Environment Agency

Environmental Destination technical report

Understanding environmental water needs

June 2025

Version: 1

We are the Environment Agency. We protect and improve the environment.

We help people and wildlife adapt to climate change and reduce its impacts, including flooding, drought, sea level rise and coastal erosion.

We improve the quality of our water, land and air by tackling pollution. We work with businesses to help them comply with environmental regulations. A healthy and diverse environment enhances people's lives and contributes to economic growth.

We can't do this alone. We work as part of the Defra group (Department for Environment, Food & Rural Affairs), with the rest of government, local councils, businesses, civil society groups and local communities to create a better place for people and wildlife.

Published by:

Environment Agency
Horizon House, Deanery Road,
Bristol BS1 5AH

www.gov.uk/environment-agency

Further copies of this report are available from our publications catalogue: www.gov.uk/government/publications or our National Customer Contact Centre: 03708 506 506

Email: enquiries@environment-agency.gov.uk

Contents

1. Introduction

1.1. Purpose

This document reports the work carried out to update the National Framework for Water Resources 2025. It presents the methodology, scenario information and results of the modelling work carried out to update the analysis of long-term abstraction reductions which may be needed to meet environmental flow thresholds under different future scenarios of climate, growth and a range of environmental ambition.

1.2. What we mean by Environmental Destination

The Environmental Destination for water resources identifies where, and by how much, water abstraction needs to change to achieve and maintain a healthy water environment, both now and in the future.

The Environmental Destination is developed by:

- defining the long-term environmental outcomes needed to ensure abstraction from rivers, lakes, wetlands and estuaries is environmentally sustainable, both to address current unsustainable abstraction and future pressures. This includes future pressures from the impact of climate change on river flows
- calculating where and by how much abstraction may need to reduce to meet these long-term environmental outcomes. The Environmental Destination does not consider how these changes will be achieved. This is done through the planning process (for example in the development of regional water resources plans, water company water resource management plans or river basin management plans (RBMPs)). These plans will inform the pace and extent to which these changes can be delivered

1.3. Overview of the environmental planning scenarios

The National Framework 2025 has developed three Environmental Destination planning scenarios in addition to our baseline analysis of current unsustainable abstraction. These planning scenarios consider a range of environmental requirements which are used to understand current and future abstraction pressures. In summary these are:

1.3.1. Baseline – current regulatory approach in today’s climate

This describes current unsustainable abstraction.

Changes to water abstraction are based on our current regulatory approach. RBMPs set out environmental objectives (under Water Framework Directive (WFD) and Habitats Regulations). We use this as the baseline to estimate environmental water requirements in today’s climate.

1.3.2. Current 2050/2080 – current regulatory approach under a changing climate

Under this scenario our regulatory approach remains the same as in section 1.3.1, but we also take account of predicted climate change impacts. This means that we continue to protect the same percentage of natural flow for the environment (see section 3.2 for an explanation of how we calculate natural flows). Flow and groundwater balance tests evolve as a proportion of natural flows as these are altered by the impacts of climate change.

1.3.3. Intermediate 2050/2080 – current regulatory approach with additional protections under a changing climate

This scenario sees greater environmental protection for Sites of Special Scientific Interest (SSSIs) rivers and wetlands, principal salmon and chalk rivers. Flow and groundwater balance tests evolve as a proportion of natural flows as climate change alters those flows.

1.3.4. Full 2050/2080 – full environmental requirements under a changing climate

This scenario builds on the intermediate 2050/2080 scenario but provides further protection for headwaters in chalk rivers and SSSIs. It assumes we will achieve good status for all WFD waterbodies (including those currently exempt) in line with government policy and supported commitments. This is assessed taking account of predicted climate change impacts. Flow and groundwater balance tests evolve as a proportion of natural flows as climate change alters those flows.

More detail on these scenarios can be found in section 3.5.

2. Aims

The aim of this work is to develop analysis to enable long term water resource planning to take account of environmental requirements for abstraction by:

- developing environmental planning scenarios that reflect different levels of environmental protection. These reflect current regulatory requirements, government commitments and legislative requirements for the longer term
- setting out a range of possible impacts from climate change and estimating future demand
- identifying where RBMP objectives, including prevention of deterioration, and requirements to protect and improve European Sites, may not be met in today's climate
- modelling the environmental planning scenarios to understand the range of futures we might be facing based on potential future demand and climate change impacts
- identifying where potential shortfalls in water resources may persist across all/individual sectors, and the scale of those deficits, for current, medium-term (2050) and long-term (2080) environmental requirements
- understanding the potential scale of the shortfall in water availability that could result from changes in abstraction under the environmental planning scenarios
- providing information to abstractors on the potential current and future risk of abstraction licence reductions. This information should be seen as a starting point from which to plan, collaborate and improve the approach suggested by national modelling

3. Methodology

3.1. Background

The Environment Agency owns and manages the Water Resources Geographical Information System (WRGIS) database. We use the WRGIS to calculate water availability on a waterbody scale. The WRGIS does this by looking at the balance between the natural flow in the river, the quantity needed to support the ecology and the water that can be licensed for abstraction.

To do this the WRGIS database contains natural flow data (what flows would be under natural conditions) and artificial influence data including: surface water abstractions, groundwater abstractions, discharges to the water environment and influences from reservoirs.

The WRGIS provides a snapshot of the water resource data and information available at that time which is manipulated for the purposes of calculating water availability. We have chosen to use the WRGIS to explore the data analysis for the National Framework 2025 because it allows running of climate and sustainability change scenarios together with environmental planning scenarios. It also allows us to understand the likely scale and distribution of any non-compliance with environmental standards that would result from each scenario.

For this updated analysis we have:

- used best available nationally consistent data – this is based on national data sets but, where possible, we have updated this with information from our local teams and water company updates
- improved on the assumptions we made in the analysis undertaken for the first National Framework. Section 4.2.1 explains how these improvements have affected the analysis outputs

3.2. Calculating natural flows

For each waterbody, we calculate the natural flow that would be in the river in the absence of any artificial influence (such as surface or groundwater water abstractions, discharges or influences from reservoirs).

We use a range of techniques to derive river flow statistics to represent these natural flows. For rivers with no hydrometric stations, we use modelled flow data to estimate the river flows. Different models may be used depending on the catchment characteristics. The models use measured hydrometric data from similar catchments (comparable in terms of size, rainfall, topography, soils and subsoils) to model flows in these rivers.

3.2.1. Defining the flow thresholds

We use thresholds to inform how much water is allocated to abstraction, and how much should remain in the environment to ensure it is protected. These thresholds are defined as a percentage of the natural flow.

In this national analysis we used the following flow thresholds.

For surface waters, for WFD compliance purposes we use the Environmental Flow Indicator (EFI).

An Abstraction Sensitivity Band (ASB) of high, medium or low sensitivity to abstraction is assigned to each waterbody based on a combination of physical habitat, macroinvertebrate and fish typologies information. Each ASB has a different EFI, associated with it. This identifies the quantity of water we want to maintain in the river to protect the ecology and subsequently the amount of water we can allow for abstraction. The percentage allowable abstraction at different four different river flows (Q95 – lowest flow, Q70, Q50 and Q30 highest flow) as shown in Table 1.

For groundwaters, we use 4 groundwater tests to assess good status. In the majority of cases reducing groundwater abstraction to achieve the EFI for surface waters will also achieve the groundwater tests. Taking this approach has significantly reduced the complexity of our modelling as it does not include the groundwater balance tests. However, it is possible for the groundwater balance to be in deficit after reductions in abstraction.

Table 1 Percentage allowable abstraction from natural flows at different sensitivity bands and at different flow snapshots (Q30 is the highest and Q95 is the lowest flow)

Abstraction sensitivity band	Q30	Q50	Q70	Q95
ASB3 ‘high’	24%	20%	15%	10%
ASB2 ‘moderate’	26%	24%	20%	15%
ASB1 ‘low’	30%	26%	24%	20%

For European Site and SSSI rivers, relevant waterbodies have been identified using a list of designated riverine sites provided by Natural England. We have based our analysis on the long-term Common Standards Monitoring Guidance (CSMG) targets for rivers as set out in the Joint Nature Conservation Committee guidance. We recognise that there may be local agreements which identify a more appropriate flow target but these are not included as this information is held locally. CSMG identifies targets based on river size and flow condition and as such differs from the range of targets we currently use within WRGIS. For the purposes of this analysis we have generated a new subset of ASBs to apply to European sites and SSSI rivers. These have been as closely matched as possible to the CSMG relevant waterbodies based on the information currently available. These are shown in Table 2.

Table 2 Percentage allowable abstraction from natural flows at different abstraction sensitivity bands equivalent to CSMG

Type	Abstraction sensitivity band	Q30	Q50	Q70	Q95
River	ASB4	10%	20%	15%	10%
Headwater	ASB5	15%	15%	10%	5%
WFD high hydrology	ASB6	10%	10%	10%	5%

ASB 4, 5 and 6 are only used for the purpose of this National Framework 2025 environmental scenario work. They are not part of the standard water availability calculation.

3.2.2. Accounting for existing abstraction influence on natural flows

In this analysis we have used three estimates of abstraction:

1. Recent actual (RA) – this represents current average abstraction rates. This is calculated using abstraction returns data over a 6-year period. This is typically the period 2016 to 2021.
2. Future predicted (FP) – abstraction rates are based on recent actual abstraction rate multiplied by a growth factor to project abstraction to 2050. For the purposes of National Framework 2025 work the future predicted scenario is not capped at the licensed limit, therefore the future predicted rate can exceed the current licensed limit where there is future demand.
3. Fully licensed (FL) – abstraction rates are based on fully licensed quantities.

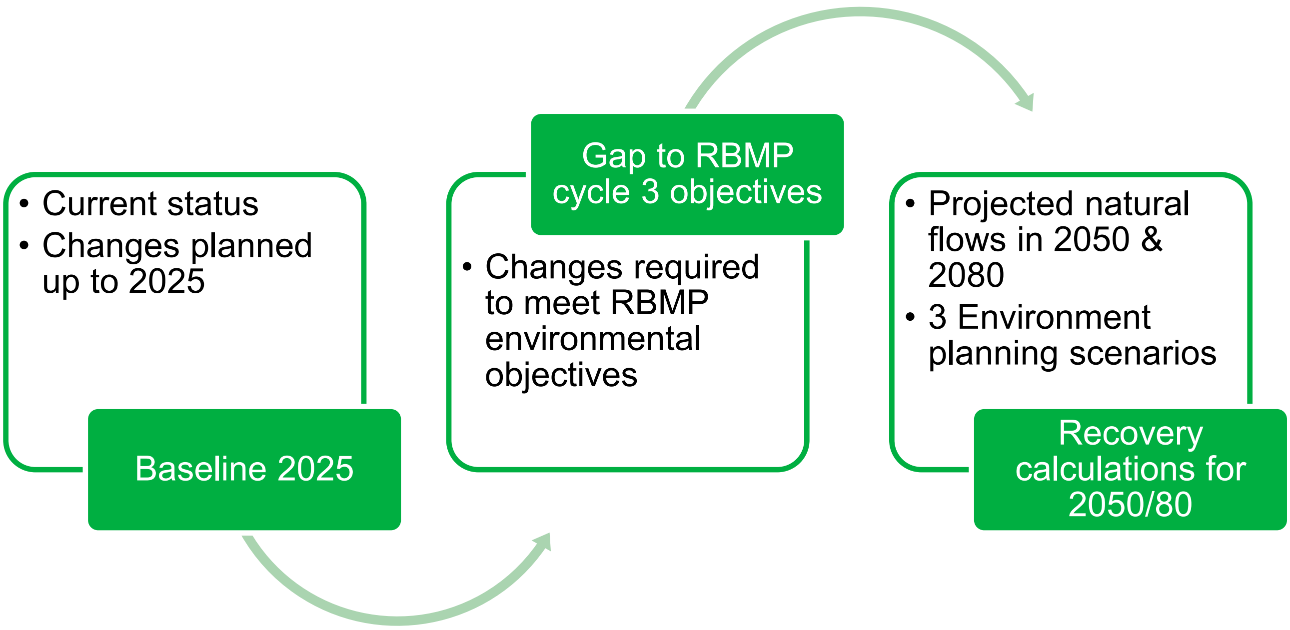
We screen all river waterbodies (except those in flow regulated rivers) to show where abstraction impacts may be causing flows to fall below EFIs (or CSMG) when the flow is low. Low flow is defined as Q95, the long-term average flow exceeded 95% of the time. If the flow in the recent actual scenario is higher than the EFI at Q95, then the waterbody is flow compliant. If the recent actual scenario falls below the EFI at Q95, the waterbody is non-flow compliant.

The WRGIS calculates water availability at four flow snapshots. From high to low, these are: Q30 (the flow exceeded 30% of the time), Q50, Q70 and Q95. This is calculated at the outflow point of each WRGIS integrated waterbody. The WRGIS integrated waterbody network is made up of all WFD river, lake and transitional waterbodies plus the Catchment Abstraction Management Strategy (CAMS) assessment points and coastal catchments.

3.3. Our approach to the analysis

The infographic in Figure 1 summarises the overall approach. Each of the steps are described in detail in sections 3.2.1 to 3.5.

Figure 1 The overall approach to the analysis



3.3.1. Calculating the 2025 baseline

In the first National Framework for Water Resources, we established a starting point, or baseline, for 2025, which we used to assess the gap to meet RBMP objectives and future water resource needs. This analysis updates this baseline using latest data and improved assumptions.

The baseline takes into account the planned licence changes we expect to be in place by the end of 2025 including:

- water industry changes as detailed in the Asset Management Programme (AMP) 6 National Environment Programme (NEP5) and AMP7 Water Industry National Environment Programme (WINEP) schemes

- changes to time-limited licences in the most seriously damaged waterbodies
- changes to licences in the unused and under-used licence programme
- changes to non-water company licences linked to sites remaining in the restoring sustainable abstraction programme

The following assumptions apply to this analysis:

- we have assumed that waterbodies that were at good ecological status in 2022 will remain at good in 2025
- waterbodies that were assessed (at a river basin plan level) as not cost-beneficial to solve for water resources in the RBMP timescale have been excluded from the 2025 baseline. This means we assume no abstraction reductions are required for these waterbodies in the short term. We refer to these as water resource (WR) non-economic waterbodies
- we have assumed there are no changes to discharges
- for this analysis, we have based expected reductions resulting from AMP7 WINEP and NEP5 schemes on abstraction reduction quantities these schemes are expected to achieve. This is an improved assumption to that made in the first National Framework where we assumed that these schemes would address the whole problem and enable the relevant waterbody to achieve good ecological status by 2027

These are large assumptions, made on a national scale and should not supersede local investigations that have used more detailed modelling work.

Section 3.6 explains how we have used the 2025 baseline to calculate potential abstraction reductions going forward.

3.3.2. Estimating abstraction in 2050

For this analysis we need to estimate future abstraction rates in 2050. To understand this we have considered both:

- if abstractors abstract to their fully licensed (FL) limits
- if rates of abstraction grow relative to current use. We refer to this as future predicted (FP)

These two analyses are undertaken separately. We have used the FL dataset for most purposes because it provides the best information to abstractors on how their licence may need to change in the future. The FP dataset is used for some specific applications related to understanding how actual abstraction may need to change and to understand potential growth in existing licensed abstraction.

To estimate FP abstraction rates, we apply a growth factor to the recent actual (RA) abstraction rate. In this case we have also allowed the future predicted rates to exceed the fully licensed rates to represent where abstractors may require more water in 2050 compared to what they are licensed to abstract now. This information will be used to analyse where some sectors may have greater water needs than current abstraction licences allow, and therefore where action is likely to be required to ensure sustainable water supplies are available. FP is designed to help understand potential future water needs rather than understanding the risk of future abstraction licence reduction.

We applied the growth factors per sector, and these are detailed in Table 3. More information on how these factors were derived can be found in the source report – Understanding future water demand outside of the water industry work completed by Wood Environment & Infrastructure Solutions UK Limited (2019).

Table 3 Growth factor per sector applied to abstractions

Sector	Growth factor	Source
Water company	Factor per water resource zone	Phase 1 growth factors are baseline 45BL distrubution input (DI) figures, worst case/not including any reductions. Phase 2 growth factors are WRMP24 Final Plan 45FP DI figures except where these are negative where the factors are capped at 1 to ensure the reduction is not double counted as is likely to have been modelled as abstraction reduction within WRMP24. Explanation of these growth factors can be found in Water Resources Planning Tables – Instructions.
Amenity/ environment	1	Flat forecast of 1 based on 'Understanding future water demand outside of the water industry' report.
Horticulture	2.01 For abstractions within WRSE a factor of 1.32 is used	Based on the average for horticulture for the 4 scenarios explored in the Cranfield (2018): Task 2 Agricultural demand forecasts (Part II): future demand.
Spray irrigation agriculture	1.44 (for all except spray irrigation – anti frost)	Based on 'Understanding future water demand outside of the water industry' report.
Other agriculture	1 (includes spray irrigation – anti frost)	Flat forecast of 1. For source, see note 1 at end of table.

Sector	Growth factor	Source
Power generation	Future rates set to fully licensed quantities	Future energy requirements are largely associated with new abstraction. This is considered separately as part of the National Framework.
Paper	1.12 For abstractions within WRSE a factor of 1.7 is used	See note 1 at end of table.
Food and drink	1.25	See note 1 at end of table.
Chemical	1.22	See note 1 at end of table.
Other spray irrigation (non-agriculture)	1	Flat forecast of 1. For source, see note 1 at end of table.
Industry and any others	Factor per water resource zone	Based on difference between 2023/24 and 2049/50 non-household (12FP + 13FP) use from revised draft WRMP24) .

Note 1: Source – Understanding future water demand outside of the water industry work completed by Wood Environment & Infrastructure Solutions UK Limited (2019).

This same abstraction and discharge data has been applied to all the environmental scenarios. The sources of discharge growth factors are listed in Table 5.

We use the comparison of the future predicted scenario (for the different environmental scenarios) against the recent actual scenario from the 2025 baseline to represent the estimated change in abstraction between 2025 and 2050/2080 time periods.

Table 4 Growth factors applied to discharges

Sector	Growth factor	Source
Water Company	Factor per water resource zone	Based on difference between 2023/24 and 2049/50 DI (45FP) from revised draft WRMP24
All other sectors	Factor per water resource zone	Based on difference between 2023/24 and 2049/50 non-household (12FP + 13FP) use from revised draft WRMP24

3.4. Estimating natural flows in 2050

3.4.1. Estimating natural flows in the first National Framework

It is widely accepted that climate change will affect natural river flows in the future. This is an important consideration for this analysis. For the first framework we used the Future Flows Hydrology (FFH) model to estimate future river flows. The underlying climate model for this was HadCM3 (Met Office climate prediction model) which also provided the basis for the UKCP09 climate projections.

Although at the time the latest UK Climate Projections 2018 (UKCP18) were available, there was no widespread analysis of river flows using this and therefore it was not possible to use UKCP18 as part of that analysis.

3.4.2. Developing the approach

Since the first framework, hydrological modelling has been updated and for this analysis we have been able to use UKCP18 projections. During 2022 the UK Centre for Ecology & Hydrology (UKCEH) and project partners, released the latest Hydrological projections for the UK, based on UK Climate Projections 2018 (UKCP18) data, from the Enhanced Future Flows and Groundwater (eFLaG) project. This project modelled 200 river flow stations and is the latest, peer-reviewed Climate Change Hydrology science.

However, the eFLaG rainfall runoff models have been calibrated on gauged flows rather than natural flows so are not directly suitable for use in this context. Also, there are 'only' 200 points on the river network modelled in eFLaG, which leaves us with a lot of gaps in understanding the expected climate for the rest of the country. As a result, we commissioned Wallingford Hydrosolutions Ltd (WHS) to develop datasets and maps of absolute and relative flow values at the waterbodies scale using the following data:

- Met Office HadUK 1km gridded precipitation datasets (and UKCEH related potential evapotranspiration datasets) as well as improved soil moisture accounting under extreme dry conditions to calibrate the CERF2-HadUK model.

- 1km downscaled bias corrected precipitation data and potential evaporation datasets generated by the eFLaG project using the UKCP18 Regional Climate Model (RCM) outputs.

The maps give an overall view of the changes we could see in flows in the near (2050s) and far (2080s) future and provide a set of climate change adjusted flow statistics for all WFD waterbodies in Britain for use in our modelling work. The 'Development of climate change adjusted flow statistics in Qube' report details the wider work.

This gives us three 30-year time periods for river flow statistics at Q30, Q50, Q70, Q90 and Q95:

- baseline (BL): 1989 to 2018
- near future (NF): 2020 to 2049 – we refer to this as 2050
- far future (FF): 2050 to 2079 – we refer to this as 2080

It is useful to note that this modelling is carefully linked with eFLaG. WHS have used the same core Climate Change datasets (changes to rainfall and evaporation) and have tried to replicate the eFLaG methodology as much as possible.

From this work we were able to apply waterbody percentage change flow factors to the WRGIS baseline natural flow percentiles to generate predicted natural flows for 2050 and 2080 at Q30, Q50, Q70 and Q95.

For groundwater, eFlag groundwater model outputs were used to apply changes in WRGIS groundwater balance calculations

3.4.3. Selecting a Representative Concentration Pathway

Representative Concentration Pathways (RCPs) are a set of climate change scenarios used to model how greenhouse gas concentrations in the atmosphere might change under different future emission scenarios. They are designed to understand the potential impacts of different climate mitigation strategies and inform policy decisions.

The range of datasets created by the UKCP modelling, eFLaG use the Regional Climate Model (RCM) datasets, as these give the gridded, daily timeseries required for the Hydrological modelling. There are 12 RCM timeseries, which run from 1980 to 2080. They represent a range of warmer-cooler or wetter-drier climate simulations.

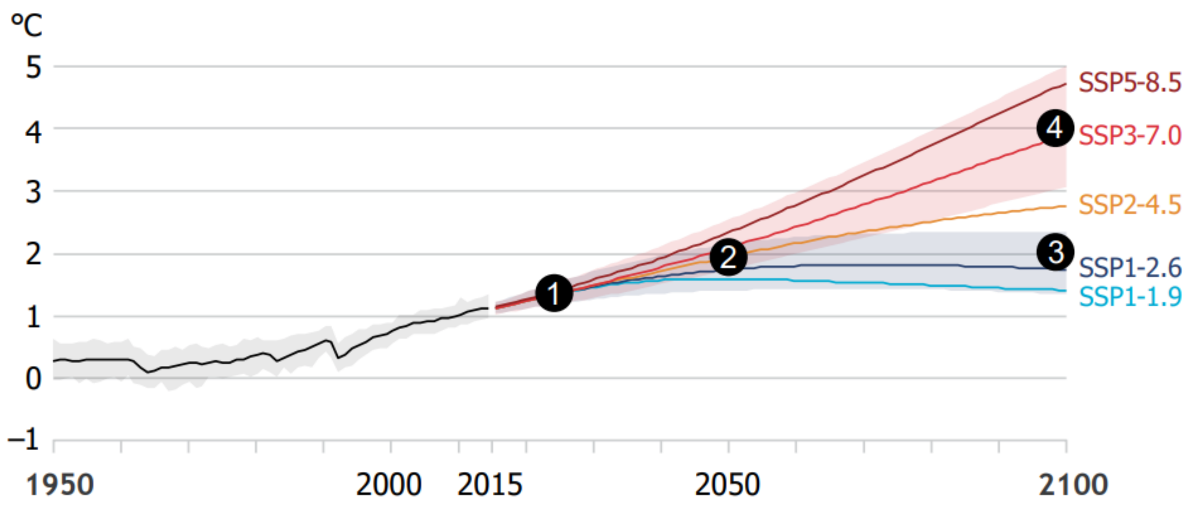
All of the RCM model runs are from the same climate model, which uses the highest increase in greenhouse gas concentrations (RCP 8.5). The Met Office have only produced regional climate models at the level of detail we require for RCP 8.5 which is why our analysis is limited to this emissions pathway.

The Environment Agency's climate impacts tool pulls together national level information on climate change impacts. It shows previous global temperature increases and how this might change under different emissions scenarios and specifically notes that:

1. The climate has already changed, with global temperatures increasing by over 1 degree.
2. By the 2050s this is expected to rise by 2°C (under a medium-high emissions pathway).
3. Temperate rise will only be kept to 2°C if emissions are managed to keep within a low emissions scenario.
4. A 4°C rise may happen by the end of the century if this is not possible.

Figure 2 presents these points in a chart.

Figure 2 Global surface temperature change relative to 1850 to 1900, from IPCC (2021)



The Climate Change Committee advice is to plan for 2°C of global warming and assess the risks for 4°C of global warming by 2100. Therefore, using RCP 8.5 (a high emissions pathway) which represents a 2°C rise by mid-century and 4°C by the end of the century for long term planning is in line with this advice.

3.4.4. Understanding the range of climate change future

The analysis provided absolute and percentage flow changes for each of the 12 Regional Climate Model (RCM) timeseries resulting in 12 equally likely model runs (referred to as 'ensemble members'). Two of these were selected to apply relative changes for each time period in WRGIS (based on distribution of changes across waterbodies) to represent a range of possible futures. What these are and how these were selected is described in section 4.1.2.

3.4.5. Estimating groundwater availability in 2050

The national modelling tools we used in this analysis are not able to directly assess requirements to achieve good groundwater status. Instead, we have assumed that reducing groundwater abstraction to achieve scenario river flows will deliver most environmental improvements and will in turn improve the groundwater status. However, this is not guaranteed as it is possible for the groundwater balance to be in deficit after reductions in abstraction necessary to meet river flow requirements have been made.

Recent research (Hughes and others 2021) has reviewed the impact of climate change on groundwater recharge and found that recharge may increase slightly by 2050, despite a shift to a shorter recharge period. This suggests that, although it represents a simplification, excluding the groundwater balance test from this analysis is unlikely to miss significant climate impacts.

3.5. Environmental planning scenarios

The National Framework 2025 has developed three Environmental Destination planning scenarios in addition to our baseline analysis of current unsustainable abstraction. This section introduces the environmental planning scenarios we have used to explore potential long-term abstraction reductions. These scenarios are termed as current, intermediate and full. A summary of these is provided below and they are explored in more detail in the subsequent sections.

Under each scenario we have analysed what abstraction recovery would be needed to meet the environmental flow targets. Table 5 provides an overall summary of the rules applied for each scenario.

Table 5 Summary of environment planning scenarios

Scenario	Description	Climate
Baseline to meet RBMP cycle 3	Changes to water abstraction are based on our current regulatory approach	Today's
Current 2050/80	Current regulatory approach under a changing climate	Near future (2050) and far future (2080)
Intermediate 2050/2080	Current regulatory approach with additional protections under a changing climate	Near future (2050) and far future (2080)
Full 2050/2080	Full environmental requirements under a changing climate	Near future (2050) and far future (2080)

3.5.1. Baseline – current regulatory requirements

Under this scenario, we applied the RBMP Cycle 3 Objectives to the 2025 baseline using natural flows in today's climate. This means we have used the associated flow target to meet that objective in our analysis. Our policy and regulatory approach remains the same to achieve and maintain GES (under WFD) and European Site Objectives (under Habitats Regulations) as set out in third cycle river basin plans.

Since the first National Framework we have revised the ASB for some chalk waterbodies based on a review of fish monitoring data and these revisions are included in this analysis.

This analysis may include waterbodies that have been identified in national data sets as an outstanding issue but have in fact been dealt with on a local scale.

3.5.2. Current 2050/2080 scenario

Under this scenario our policy and regulatory approach remains the same as that set out in 3.5.1 but we use predicted natural flows for 2050 and 2080.

For this scenario we continue to protect the same percentage of natural flow for the environment; flow and groundwater balance tests evolve as a proportion of natural flows as these are changed by the impacts of climate change. Consequently, if natural flows reduce in response to climate change both the environment and abstractors will need to adapt to climate impacts on flows and groundwater.

3.5.3. Intermediate 2050/2080 scenario

This scenario sees greater environmental protection for SSSI rivers and wetlands, principal salmon and chalk rivers. Flow and groundwater balance tests evolve as a proportion of natural flows as climate change alters those flows.

The principal salmon river waterbodies are based on the 42 'principal' salmon rivers identified for England. An enhanced ASB3 is applied to those waterbodies which are currently assigned an ASB of less than ASB3 but we have ruled out those waterbodies where salmon are unlikely to be present or outside of natural spawning areas (based on a high level review by the Environment Agency).

Chalk river waterbodies: we have increased protection for chalk rivers under this scenario to recognise the global importance and the unique habitat that chalk rivers provide. The intermediate scenario includes meeting environmental flow targets in support of GES in chalk river waterbodies which were not included in the Current scenario such as those identified as WR non-economic waterbodies (see section 3.2.1). Chalk river waterbodies have been identified based on data from Natural England and the Environment Agency.

We also identified groundwater bodies that contain Groundwater Dependent Terrestrial Ecosystems (GWDTE) which are designated sites in England. We then identified the surface waterbodies associated with these GWDTE. An ASB3 has been assigned to these surface waterbodies to enable better protection given that these sites might be at greater risk from future climate change.

3.5.4. Defining the Full scenario 2050/2080

This scenario takes account of government's published environmental commitments in addition to existing environmental legislation. As such it builds on the intermediate scenario but provides additional protection for chalk headwaters and SSSIs and assumes we will achieve good status for all waterbodies including WR non-economic waterbodies (see section 3.2.1 for an explanation of these).

The extra protection for chalk headwaters is calculated by excluding discharges from water balance calculations in headwater waterbodies. This has the effect of protecting the quantity of chalk springflow into headwaters and aims to ensure that discharges don't mask flow impacts in the upper reaches of chalk streams. The discharges are accounted for in the next waterbody downstream to ensure that the catchment water balance is maintained.

The additional protection for SSSIs is to apply the stricter CSMG flow standards to all SSSI rivers.

Flow and groundwater balance tests evolve as a proportion of natural flows as climate change alters those flows.

Table 6 provides National Environment planning scenarios for the updated ED.

Table 6 National Environment planning scenarios for updated Environmental Destination

Planning scenario	1. Non-economic WBs or less stringent objectives	2. RBMP objectives	3. No Deterioration	4. European sites	5. SSSIs	6. Chalk	7. Salmon	8. Groundwater dependent terrestrial ecosystems
Full Environmental Destination (ED) 2050/80	Included (note 1)	Surface water flows support good for all WBs with an objective of Good (note 1)	Yes	CSMG for rivers (note 2 and 3)	CSMG for rivers (note 3 and 4)	Additional protection for headwaters (note 4 and 5)	ASB3 for principal salmon rivers (note 6)	ASB3
Intermediate – pathway to ED 2050/80	Included where meet criteria for columns 3-8	Yes, where suspected or confirmed RNAG	Yes	CSMG for rivers (note 2 and 3)	Locally agreed target or CSMG for rivers default (note 3 and 4)	High confidence chalk WBs support Good for flow (note 4 and 5)	ASB3 for principal salmon rivers (note 6)	ASB3
Current ED (current regulatory targets) 2050/80 (note 2)	Excluded, except European sites	Yes, where confirmed RNAG	Yes	Agreed long-term target/ CSMG for rivers (note 2 and 3)	Current or locally agreed target	As per columns 1 to 5	As per columns 1 to 5	As per columns 1 to 5
Baseline to meet RBMP3 objectives (note 2)	As above, based on current regulatory targets	As above, based on current regulatory targets	As above, based on current regulatory targets	As above, based on current regulatory targets (note 2 and 3)	As above, based on current regulatory targets	As above, based on current regulatory targets	As above, based on current regulatory targets	As above, based on current regulatory targets

Note 1: Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (WFD Regulations)
Note 2: Statutory guidance on the practical implementation of RBMPs 2021
Note 3: Natural England condition assessment of river SSSI / ASSI and SAC habitat
Note 4: Environmental Improvement Plan 2023
Note 5: Chalkstream Restoration Strategy
Note 6: Salmon 5 Point Approach

Our ‘Principles for protecting the water environment in water resources planning’ document provides additional detail on the legislative drivers referenced in this table. This will be available later through a link from the National Framework for Water Resources 2025.

3.6. Calculating recovery numbers

We use the WRGIS outputs to understand how much water may need to be recovered to:

- meet RBMP objectives (including preventing deterioration), both now and in the future
- meet environmental requirements for each of the environmental planning scenarios for 2050 and 2080, considering both estimated growth and climate change impacts

This work was conducted in two phases. The first phase considered all reductions that may be required excluding water company proposals set out in WRMP24. This was based on WRGIS 2023 data and provides the total size of the problem.

The second phase took into account proposed abstraction reductions and options as set out WRMP24 and used the updated WRGIS 2024 data set. This outlines the size of the problem once water company investment to 2030 is implemented.

We have used the Environment Agency's Fix-It tool to identify what licence reductions may be required to meet environmental flow requirements looking across all sectors. The Fix-It tool uses the WRGIS data to calculate licence reductions required to meet a given target flow described in section 3.1.2. For this analysis the reductions to abstraction have been calculated to meet target flows at Q95 (a low flow) only.

3.6.1. Modelling assumptions for recovery calculations

The Environmental Destination scenarios presented here are for planning purposes only. More detailed local and regional analysis will also inform specific changes to individual abstraction licences. The Fix-It tool used to calculate licence reductions works on a number of assumptions. These are:

- abstraction reductions are calculated starting at the top of the catchment. Reduction to headwaters is calculated first and these reductions impact and benefit downstream reaches
- groundwater abstractions are reduced first. If the target flow has not been met by reducing groundwater abstraction, then abstraction from surface waters will be reduced
- reductions are only calculated for groundwater abstractions where the fully licensed groundwater abstraction impact on the waterbody contributes to at least 50% of the total deficit. The same principles apply to the surface water abstraction reductions – the FL surface water abstraction impacting directly on the waterbody must be at least 50% of the total deficit
- surface water abstractions are not reduced by Fix-It where the abstraction is from a reservoir, level dependent environment, or lake; where it has a flow constraint (hands-off flow condition) that is already constraining the licence at Q95; or where it is from a supported source, for example downstream of upstream release
- no reductions are proposed for abstraction licences that return 80% or more of abstracted water locally

4. Results

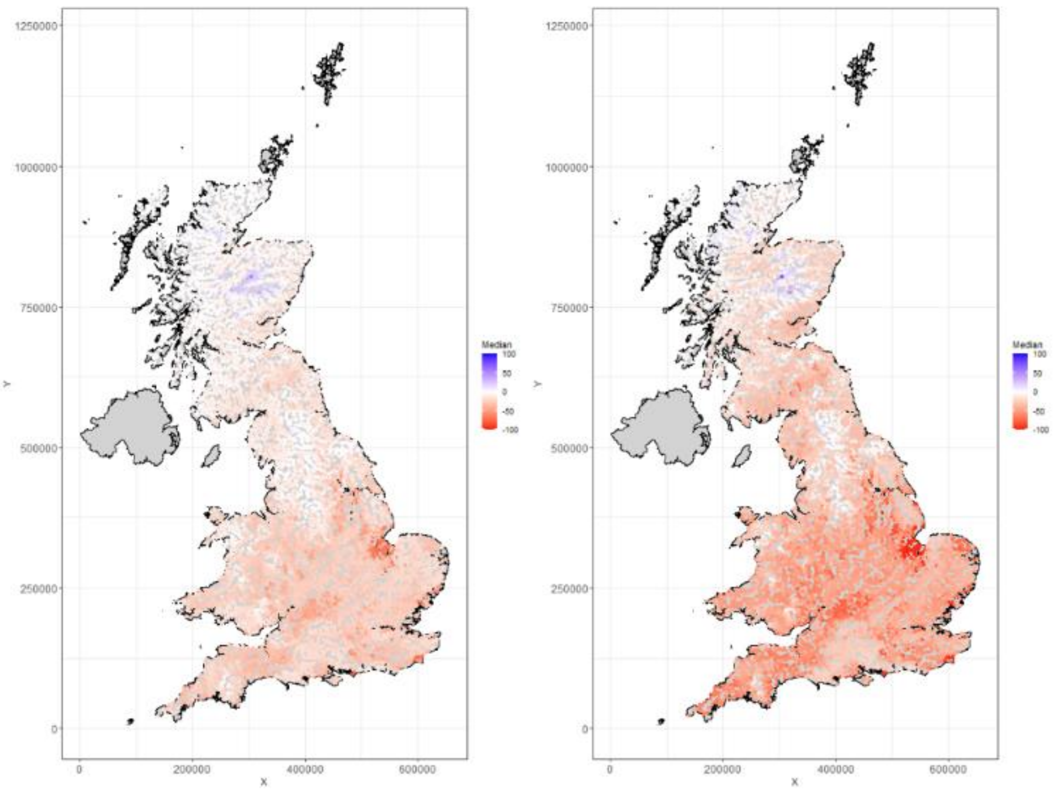
4.1. Estimating natural flows in 2050 and 2080

4.1.1. Results of the analysis

Climate change will have a significant impact on flows and water availability in 2050. Figure 3 displays the percentage difference between low natural flows of today (current Q95 natural flows) for each waterbody and for those projected for 2050 and 2080, taken as a median across all RCM ensemble projections.

Figure 3 shows at low flows the percentage changes are generally negative throughout Great Britain with the southeast exhibiting the highest percentage changes. The exceptions to this are a number of small catchments in higher altitude areas in central and northwest Scotland, and northern England, where positive percentage changes can be seen. Note that, in relation to these positive increases, the actual flow changes tend to be small.

Figure 3 Median of the RCMs' percentage changes at Q95 for the near future – 2050 (left) – and the far future – 2080 (right): Source: WHS (2024) Development of climate change adjusted FDCs in Qube



As the 12 RCMs each generate a different natural flow projection which means there are 12 equally likely futures. Figure 4 presents the variability to changes in natural low flow projections across the 12 RCM runs percentage difference for the near future (2050) and Figure 5 displays this for the far future (2080).

Figure 4 Variability within RCMs runs at Q95(low flows) for the near future (2050s). Source: Development of climate change adjusted FDCs in Qube, WHS (2024)

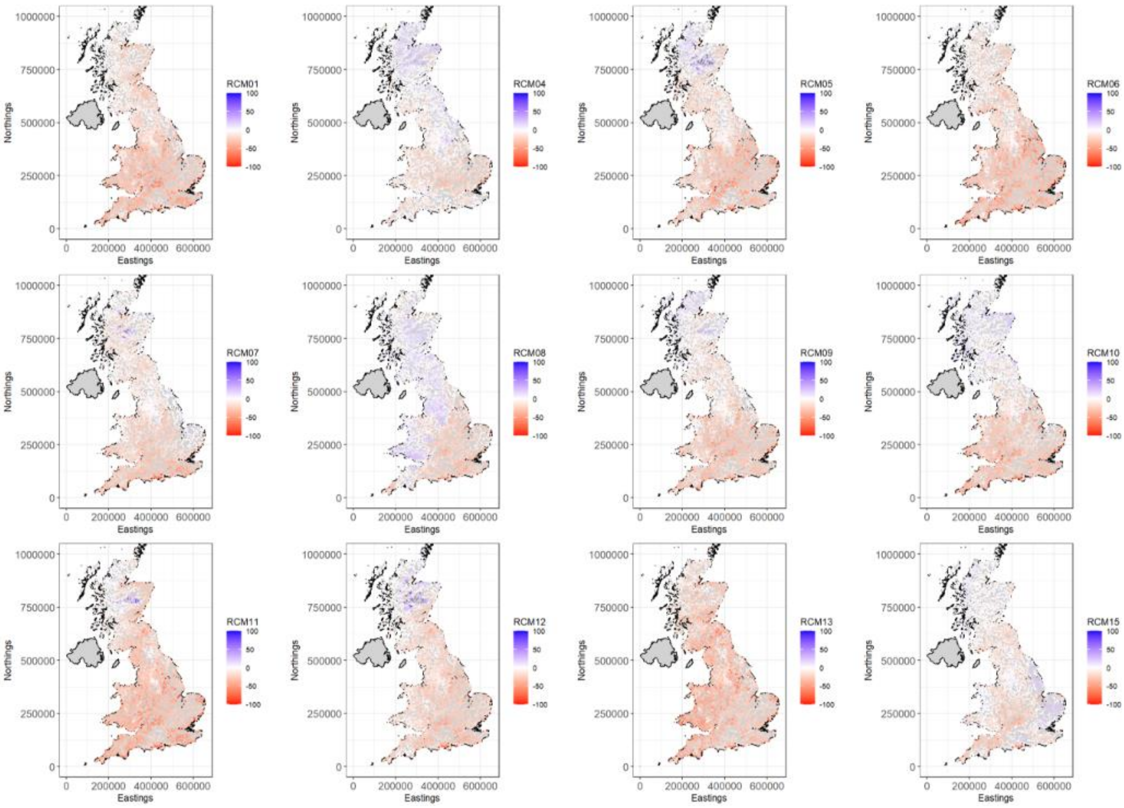
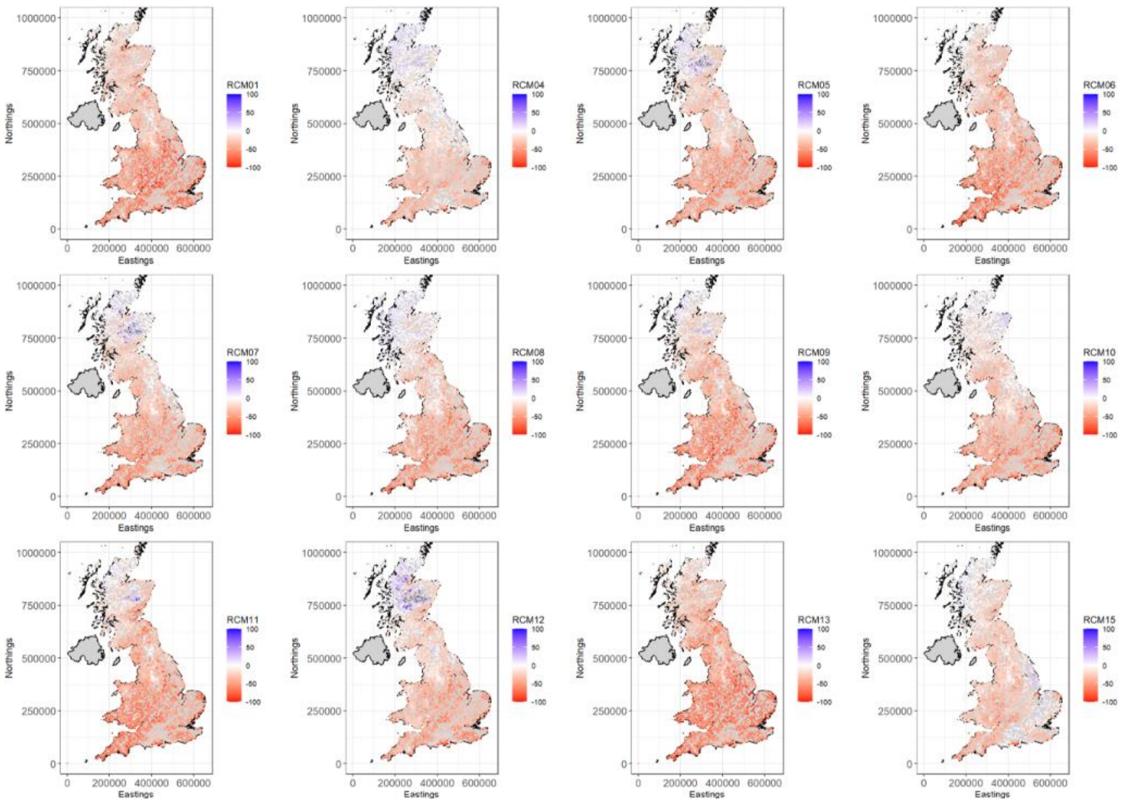


Figure 5 Variability within RCMs runs at Q95 (low flows) for the far future (2080). Source: Development of climate change adjusted FDCs in Qube, WHS (2024)



4.1.2. Defining a range of estimates

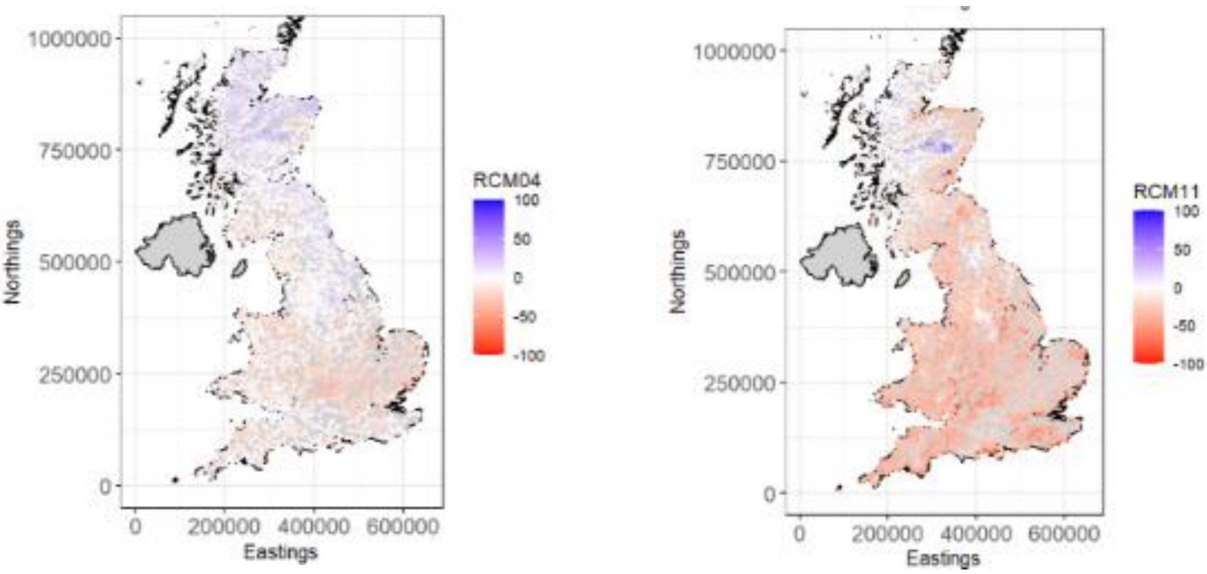
The 12 RCM runs provide a range of simulated climates. They are all judged to be equally likely but they are variable and there can be significant differences between the RCM runs, with some being consistently ‘wet’ whilst others represent a ‘drier’ possible future. To address this we have selected two of these ensemble members to reflect a potential range of future natural flows from a wetter range to a drier range and these have been used in the analysis to represent the potential range in future climate.

The RCM flow projections selected were as follows:

- RCM04 (defined as a ‘wetter range’ of future natural flows). This was selected because it is more representative of the spatial distribution of likely impacts and, whilst it is the second average wet side projection, it is not an outlier
- RCM11 (defined as a ‘drier range’ of future natural flows). This was selected because it is the second average dry side of projections but not an outlier

Figure 6 compares RCM04 and RCM11 for the near future (2050).

Figure 6 Comparison of wetter range (RC04 – left) with drier range (RCM 11 – right) for near future (2050)



For all the RCM flow projections there is spatial variability in terms of the magnitude of changes at low flows across the country. This means that the wetter range RCM will not be equally 'wetter' across all the country and similarly for the drier range RCM.

4.2. Estimated abstraction reduction

We have calculated the potential scale of abstraction reductions needed to address current unsustainable abstraction (baseline), how climate change might affect that (current 2050/2080) and considered this in relation to the government's commitments towards the environment (intermediate/full 2050/2080). These results are explained in section 4.2.1.

We have also taken account of proposals identified in the 2024 round of water company water resources management plans to understand how much these quantities might reduce by. These results are explained in section 4.2.2.

4.2.1. Potential scale of abstraction reductions to meet environmental requirements now and in the future (excluding WRMP24 actions)

The abstraction reductions calculated at an England scale as assessed for each environmental planning scenario and time period (as a total of surface and groundwater abstraction reductions) are summarised in Table 7. Numbers have been rounded to the nearest 10Ml/d. The results for baseline requirements in today's climate are shown for both recent actual and fully licensed whilst the result for 2050s are shown in terms of fully licensed quantities. This does not include predicted growth factors which are applied to recent actual quantities. Details for both recent actual quantities and 2080 figures can be found in Annex 1 and 2.

Table 7 Potential recovery required to meet environmental requirements now (baseline) and in 2050 climate (total for England) excluding WRMP24 in Ml/d

Scenario	Potential reductions (baseline), RA	Potential reductions (baseline), FL	Potential reductions 2050 'Wetter range' (FL inc. baseline)	Potential reductions 2050 'Drier range' (FL inc. baseline)
Current	2,200	3,200	4,740	4,730
Intermediate	not applicable	not applicable	5,380	5,290
Full	not applicable	not applicable	5,430	5,340

The drier range 2050 intermediate and fll scenarios show lower reduction estimates than the wetter scenarios. This is in part due to the spatial variability in climate change impacts across the country (as described in section 4.1.2) but the modelling also shows the effect of licences with hands-off flow conditions being constrained earlier under drier conditions.

The results suggest that, even after planned actions to 2025 are implemented, there is a potential need to reduce fully licensed abstraction by up to 3,200Ml/d to address current unsustainable abstraction. This represents approximately 60% of the total challenge, climate change pressures represent approximately 30% to 35% and meeting the full range of government commitments to the environment represent approximately 5% to 10%.

The gap to meet environmental requirements now is significantly different to that which we reported in the first National Framework. This is due to the assumptions we made regarding water company schemes planned for implementation up to 2025. For the previous framework we assumed that, if there was a scheme in a waterbody, it would fix the waterbody.

This time around we have looked at those schemes and used the expected abstraction reduction these will achieve and, based on this, changed the quantity values in our standalone versions of the WRGIS which we use to conduct the analysis. This provides a better planning assumption than that used in first framework and better reflects the more detailed analysis that regional groups did in generating the first regional plans.

Table 8 breaks these national results down by each regional group under each assessed scenario (as a total of surface and groundwater abstraction reductions) for 2050. Numbers have been rounded to the nearest 10Ml/d – this means the totals in table 8 may be marginally different to those in table 7.

Some rivers arise in Wales but have waterbodies that cross the England-Wales border. Where this is the case, we have included abstractions which affect waterbodies in England so that the condition of waterbodies shared between the two nations is assessed and can be managed holistically. These are attributed to the relevant region.

Abstraction reductions identified are greatest in Water Resources West for the baseline and greatest in Water Resources South East across all scenarios in the 2050s.

Table 8 Summary of potential reductions by region for each environmental planning scenario; figures for 2050 include the baseline and are based on FL abstraction and are in Ml/d

Region	Baseline RA	Baseline FL	Current 2050 'Wetter range'	Inter-mediate 2050 'Wetter range'	Full 2050 'Wetter range'	Current 2050 'Drier range'	Inter-mediate 2050 'Drier range'	Full 2050 'Drier range'
WCWR	190	320	460	500	410	480	540	450
WR East	460	660	760	970	1,020	790	1,000	1,050
WR North	320	430	590	650	670	620	660	680
WRSE	360	560	1,810	2,100	2,170	1,840	2,070	2,140
WR West	880	1,210	1,120	1,150	1,150	1,000	1,020	1,020
Total	2,200	3,180	4,740	5,370	5,420	4,730	5,290	5,340

Figure 7 Baseline – potential abstraction reduction by waterbody, fully licenced

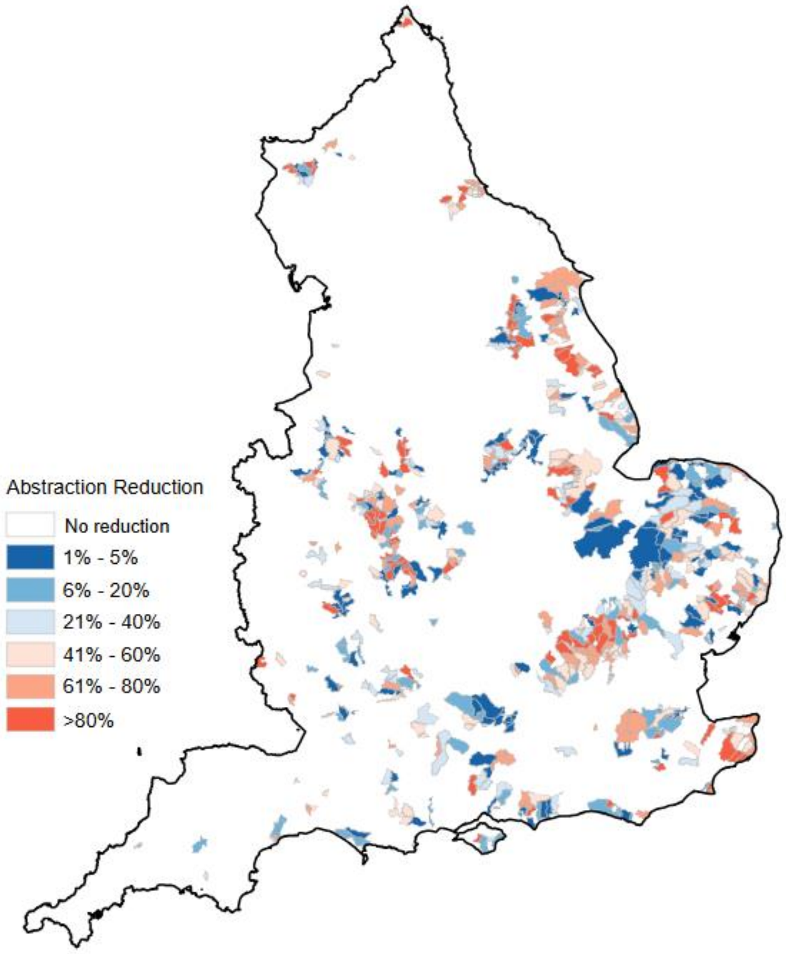


Figure 7 shows how these reductions look at a waterbody scale at fully licensed quantities. This map shows the potential abstraction reductions against today's baseline environmental requirements – there is a potential need to reduce fully licensed abstraction by up to 3,200Ml/d to address current unsustainable abstraction. This does not include the proposed reductions associated with WRMP24.

In Figure 8 two maps show how this may change by the 2050s looking at the range of environmental expectations (from current regulatory requirements to full environmental expectations) under the two climate change scenarios (wetter to drier range). These show that, by the 2050s, this total need (full expectations) could rise to 5,400 Ml/d.

Figure 8 Potential abstraction reduction (FL) by waterbody in 2050 excluding WRMP24

Map on left: Current regulatory requirements by waterbody in a wetter range climate.
Map on right: Full environmental expectations in a drier range climate.

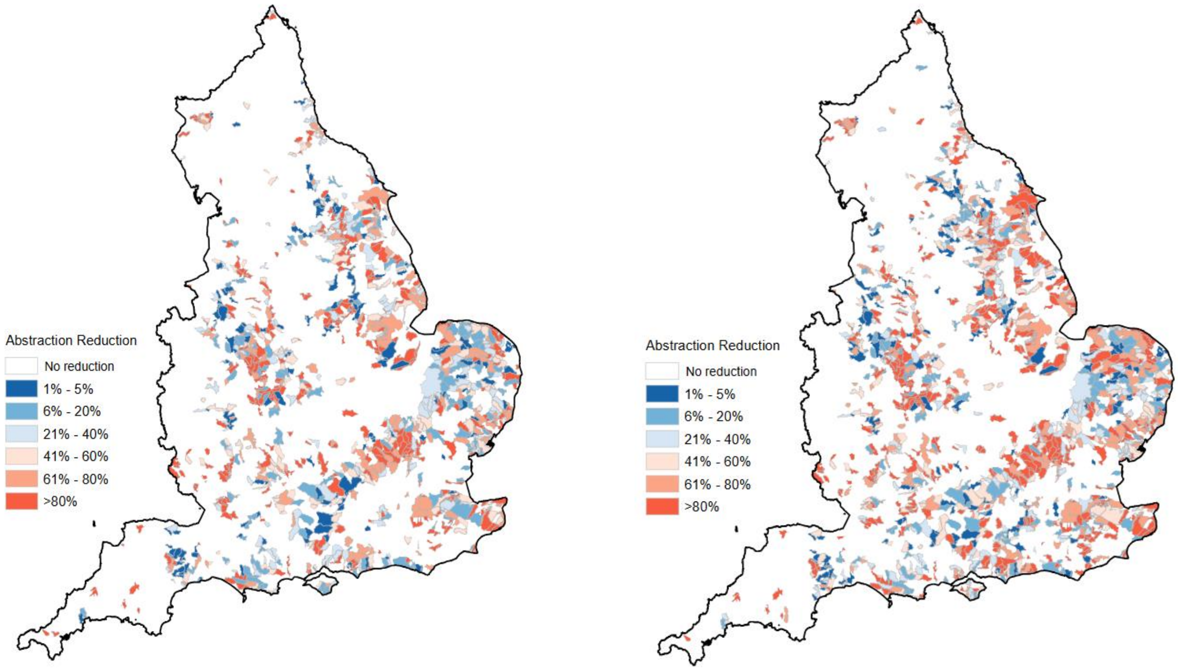


Table 9 breaks these national results down by sector under each assessed scenario (as a total of surface and groundwater abstraction reductions. This shows that public water supply (PWS) accounts for approximately 90% of the total abstraction reductions required to address current unsustainable abstraction and up to 85% in the future (based on FL). These are national results, and sectorial impacts will differ on a more local individual waterbody scale. Numbers have been rounded to the nearest 10Ml/d – this means the totals in table 9 may be marginally different to those in table 7.

Table 9 Summary of potential reductions by sector for each environmental planning scenario (Ml/d); figures for 2050 include the baseline

Sector	Base-line RA	Base-line FL	Current 2050 'Wetter range'	Inter-mediate 2050 'Wetter range'	Full 2050 'Wetter range'	Current 2050 'Drier range'	Inter-mediate 2050 'Drier range'	Full 2050 'Drier range'
Agriculture	60	110	180	200	200	200	220	230
Industrial	50	140	270	310	320	280	330	340
Amenity	0	0	0	0	0	0	0	0
Other	20	40	190	290	300	200	310	310
PWS	2,060	2,880	4,010	4,500	4,530	3,940	4,420	4,450
Power generation	0	10	90	70	70	100	10	10
Total	2,190	3,180	4,740	5,370	5,420	4,720	5,290	5,340

4.2.2. Potential scale of abstraction reductions to meet environmental requirements now and in the future (including WRMP24 actions)

The abstraction reductions calculated at an England scale as assessed for each environmental planning scenario and time period (as a total of surface and groundwater abstraction reductions) are summarised in Table 10. The results for baseline requirements in today's climate are shown for both recent actual and fully licensed whilst the result for 2050 are shown in terms of future predicted and fully licensed quantities. Future predicted includes predicted growth factors which are applied to recent actual abstraction quantities. We have not included details of the analysis for 2080 in this report as WRMP24 actions primarily relate to the period up to 2050.

Table 10 Potential recovery required to meet environmental requirements in 2050 climate including WRMP24 proposed reductions (total for England) for both future predicted and fully licensed quantities (Ml/d)

Scenario	Potential reductions 2050 FP – ‘Wetter range' (inc. baseline)	Potential reductions 2050 FL – 'Wetter range' (inc. baseline)	Potential reductions 2050 FP – 'Drier range' (inc. baseline)	Potential reductions 2050 FL – 'Drier range' (inc. baseline)
Current	1,240	2,120	1,370	2,300
Intermediate	1,370	2,350	1,490	2,490
Full	1,510	2,570	1,650	2,740

The proposed actions in WRMP24 would have the effect of reducing the overall abstraction reductions required from 5,400Ml/d to between 2,570 and 2,740Ml/d considering full environmental requirements for FL quantities.

Tables 11 and 12 break these national results down by each regional group under each assessed scenario (as a total of surface and groundwater abstraction reductions) for future predicted and fully licensed quantities.

Table 11 Summary of potential 2050 reductions by region for each environmental planning scenario, including the baseline for future predicted (FP) (Ml/d)

Region	Current 2050 'Wetter range'	Inter-mediate 2050 ‘Wetter range'	Full 2050 'Wetter range'	Current 2050 'Drier range'	Inter-mediate 2050 'Drier range'	Full 2050 'Drier range'
WCWR	130	130	150	160	170	200
WR East	330	370	400	350	380	420
WR North	270	290	290	300	320	320
WRSE	210	210	240	230	230	260
WR West	300	370	420	320	390	440
Total	1,240	1,370	1,510	1,370	1,490	1,650

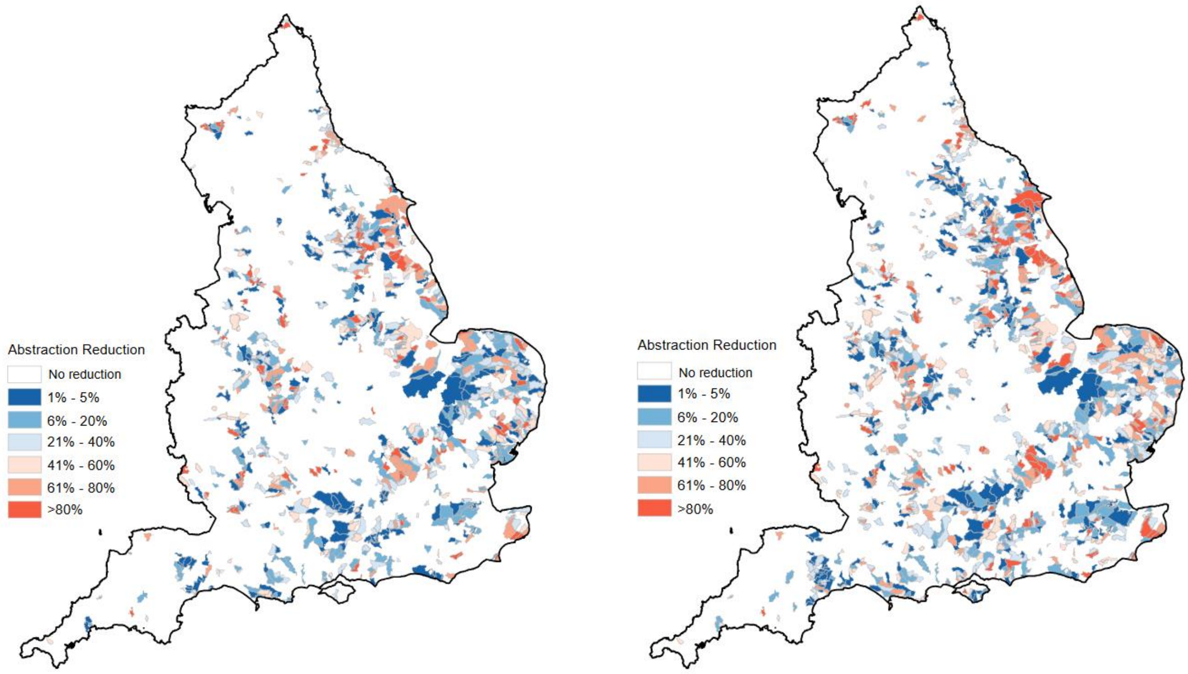
Table 12 Summary of potential 2050 reductions by region for each environmental planning scenario, including the baseline for fully licenced (FL) (Ml/d)

Region	Current 2050 'Wetter range'	Inter-mediate 2050 ‘Wetter range'	Full 2050 'Wetter range'	Current 2050 'Drier range'	Inter-mediate 2050 'Drier range'	Full 2050 'Drier range'
WCWR	270	270	300	320	320	370
WR East	490	530	590	520	560	620
WR North	470	540	560	500	550	570
WRSE	400	420	460	430	440	490
WR West	490	580	650	530	630	690
Total	2,120	2,340	2,560	2,300	2,500	2,740

In Figure 8 two maps show how these required reductions may change by the 2050s once WRMP24 actions are taken into account. They show the remaining abstraction reductions once the proposed measures are considered at a waterbody scale at fully licensed quantities for a range of environmental expectations (from current regulatory requirements to full environmental expectations) under the two climate change scenarios (wetter to drier range).

The results described in section 4.2 are based on analysis commissioned by the Environment Agency (WSP 2025).

Figure 9: Potential abstraction reduction (FL) in 2050 by waterbody including WRMP24 proposals. Map on left: Current regulatory requirements by waterbody in a wetter range climate. Map on right: Full environmental expectations in a drier range climate.



5. Summary

At an England level, current unsustainable abstraction accounts for the biggest proportion of the total abstraction reductions required by volume – 60% of the abstraction reduction to enable environmentally sustainable abstraction in 2050. Climate change impacts on natural low flows equate to 30% of the reductions needed. Meeting full environmental requirements adds an additional 10%.

These proportions will change at different scales (regional, catchment, waterbody).

To address current unsustainable action, reductions to fully licensed (FL) volumes of abstraction of around 3,200Ml/d will be required. Of this 2,200Ml/d relates to recent actual (RA) abstraction. PWS abstraction accounts for the biggest proportion of this for FL (90%).

The impact of climate change could see these figures for fully licensed abstraction rise from between 4,730Ml/d for current environmental regulatory requirements to 5,430Ml/d for full environmental requirements.

Taking account of proposals in WRMP24, these figures for fully licensed abstraction could reduce from between 2,120Ml/d for current environmental regulatory requirements to 2,740Ml/d using full environmental requirements. This represents an overall reduction of between 45% and 51% overall.

Abstraction reductions resulting from WRMP24 proposals include expectations regarding reduce demand for water including reductions to household Per Capita Consumption. This analysis does not consider confidence in delivering these actions, but this will be an important consideration for planning.

The Environmental Destination does not consider how these changes will be achieved. This is done through the planning process – the information provided here should be seen as a starting point from which to plan, collaborate and improve, improve the data and develop a regional plan.

6. Limitations of the work

The national framework scenarios presented here are for planning purposes only. More detailed local and regional analysis is required to inform licence decision making. Sections 3.2.1 and 3.6.1 set out the detailed assumptions we have made in our analysis, but the following general points should also be noted.

The WRGIS is a snapshot in time and is the best national information we have on water availability. However, it does not represent catchments in as much detail as more locally-specific models can. Also, WRGIS may differ from other models in the assumed distribution of the impact of abstractions.

The baseline calculations were completed on a national scale and should not override local investigations that have used more detailed modelling work.

To establish the 2025 baseline, we had to estimate several licence reductions as the exact licence quantities were not available. Once these licence changes are identified and implemented this could alter the scale of reduction needed to achieve sustainable abstraction in the baseline.

We have applied the objectives from cycle 3 RBMPs to the 2025 baseline. This may include waterbodies that have been identified in national data sets as an outstanding issue but have in fact been dealt with on a local scale. These can be quickly removed by regional and local refinement.

We have allowed the future predicted abstraction and discharge rates to exceed the fully licensed rates as this represents where abstractors may require more water in 2050 compared to what they are licensed to abstract now. In practice these licence limits are likely to constrain abstraction under certain scenarios, reducing the potential growth in abstraction.

These are ‘environmental flow’ planning scenarios presented for further consideration and analysis by the Regional Water Resources Groups to inform their Environmental Destination aims and actions. There has been no assessment of the actual ecological benefits that flow compliance would deliver, or of their total cost, best value timing or affordability.

The two UKCP18 climate change projections (RCM04 and RCM11) selected to represent ‘drier’, or ‘wetter’ range outcomes, are also spatially variable – so that the relationships between them are not consistent everywhere.

The future calculations of environmental flow thresholds are allowed to evolve in relation to projected natural flows (in most cases, natural low flows are likely to be lower in the long term). However, in the analysis abstraction licence constraints such as hands-off flow conditions are assumed to remain fixed at present-day levels, which is unlikely to be sustainable in the long term

Fix-It carries out an analysis at the Q95 level only. As most waterbody flow issues are at their peak during Q95 low flows this is largely adequate for assessment purposes. However, it should be noted that some areas have flow issues at other percentage exceedance (Q) values and not just at Q95 but we were not able to consider these in this analysis hence the need to review local modelling where available.

The Fix-It calculations of groundwater abstraction reductions are based on the assumed spatial (across waterbodies) and temporal (lowest flow impact factor) distributions of impacts in the WRGIS. These provide a good starting point for analysis and typically indicate that comparatively large reductions in headwater abstractions may be required to deliver relatively small increases in flow. However, in many cases, the WRGIS assumptions have not been reviewed and revised to reflect the more reliable predictions available from the Environment Agency's regional groundwater models.

The WRGIS projections and calculations are based on simple flow duration curve analysis. They do not consider potential adaptations in the time series operation of abstractions, reservoirs, transfers or augmentation schemes which may, in reality, be important in maintaining low flow resilience in the face of climate change. Better time series reservoir, water resources and groundwater modelling could help build confidence in the predicted flows and smarter abstraction adaptation options assessment.

6.1. Future work

Going forward we are looking to evolve our data through continuous improvement of data, rather than conducting a future standalone assessment as outlined here. Information on our Water Hub explains how to find out more.

7. Annexes

7.1. Annex 1 – Summary of recent actual data phase 1

This is provided as a downloadable table on our data sharing platform. Please search for Environmental Destination data tables National Framework Water Resources 2025.

7.2. Annex 2 – 2080 figures

This is provided as a downloadable table on our data sharing platform. Please search for Environmental Destination data tables National Framework Water Resources 2025.

8. References

A. Hughes, M. Mansour, R. Ward, N. Kieboom, S. Allen, D. Seccombe, M. Charlton, C. Prudhomme, The impact of climate change on groundwater recharge: National-scale assessment for the British mainland, Journal of Hydrology, Volume 598, 2021, 126336, ISSN 0022-1694.

Cranfield (2018), Task 2 Agricultural demand forecasts (Part II): future demand. Cranfield Water Science Institute Final Technical report.

Wallingford HydroSolutions WHS (2024), Development of climate change adjusted flow statistics in Qube.

Wood Environment & Infrastructure Solutions UK Limited (2019), Understanding future water demand outside of the water industry work.

WSP (2025), WRGIS NF2 – Refreshing the National Framework for Water Resources: Updating long term environmental needs analysis, Environment Agency report.

9. List of abbreviations

45FP, 45BL, 12FP and 13FP – These refer to [growth factor tables in the water company WRMPs]

AMP – Asset Management Programme

ASB – Abstraction Sensitivity Band

BL – baseline

CERF – (Wallingford Hydrosolutions') Continuous Estimation of River Flows model

CSMG – Natural England's Common Standards Monitoring Guidance

DI – distribution input

EFI – Environmental Flow Indicator

eFLAG – [Enhanced Future Flows and Groundwater (eFLaG) project]

FDC – flow duration curve

FF – far future

FFH – Future Flows Hydrology

FL – fully licenced

FP – future predicted

GW – groundwater

GWDTE – Groundwater Dependent Terrestrial Ecosystems

HadCM3 – [Hadley Centre Coupled Model version 3]

Ml/d – megalitres per day

NF – near future

PWS – public water supply

Q30/Q50/Q70/Q95 – The flow that is exceeded 30%, 50%, 70% or 95% of the time

Qube – Qube is a web-based water resource model that can be used to estimate natural and influenced flow durations curves (FDCs) and time series for ungauged sites throughout the UK and Ireland

RA – recent actual

RBMP – river basin management plan

RCM – Regional Climate Model

RCP8.5 – Representative Concentration Pathway 8.5

SSSI – Site of Special Scientific Interest

UKCP09 – UK Climate Projections 2009

WB – waterbody

WFD – Water Framework Directive

WINEP – Water Industry National Environment Programme

WR – water resources

WRGIS – Water Resource Geographical Information System

WRMP24 – Water Resources Management Plan 2024