastal	Artificial
Purpose for which water body designated						
Protection of wider environment	Biodiversity	1 10 km	1 7 km^2	0	0	0
	Built heritage	0	0	0	0	0
Water storage	Drinking water supply	16 184 km	11 14 km^2	0	0	6 7 km
	Power generation	12 132 km	3 11 km^2	0	0	0
Flood protection and land drainage	Urban and agriculture	30 364 km	0	0	0	0
Other sustainable development activities		0	0 0	1 1 km^2	0	0

[3] www.wfduk.org
[4] www.sepa.org.uk/water/river_basin_planning/significant_issues.aspx
[5] www.sepa.org.uk/water/water_publications/swmi.aspx

3. Classification of heavily modified and artificial water bodies

Heavily modified and artificial water bodies are assessed against their ecological potential. This is a measure of how the ecological quality of such a water body compares with the maximum quality achievable given the physical constraints imposed by its use. In Scotland the ecological potential classification is grouped into good or better and moderate, poor or bad. In England the classifications have been grouped together as 'good or better' or 'moderate or worse'. Within this chapter the combined Scottish and English data are reported using the English groupings.

If you want to find out about the classification results for a particular water body, please use the interactive map on SEPA's website: www.sepa.org.uk/water/river_basin_planning.aspx

To classify the ecological potential of heavily modified and artificial water bodies, SEPA and the Environment Agency applied the methodology[6] recommended by the UK Technical Advisory Group[7] (UKTAG). This method is based on an approach agreed between Member States and the European Commission under the Common Implementation Strategy for the Water Framework Directive[8].

The approach requires agreed mitigation measures appropriate for each use to be implemented to improve the hydromorphological characteristics (water flow and physical conditions) as much as possible without having significant adverse impacts on the use or the wider environment. For example, among other factors, a hydropower scheme must allow fish passage through an appropriate mechanism such as a functioning fish pass, and also release adequate compensation flow to sustain the natural ecology downstream of the dam, as long as these provisions do not impact significantly on power generation.

The application of the methodology required a judgement to be made on whether a mitigation measure would have a significant impact on the use. In some cases, consideration of cumulative effects is important in assessing the significance of impacts on the benefits provided by a particular type of use. Where all appropriate mitigation measures are in place, a water body is assessed as meeting good ecological potential.

The application of this classification process requires knowledge of the specific characteristics of the water bodies as well as of the needs of the users reliant on the modified or artificial characteristics.

In England, expert consultants identified appropriate mitigation measures with input from affected sectors. In Scotland, mitigation measures were discussed and agreed at a series of workshops with water managers and other stakeholders. This process is described in Annex 2 available on the SEPA website at www.sepa.org.uk/water/river_basin_planning.aspx

All artificial and heavily modified water bodies are assessed using the same standards as apply to similar unmodified water bodies (see Chapter 1 available on the SEPA website at www.sepa.org.uk/water/river_basin_planning.aspx). These results have been used by SEPA and the Environment Agency to assist further in understanding the degree of impacts the modifications or other factors have on the overall health of the water body.

Once the mitigation measures have been assessed and the severity of impact on hydrology and morphology accounted for, the assessments for other water quality elements used in all surface water bodies are combined to give the overall ecological potential classification. For example, a HMWB could have all the mitigation measures in place for the use to allow it to reach good ecological potential but if water quality is poor due to pollution, the best its overall ecological potential could be is poor.

Due to the complex assessments required for HMWBs and AWBs SEPA used a number of working assumptions additional to those set out in the UKTAG methodology.

[6] www.wfduk.org/tag_guidance/Article%20_11/POMEnvStds/gep_guidance_final

[7] The UK Technical Advisory Group on the Water Framework Directive established by the UK government administrations and comprising representatives from SEPA, the Environment Agency, the Environment & Heritage Service for Northern Ireland, SNH, Natural England, Countryside Council for Wales and the Department for the Environment & Local Government in the Republic of Ireland.

[8] www.wfduk.org

3.1 Classification results for impacts from designated uses

We have split the classification results for HMWBs and AWBs into classification of:

- hydrology and morphology related to the designated use;
- the overall ecological potential once water quality and other factors are taken into account.

This makes it clear where mitigation measures related to the designated use are in place and where other factors (eg water quality (chemistry) or the presence of invasive non-native species) not related to the designated use are affecting the overall ecological potential classification.

The assessments of the ecological potential class of heavily modified and artificial water bodies for all Scottish and English HMWBs and AWBs in terms of only hydrology and morphology following the mitigation measures assessment are summarised in Table 2 in terms of:

(a) type of water body (river, loch, estuary, coastal);

(b) designated use of the water body.

These results are based on the information available to SEPA and the Environment Agency as of September 2009.

Table 2(a): Classification of ecological potential for heavily modified and artificial water bodies for hydromorphological impacts only (excluding assessment of water chemistry etc) by water body type

		Good or better	Moderate or worse	Total
River	Number	17	40	57
	Length (km)	172	498	670
Loch/lake	Number	7	9	16
	Area (km²)	16	9	25
Estuary	Number	1	0	1
	Area (km²)	2	0	2
Coastal	Number	0	0	0
	Area (km²)	0	0	0
Artificial (canals)	Number	0	0	0
	Length (km)	0	0	0
Artificial (other)	Number	6	0	6
	Length (km)	7	0	7
	Area (km²)	0	0	0
Total number of water bodies		**31**	**49**	**80**

Table 2(b): Classification of ecological potential for heavily modified and artificial water bodies for hydromorphological impacts only (excluding assessment of water chemistry etc) by purpose for which water body designated

Purpose		Good or better			Moderate or worse			Total		
		Number	Length	Area	Number	Length	Area	Number	Length	Area
Wider environment	Biodiversity	2	10	7	0	0	0	2	10	7
	Built heritage	0	0	0	0	0	0	0	0	0
Navigation	Canals	0	0	0	0	0	0	0	0	0
	Inland waterways excluding canals	0	0	0	0	0	0	0	0	0
	Ports and harbours	0	0	0	0	0	0	0	0	0
Water storage	Water supply	16	61	5	17	130	9	33	191	134
	Power generation	4	22	11	11	110	0.5	15	132	11
	Navigation	0	0	0	0	0	0	0	0	0
Flood protection and land drainage	Urban and agriculture	9	97	0	21	267	0.0	30	364	0
Other sustainable development activities		2	0	1.5	1	0.1	0	3	0.1	2

3.2 Classification results for overall ecological potential

Table 3 combines the results in Table 2 with monitoring results used to assess the effects of pollution, if any, on the water bodies concerned and of other pressures to give overall ecological potential. The data on the effects of pollution and other pressures is based on information available as of September 2009.

Map 1 shows the overall ecological potential results for heavily modified and artificial water bodies.

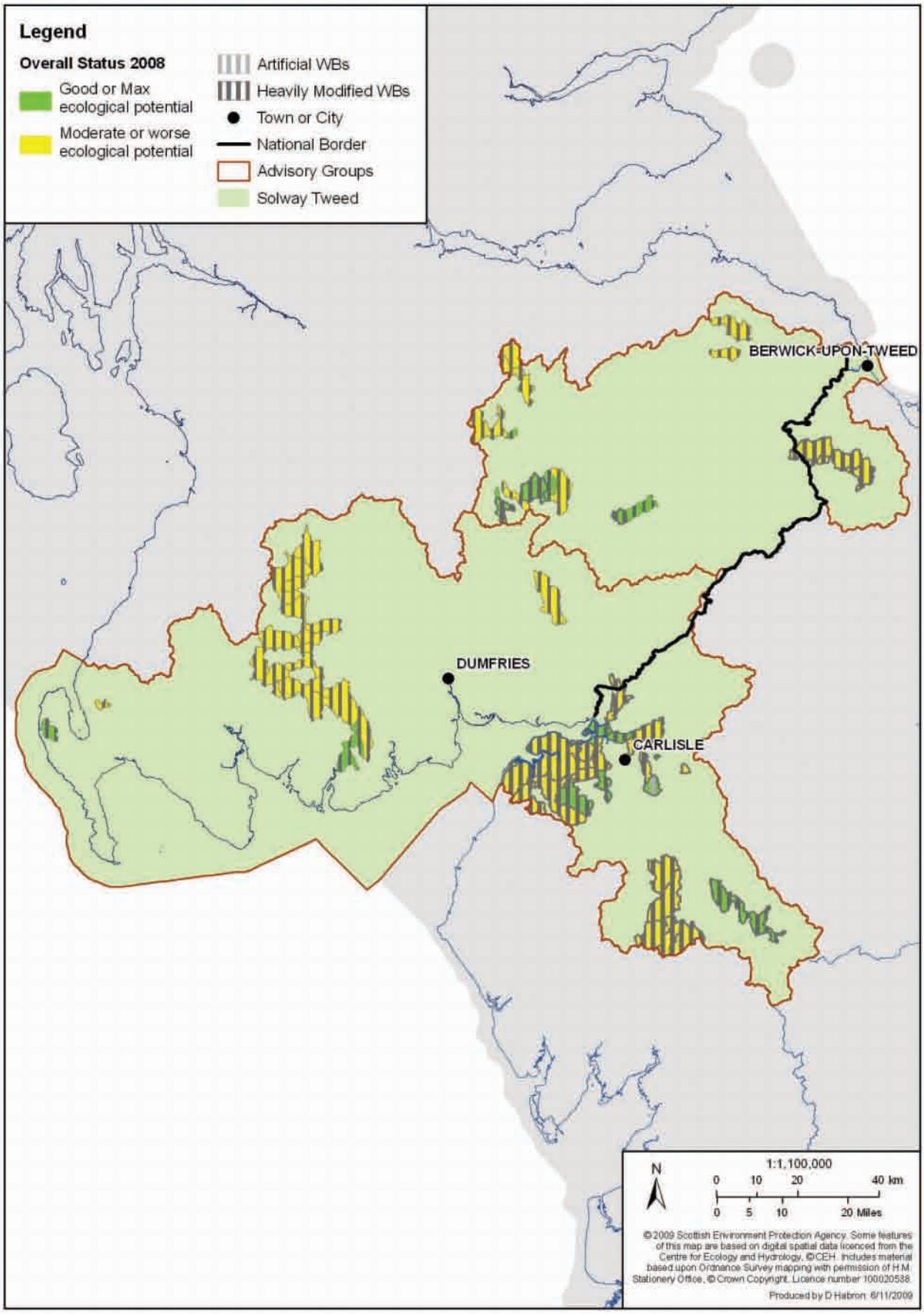
Table 3(a): Overall ecological potential classification results for heavily modified and artificial water bodies by water type

		Good or better	Moderate or worse	Total
River	Number	13	44	57
	Length (km)	124	546	670
Loch/lake	Number	4	12	16
	Area (km²)	4	21	25
Estuary	Number	1	0	1
	Area (km²)	1	0	1
Coastal	Number	0	0	0
	Area (km²)	0	0	0
Artificial (canals)	Number	0	0	0
	Length (km)	0	0	0
Artificial (other)	Number	6	0	6
	Length (km)	7	0	7
	Area (km²)	0	0	0
Total number of water bodies		**24**	**56**	**80**

Table 3(b): Overall ecological potential classification results for heavily modified and artificial water bodies by purpose for which water body designated

Purpose		Good or better			Moderate or worse			Total		
		Number	Length	Area	Number	Length	Area	Number	Length	Area
Wider environment	Biodiversity	2	0	0	0	10	7	2	10	7
	Built heritage	0	0	0	0	0	0	0	0	0
Navigation	Canals	0	0	0	0	0	0	0	0	0
	Inland waterways excluding canals	0	0	0	0	0	0	0	0	0
	Ports and harbours	0	0	0	0	0	0	0	0	0
Water storage	Water supply	13	32	4	20	159	10	33	191	14
	Power generation	1	15	0	14	117	11	15	132	11
	Navigation	0	0	0	0	0	0	0	0.0	0
Flood protection and land drainage	Urban and agriculture	8	85	0	22	280	0	30	364	0
Other sustainable development activities		2	0	2	1	0.1	0	3	0.1	2

Map 1: Overall ecological potential classification results for heavily modified and artificial water bodies



4. Objectives for heavily modified and artificial water bodies

The objective for a water body designated as heavily modified or artificial that is not already at maximum or good ecological potential is to restore it with the aim of achieving good ecological potential by 2015.

Under certain circumstances the deadline for achieving good ecological potential may be extended to 2021 or 2027, or a less stringent objective may be applied. For example, an extended deadline could be applied if achieving good ecological potential by an earlier date would be disproportionately expensive or technically infeasible. This flexibility allows improvements to be prioritised over successive planning cycles whilst not imposing unreasonable burdens on those who have to pay for them.

Phasing measures may also allow significant environmental improvements to be made without significant adverse impacts on the benefits provided by the uses of water bodies. For example, increasing the compensation flow from a hydropower dam to benefit river ecology is likely to result in a reduction in the electrical output which could cause difficulties for electricity supply. However, if phased over the longer term, the reduction might be offset by increases in output made elsewhere during the intervening period and consequently not represent a significant adverse impact.

In setting objectives for heavily modified and artificial water bodies, the Environment Agency and SEPA have followed UKTAG guidance as well as principles for objective setting laid down by the Scottish Government and Defra.

SEPA and the Environment Agency have identified improvements for the hydromorphological characteristics of HMWBs/AWBs and used this to identify objectives for 2015, 2021 and 2027. These objectives take account of the extent to which other impacts on the water bodies (eg impacts on their water quality and chemistry) are expected to be reduced over time. Information on the general approach used for objective setting and on how SEPA and the Environment Agency has identified improvements relevant to impacts on water quality is set out in Chapter 2 available on the SEPA website at www.sepa.org.uk/water/river_basin_planning.aspx

The objectives set are intended to strike the right balance between the protection and improvement of the water environment (taking account of the benefits this brings) and the interests of those who depend upon it for their livelihoods and quality of life. By definition, none of the objectives should have a significant adverse affect on the use for which the modified or artificial water bodies were created.

In order to set objectives, improvements are predicted for both the mitigation measures test related to the designated use (the hydromorphological objective) and also improvements to the overall ecological potential once water quality (chemistry) is taken account of (the overall objective). This makes it clear where improvements related to the designated use are being made by water managers and where other factors, such as water quality (chemistry), not related to the designated use, are affecting the overall ecological potential objectives.

If you would like information on the objectives for particular water bodies, please use the interactive map on SEPA's website: www.sepa.org.uk/water/river_basin_planning.aspx

4.1 Anticipated improvements to impacts from designated uses

The objectives identified for the hydromorphological characteristics of the heavily modified and artificial water bodies were identified based on consideration of:

(i) the level of confidence in the classification;

(ii) the spatial extent of adverse impacts;

(iii) the scale of mitigation required and hence the costs and the extent of technical planning and preparation required;

(iv) planned asset refurbishment or replacement schedules.

These considerations helped to identify environmental priorities and balance them against judgements of what was likely to be technically feasible and proportionate to achieve over a given timescale. The companies and organisations relying on the heavily modified or artificial characteristics provided information to help make these judgements.

Table 4 shows ecological potential objectives by water body type and designated purpose for both Scottish and English HMWBs and AWBs, taking into account the mitigation measures which are planned in each river basin planning cycle to address the hydromorphological impacts from the designated uses.

Table 4(a): Objectives for 2015, 2021 and 2027 for ecological potential for heavily modified and artificial water bodies for hydromorphological impacts only (excluding assessment of water chemistry etc) by water body type

Type		2008 (classification)		2015		2021		2027	
		Good or better	Moderate or worse	Good or better	Moderate or worse	Good or better	Moderate or worse	Good or better	Moderate or worse
River	Number	17	40	22	35	25	32	57	0
	Length (km)	172	498	338	422	271	399	670	0
Loch	Number	7	9	9	7	10	6	16	0
	Area (km²)	16	10	20	5	20	5	25	0
Estuary	Number	1	0	1	0	1	0	1	0
	Area (km²)	1	0	1	0	1	0	1	0
Coastal	Number	0	0	0	0	0	0	0	0
	Area (km²)	0	0	0	0	0	0	0	0
Artificial (canals)	Number	0	0	0	0	0	0	0	0
	Length (km)	0	0	0	0	0	0	0	0
Artificial (other)	Number	6	0	6	0	6	0	6	0
	Area (km²)	7	0	7	0	7	0	7	0

Table 4(b): Objectives for 2015, 2021 and 2027 for ecological potential for heavily modified and artificial water bodies for hydromorphological impacts only (excluding assessment of water chemistry etc) by purpose for which water body designated

Type		2008 (classification)		2015		2021		2027	
		Good or better	Moderate or worse	Good or better	Moderate or worse	Good or better	Moderate or worse	Good or better	Moderate or worse
Protection of wider environment	Biodiversity	2	0	1	1	1	1	2	0
	Built heritage	0	0	0	0	0	0	0	0
Navigation	Canals	0	0	0	0	0	0	0	0
	Inland waterways excluding canals	0	0	0	0	0	0	0	0
	Ports and har bours	0	0	0	0	0	0	0	0
Water storage	Water supply	13	20	21	12	21	12	33	0
	Power generation	1	14	6	9	10	5	15	0
	Navigation	0	0	0	0	0	0	0	0
Flood protection and land drainage	Urban and agriculture	9	21	9	21	10	20	30	0
Other sustainable development activities		2	1	2	1	2	1	3	0

Table 4(b): Objectives for 2015, 2021 and 2027 for ecological potential for heavily modified and artificial water bodies for hydromorphological impacts only (excluding assessment of water chemistry etc) by purpose for which water body designated (continued)

Purpose		Good or better		Moderate or worse	
2015		Length	Area	Length	Area
Wider environment	Biodiversity	10	7	0	0
	Built heritage	0	0	0	0
Navigation	Canals	0	0	0	0
	Inland waterways excluding canals	0	0	0	0
	Ports and harbours	0	0	0	0
Water storage	Water supply	107	9	84	5
	Power generation	51	11	81	0.51
	Navigation	0	0	0	0
Flood protection and land drainage	Urban and agriculture	97	0	267	0
Other sustainable development activities		0	2	0	0.1

Purpose		Good or better		Moderate or worse	
2021		Length	Area	Length	Area
Wider environment	Biodiversity	0	7	10	0
	Built heritage	0	0	0	0
Navigation	Canals	0	0	0	0
	Inland waterways excluding canals	0	0	0	0
	Ports and harbours	0	0	0	0
Water storage	Water supply	107	9	84	5
	Power generation	74	11	58	0
	Navigation	0	0	0	0
Flood protection and land drainage	Urban and agriculture	106	0	258	0
Other sustainable development activities		0	2	0	0.1

Purpose		Good or better		Moderate or worse	
2027		Length	Area	Length	Area
Wider environment	Biodiversity	10	7	0	0
	Built heritage	0	0	0	0
Navigation	Canals	0	0	0	0
	Inland waterways excluding canals	0	0	0	0
	Ports and harbours	0	0	0	0
Water storage	Water supply	191	14	0	0
	Power generation	132	11	0	0
	Navigation	0	0	0	0
Flood protection and land drainage	Urban and agriculture	364	0	0	0
Other sustainable development activities		0	2	0	0

4.2 Anticipated improvements to all impacts

Table 5 combines the results in Table 4 with improvements planned to address pollution (water chemistry) and other pressures to give results for overall ecological potential for each river basin planning cycle by water body type and purpose.

The estimates for objectives for 2021 and 2027 will be reviewed prior to issuing an updated river basin management plan in 2015.

Table 5(a): Overall ecological potential objectives for 2015, 2021 and 2027 for heavily modified and artificial water bodies by water body type

Type		2008 classification		By 2015		By 2021		By 2027	
		Good or better	Moderate or worse	Good or better	Moderate or worse	Good or better	Moderate or worse	Good or better	Moderate or worse
River	Number	13	44	16	41	18	39	51	6
	Length (km)	124	546	175	496	184	487	629	41
Loch	Number	4	12	7	11	8	8	15	1
	Area (km^2)	4	21	10	15	10	15	18	7
Estuary	Number	1	0	1	0	1	0	1	0
	Area (km^2)	1	0	1	0	1	0	2	0
Coastal	Number	0	0	0	0	0	0	0	0
	Area (km^2)	0	0	0	0	0	0	0	0
Artificial (canals)	Number	0	0	0	0	0	0	0	0
	Length (km)	0	0	0	0	0	0	0	0
Artificial (other)	Number	6	0	6	0	6	0	6	0
	Area (km^2)	7	0	7	0	7	0	7	0

Table 5(b): Overall ecological potential objectives for 2015, 2021 and 2027 for heavily modified and artificial water bodies by purpose[9]

Type		2008 classification		By 2015		By 2021		By 2027	
		Good or better	Moderate or worse	Good or better	Moderate or worse	Good or better	Moderate or worse	Good or better	Moderate or worse
Protection of wider environment	Biodiversity	0	2	0	2	0	2	1	1
	Built heritage	0	0	0	0	0	0	0	0
Navigation	Canals	0	0	0	0	0	0	0	0
	Inland waterways excluding canals	0	0	0	0	0	0	0	0
	Ports and harbours	0	0	0	0	0	0	0	0
Water storage	Drinking water supply	13	20	18	15	19	14	32	1
	Power generation	1	14	5	10	4	11	9	6
	Navigation	0	0	0	0	0	0	0	0
Flood protection and land drainage	Urban and agriculture	8	22	8	22	8	22	29	1
Other sustainable development activities		2	1	2	1	2	1	3	0

Purpose		Good or better		Moderate or worse	
2015		Length	Area	Length	Area
Wider environment	Biodiversity	0	0	10	7
	Built heritage	0	0	0	0
Navigation	Canals	0	0	0	0
	Inland waterways excluding canals	0	0	0	0
	Ports and harbours	0	0	0	0
Water storage	Water supply	83	6	108	8
	Power generation	15	4	117	8
	Navigation	0	0	0	0
Flood protection and land drainage	Urban and agriculture	85	0	280	0
Other sustainable development activities		0	2	0	0.1

[9]Note that a water body may have more than one designated use, and as such, may be counted more than once.

Table 5(b): Overall ecological potential objectives for 2015, 2021 and 2027 for heavily modified and artificial water bodies by purpose (continued)[9]

Purpose		Good or better		Moderate or worse	
2021		Length	Area	Length	Area
Wider environment	Biodiversity	0	0	10	7
	Built heritage	0	0	0	0
Navigation	Canals	0	0	0	0
	Inland waterways excluding canals	0	0	0	0
	Ports and harbours	0	0	0	0
Water storage	Water supply	85	6	106	8
	Power generation	22	4	110	7
	Navigation	0	0	0	0
Flood protection and land drainage	Urban and agriculture	85	0	280	0
Other sustainable development activities		0	2	0	0.1

Purpose		Good or better		Moderate or worse	
2027		Length	Area	Length	Area
Wider environment	Biodiversity	10	0	0	7
	Built heritage	0	0	0	0
Navigation	Canals	0	0	0	0
	Inland waterways excluding canals	0	0	0	0
	Ports and harbours	0	0	0	0
Water storage	Water supply	190	14	0	0
	Power generation	92	4	40	6
	Navigation	0	0	0	0
Flood protection and land drainage	Urban and agriculture	26	0	338	0
Other sustainable development activities		0	2	0	0

[9]Note that a water body may have more than one designated use, and as such, may be counted more than once.