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NEEDS YOU.

WATER FOR WILDLIFE: TACKLING DROUGHT AND UNSUSTAINABLE ABSTRACTION



WORKING
TOGETHER TO
CONSERVE AND
PROTECT
ENGLISH RIVERS



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FOR YOUR
PLANET



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SUMMARY

WWF's latest Living Planet Report shows that populations of freshwater species have declined by 81% since 1970, faster than in any other species group on the planet¹. Nature and wildlife are losing out in the rush to exploit the planet's water resources. In England and Wales, fewer than one in five rivers are classed as in good ecological health². Nearly a quarter of rivers in England are at risk from unsustainable water abstraction³, with water taken for use in homes, businesses and farms without enough left in rivers for wildlife to thrive. With the pressures of climate change and population growth, action is urgently needed.

We must act now. Britain experienced the driest winter and early spring for more than 20 years according to the Met Office. Low river flows, particularly in the south-east, are likely this summer⁴. Rivers have dried up in some places with potentially devastating effects on wildlife.

And it's not just wildlife that is under pressure. Recent analysis shows that the economic and social costs of drought far exceed the costs of addressing the problem⁵, and that the rate of return on investment of improving river health is high⁶. At a time when the public purse is under pressure and the economic outlook is so uncertain, there is a strong case for leveraging investment in rivers for the benefit of taxpayers.

There is a strong public mandate for action. New research we commissioned shows that four out of five people think that wildlife has as much of a right to water as people⁷. But only one in five agreed that there are sufficient regulations in place to protect rivers from high water use.

**ONLY 1 IN 5 PEOPLE
THINK THE RIGHT
REGULATIONS ARE IN
PLACE TO PROTECT
RIVERS FROM HIGH
WATER USE**

In 2011, the UK government recognised that the current water abstraction regime (which controls how much water is taken out of rivers for use by farms, businesses and households) was out of date and not fit for purpose. In its *Water for Life* White Paper⁸, Defra set out its intention to reform the abstraction regime to ensure sufficient water for wildlife and economic growth. The resulting legislation to make this a reality was due this spring. But in April 2017, in the midst of a developing drought, the minister confirmed that new legislation was on hold due to insufficient parliamentary time to take it forward.

Urgent reform of abstraction is needed now to mitigate the devastating effects of drought and restore river health.

At WWF, we urge the new government to bring forward the promised Water Bill for England and Wales and make immediate improvements to the current system. These must include:

1. Transposing the Water Framework Directive in full as part of the Great Repeal Bill and establishing mechanisms and sanctions to enforce its implementation and uphold its 2027 deadline after we leave the European Union.
2. Introducing a new 'Restoring Sustainable Abstraction' scheme to take urgent action in the 555 river water bodies where the environmental regulators indicate that abstraction is already damaging habitats and wildlife.
3. Ensuring immediately that all licences and permits prevent future damaging abstraction - with a system that links abstraction to availability, encourages efficient use, and ensures sufficient water for wildlife in every river.
4. Devising a national strategy to cut water waste, including plans to: make every home and business water efficient; engage the public about the value of water; and make paying for water fairer, through universal metering.

These actions should form a key part of the 25 year plan for the environment which the last government committed to produce as part of its vision to be the first generation since the industrial revolution to leave our environment in better shape than we found it⁹. Such a plan is vital and should focus on maximising the value of nature to people and avoiding the economic and social costs that occur as a result of its decline. We recommend that the forthcoming plan sets key targets for water to ensure that the ecological health of our rivers is secured by the deadline of 2027, as required by current legislation.

**LESS THAN ONE
IN FIVE RIVERS
IN ENGLAND
AND WALES ARE
CLASSED AS IN GOOD
ECOLOGICAL HEALTH**

1. THE LEGACY OF POOR DROUGHT MANAGEMENT: UNSUSTAINABLE ABSTRACTION

The right to abstract water from water bodies (such as rivers, aquifers and reservoirs) in England and Wales was formally created by the Water Act of 1963. At the time, this was done with little or no consideration of the natural environment and what was sustainable. This system, which underpins all water supply sources, is now fundamentally broken.

A freedom of information request we made to the Environment Agency in late 2016¹⁰ showed that nearly a quarter of rivers in England are at risk from too much water being abstracted, leaving too little for wildlife:

- 14% are classified as ‘over-abstracted’, meaning water removal is causing rivers to drop below levels required to sustain wildlife.
- 9% are ‘over-licensed’, meaning the river would be over-abstracted if licence holders took all the water they were entitled to.

In addition, 24% of aquifers are classed as in ‘poor quantitative status’ – meaning that water is being abstracted from underground supplies faster than it can be naturally replenished. The resulting diminishing groundwater levels put household water supplies at risk and also hamper the important contribution groundwater makes to river flows during dry periods.

Imagine a river. A lovely, tranquil English chalk stream. Crystal clear waters, clean gravel beds, emerald green underwater plants – a haven for wildlife: the timid water vole, the rising mayfly, the wild brown trout. You won’t find this scene anywhere else in the world except pockets of northern France. These wonderful habitats are our water rainforests – ours to enjoy, ours to protect. But at the moment, we’re behaving as though they’re ours to destroy. Because, of England’s 224 chalk streams, only 12 receive special protection and only 19% meet good ecological status¹¹ as defined by the EU Water Framework Directive. Half are at risk from unsustainable levels of over-abstractation because the naturally filtered crystal-clear water requires little treatment and is a cheap source of water for homes. And when drought begins to bite, these precious streams are often the first to dry up, and wildlife suffers.

WHAT THE PUBLIC THINK

Every river should be healthy: it should have sufficient flow to sustain wildlife, provide clean water supplies, and be a place for people to relax and enjoy. This is not just the view of WWF – it’s also what the public think, according to a recent public opinion poll we commissioned¹².

The poll results show that the public care about rivers and believe wildlife has as much of a right to water as people do. The majority of people are worried about the harm done to the environment when too much water is taken from rivers. They want rules to ensure there’s enough water left in rivers for people and wildlife, but many are unsure whether the existing rules are sufficient to do this.

- 80% of people think that wildlife has as much of a right to water as people have.
- 69% of people are worried about the environmental impact of taking water out of rivers and think the government should restrict the amount of water that is taken from rivers.
- Only one in five people agree that there are sufficient regulations in place to protect rivers from high water use.

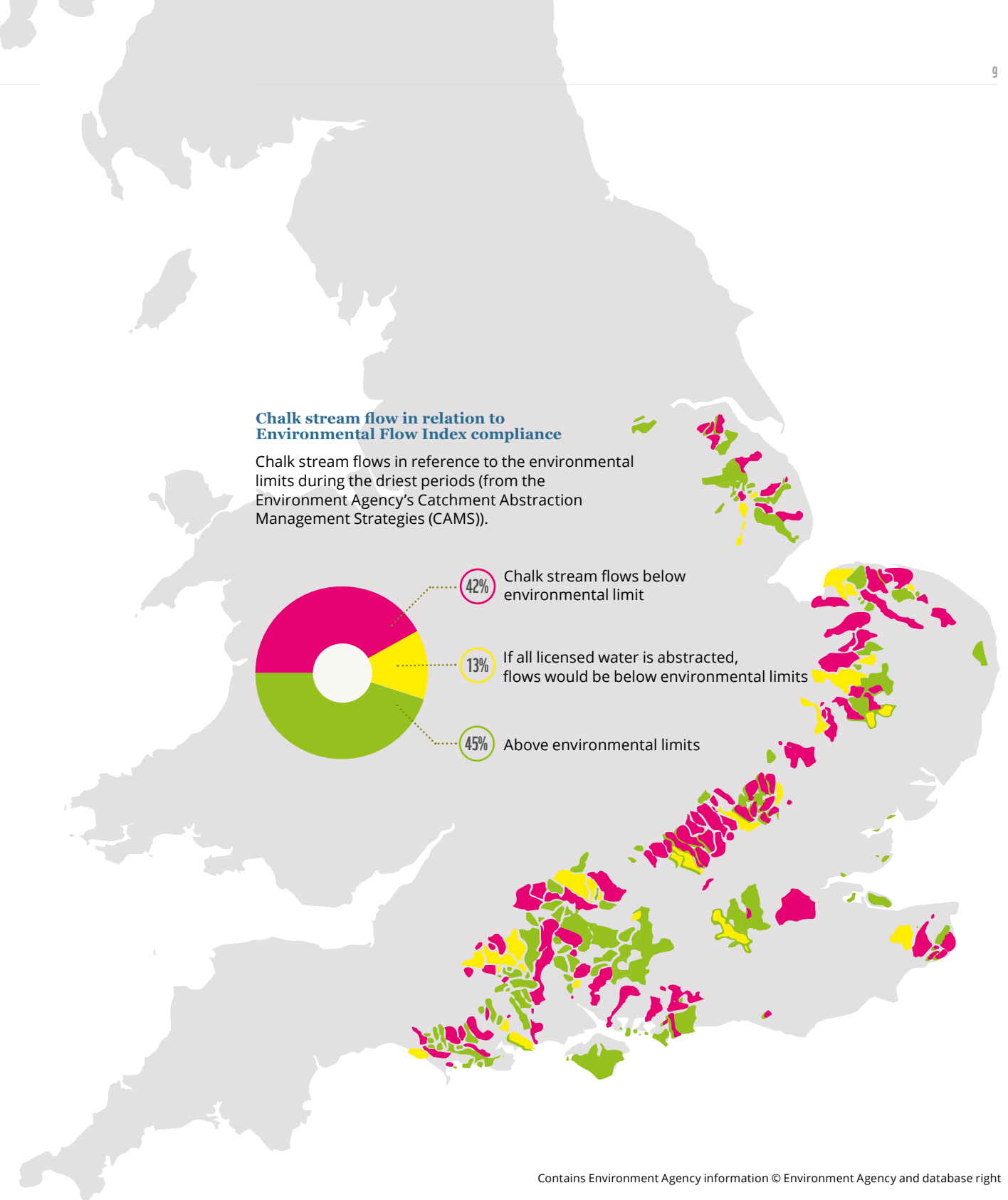
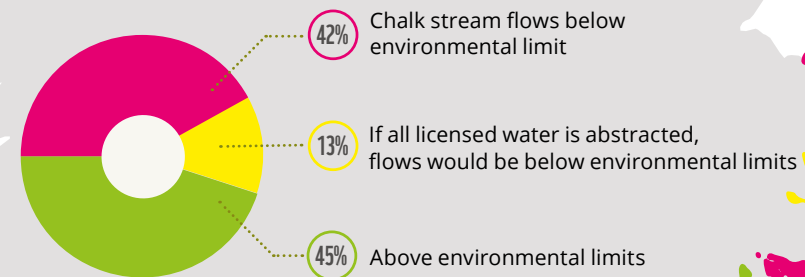
The public want to do the right thing and help save water; there is appetite for using water efficiency measures like installing a water meter or eco-shower. They look to government, the Environment Agency and water companies to take an active role in educating and providing incentives to help save water.

- 85% agree that individuals should do more to reduce water wastage in their homes.
- 70% of people either already have a meter or would welcome one.
- Less than a third (30%) of people realise they could request free water efficiency kits such as an eco-shower head from their water company.
- Over 80% of people agree the government should do more to encourage homes and businesses to be more water efficient.

Clearly there is a big opportunity for the government and water companies to harness the public’s enthusiasm for protecting the environment and saving water.

Chalk stream flow in relation to Environmental Flow Index compliance

Chalk stream flows in reference to the environmental limits during the driest periods (from the Environment Agency’s Catchment Abstraction Management Strategies (CAMS)).





WHY WILDLIFE NEEDS WATER

River flow is the most important factor for a healthy river ecosystem¹³: it influences the river's shape and habitat, the transport of nutrients, and the quality of water. When river flows are lower, pollutants become more concentrated, the river slows and becomes choked with sediment, water temperature increases and weirs and other structures become insurmountable obstacles making it impossible for fish and invertebrates to pass. Unnaturally low flows decrease the available space for aquatic animals to live and breed, leading to increased competition and stress on their populations. This ultimately affects the whole ecosystem, from the smallest bug to the biggest fish.

Many species of fish are particularly vulnerable, especially migratory species such as Atlantic salmon, sea trout, European eel, river lamprey and sea lamprey that struggle to migrate upstream in low flow conditions.

Bird species such as common sandpiper and dipper have been shown to suffer when river flows drop, due to the effect it has on their prey – namely invertebrates and small fish¹⁴. A study on the Tewinbury Lagoon, a Site of Special Scientific Interest in Hertfordshire, linked kingfisher numbers to water levels in the lagoon¹⁵.

Water voles, which live on the banks of slow-moving rivers and wetlands, are also vulnerable to declining water levels. They are Britain's fastest-disappearing mammal, suffering a staggering 90% since the 1970s. When flows are reduced, water voles become more vulnerable to predators such as American mink, fox and stoat: they are unable to flee into the water and gain access to their riverbank burrows via underwater entrances. Monitoring by the Suffolk Wildlife Trust shows clear declines in water vole populations when water levels drop¹⁶.

DROUGHT ON THE HORIZON?

Right now the situation is particularly perilous. Britain experienced the driest winter and early spring for more than 20 years, according to the Met Office¹⁷. Winter is when groundwater is recharged by rainfall, building the resilience of river ecosystems to dry spells.

In May 2017 the Centre of Ecology and Hydrology indicated that the summer was likely to include low levels of soil moisture and low river flows causing agricultural stress and exerting pressure on the river environment¹⁸. Low flows are particularly likely in rivers in south-east England fed by groundwater. In April a number of rivers stopped flowing or were reporting extremely low flows, such as the River Chess in Hertfordshire and the River Colne in London.

PROGRESS IN TACKLING UNSUSTAINABLE ABSTRACTION

In 1993 the National Rivers Authority (the precursor to the Environment Agency and Natural Resources Wales) set up a then ground-breaking initiative to tackle the problem of over-abstraction. This later became the Restoring Sustainable Abstraction Programme. Since 1993 more than 500 abstraction sites have been investigated and action taken, including 254 sites where licences have actually been amended – many voluntarily. A further 166 licences remain, and the Environment Agency expects these to be assessed or amended to ensure sustainable abstraction by 2020¹⁹. Many of the necessary amendments will have to be compulsory.

Our freedom of information request to the Environment Agency²⁰ showed that this is just the tip of the iceberg. In addition to those in the Restoring Sustainable Abstraction programme, there are a further 555 river water bodies where abstraction is causing ecological damage (shown in the map opposite). Given that many over-abstracted rivers have multiple users abstracting from them, these water bodies could relate to thousands of individual licences.

At the current rate of progress it could be 2050 before today's damage is addressed²¹. But even this may be impossible. Under current law (the Water Act of 1963) the Environment Agency has to pay compensation to certain abstractors (farmers and some industrial/manufacturing businesses) if it amends a licence to protect the environment. But the Environment Agency told us it has “no mechanism to fund²²” changes to licences to protect the environment.

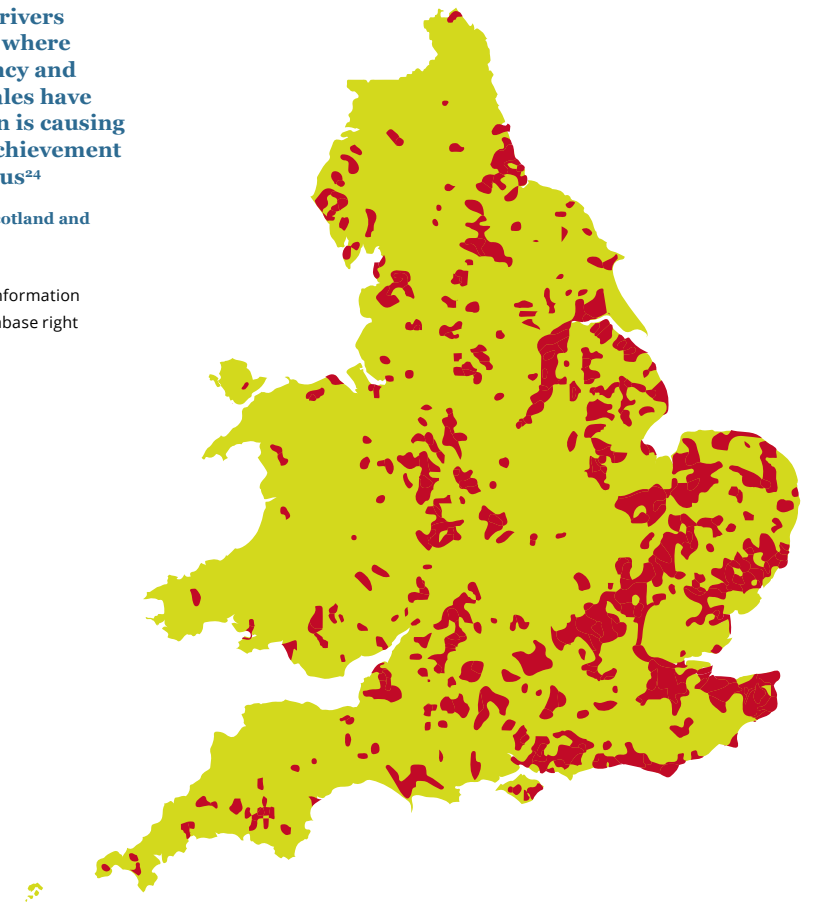
Previous UK governments have long acknowledged that the current system of abstraction is not fit for purpose. The 2011 Water White Paper *Water for Life*²³ promised new legislation for England and Wales to address it. But earlier this year the minister responsible confirmed an indefinite delay to this long overdue Water Bill, citing limited parliamentary time owing to Brexit as a significant factor in their decision. Without this essential legislation there is no way to guarantee long-term protection for our environment.

69% OF PEOPLE ARE WORRIED ABOUT THE IMPACT ON THE ENVIRONMENT OF TAKING TOO MUCH WATER FROM RIVERS

Map showing (in red) rivers in England and Wales where the Environment Agency and Natural Resources Wales have shown that abstraction is causing damage, preventing achievement of good ecological status²⁴

(Data was not available for Scotland and Northern Ireland.)

Contains Environment Agency information
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Climate change is making a bad situation worse. Research published in 2017 showed that our changing climate is already having an impact on some of our most treasured and special places around the UK²⁵. Another report by the UK Committee on Climate Change found that climate change is projected to reduce the amount of water in the environment that can be sustainably withdrawn while increasing the demand for irrigation during the driest months²⁶. The report concluded that priority action was needed to address the risk of shortages and prevent further ecological damage given that the UK as a whole was projected to have far greater demand for water than resources available²⁷. In 2011 the Environment Agency concluded that, in the context of climate change, “continuing with the current approach to water resource management will compromise the environment, the economy, or society - singly or in combination”²⁸.



“I fear for the future as this is only going to get worse if nothing is done about it. People see rivers as a resource for themselves instead of seeing the overall landscape scale.”

Peter King, Ouse and Adur Rivers Trust

2. POLICY RECOMMENDATIONS FOR THE NEW GOVERNMENT

It's time to refocus the abstraction problem: moving away from a supply-dominated water licensing system to a resilient system that protects the environment and encourages efficient use.

We need environmental limits on abstraction – not just for single sites, but across whole river catchments. This would keep rivers flowing, enabling wildlife to cope better with change.

Clear environmental limits on every licence would also remove the current uncertainty over environmental requirements for water companies. This is inflating costs, hindering longer-term water resources planning, and acting as a constraint to resolving over-abstraction.

This issue has been overlooked for too long; the new government has the opportunity to transform the system and make it a priority to keep our rivers flowing. We urgently need an effective, determined effort to push through the necessary reforms to ensure all existing unsustainable licences across all sectors are amended and future abstraction is restricted to sustainable limits. The Water Framework Directive legally binds the government to do this all by 2027 at the latest.

WWF believes that a new Water Bill is needed now to deliver the government's abstraction reform proposals, set out in their 2013 consultation paper, *Making the Most of Every Drop*²⁹. If pressures on parliamentary time prevent that, abstraction reform must be immediately delivered through secondary legislation to improve the current system while we await primary legislation.

8 IN 10 PEOPLE THINK WATER COMPANIES SHOULD DO MORE TO ENCOURAGE HOMES AND BUSINESSES TO BE WATER EFFICIENT

We urge the new government to bring forward the promised Water Bill for England and Wales and make immediate improvements to the current system. These must include:

- 1. Transposing the Water Framework Directive in full as part of the Great Repeal Bill and establishing mechanisms and sanctions to enforce its implementation and uphold its 2027 deadline after we leave the European Union.**
- 2. Introducing a new 'Restoring Sustainable Abstraction' scheme to take urgent action in the 555 river water bodies where the environmental regulators indicate that abstraction is already damaging habitats and wildlife.**
- 3. Ensuring immediately that all licences and permits prevent future damaging abstraction – with a system that links abstraction to availability, encourages efficient use, and ensures sufficient water for wildlife in every river.**
- 4. Devising a national strategy to cut water waste, including plans to: make every home and business water efficient; engage the public about the value of water; and make paying for water fairer, through universal metering.**

SAFEGUARDING THE WATER FRAMEWORK DIRECTIVE

The Water Framework Directive requires the government to ensure that all abstraction is restricted to sustainable limits in order to support rivers achieving good ecological status. Importantly, the directive legally binds the government to do this by 2027 at the latest. The government's Brexit white paper guaranteed that this important piece of legislation – and its 2027 deadline – would be transposed into UK law³⁰. This is a promising first step but alone it is not enough: the Water Framework Directive must be transposed in full and mechanisms and sanctions established to enforce its implementation and uphold its 2027 deadline after we leave the European Union.

A NEW RESTORING SUSTAINABLE ABSTRACTION SCHEME

The current Restoring Sustainable Abstraction (RSA) programme is clearly not fit for purpose. We propose that Defra should announce an urgent refresh of the RSA programme and revoke all damaging abstraction licences by 2020. This should be extended to all the 555 water bodies that are failing to meet good ecological status.

This 'RSA 2' should:

- Establish environmental objectives for abstraction based on a catchment-level understanding of environmental water needs, in time for incorporation into water company business plans (2020-25) and ahead of discussions with other licence holders over solutions.
- Support achievement of good ecological status by 2027, as well as preventing deterioration in status.
- Separate the process of scientific assessment of environmental water needs from discussions about how environmental objectives will be met.
- Ensure damaging abstraction that is relatively easy to tackle is addressed quickly rather than spending many years gathering evidence.
- Require progress to be reported to Parliament through inclusions in the Climate Change Committee Adaptation Sub-Committee reports.



Three key new tools are required for the Environment Agency and Natural Resources Wales to deliver the new RSA successfully:

a. A more robust approach to serious damage caused by

abstraction. Where abstraction is clearly causing serious damage, the regulator needs to be bold and revoke these licences, without compensation. WWF calls for the government to revise guidance on what exactly constitutes ‘serious damage’, in order to enhance regulator confidence in the use of this policy.

b. New incentives for farmers to reduce abstraction licences as part of the transition to a new domestic agricultural policy.

Where abstraction by farmers is having adverse ecological impact, but not serious damage, the current law requires payment of compensation. Without new primary legislation to amend this, the government must put incentive mechanisms in place for farmers to reduce their environmental impact. The transition from the Common Agricultural Policy to a new domestic policy post-Brexit is a prime opportunity to better protect the environment from abstraction for agriculture. We call on the government to secure a one-off fund from the Treasury to encourage farmers to address damaging abstraction. This could work similarly to the Wessex Water Entrade scheme, where farmers offering the greatest reductions in environmental impact at the lowest cost are awarded funding in return for voluntarily amending their licences.

c. All damaging abstractions by water companies should be addressed through the 2020-25 water company business plans.

All water company abstractions affecting the 555 damaged river water bodies should be included in the National Environment Programme. This should be developed by the Environment Agency, Natural England and Natural Resources Wales and approved by Ofwat as part of the next periodic price review (PR 19). In addition, Ofwat’s Abstraction Incentive Mechanism (AIM) should be reformed to ensure that water companies take water from less environmentally-sensitive sources, such as chalk streams and groundwater, during low-flow periods. Currently, water companies generally seek cheap sources of water like groundwater and clean rivers rather than sources requiring significant treatment and pumping costs. AIM requires networked, flexible water supply systems that can take water from a number of sources to different demand areas. Ofwat must therefore allow companies to invest in networks and reduce water demand in areas under environmental pressure, thereby increasing the resilience of the water supply system.

PREVENTING FUTURE DAMAGING ABSTRACTION THROUGH SECONDARY LEGISLATION

WWF wants to see all licences in England and Wales move to an environmental permitting regime, with new controls to protect the environment. This is already possible under existing legislation (the Water Act 2014). This could be rolled out, starting with a number of catchment pilots that will demonstrate how environmental permitting will work in practice.

Defra’s proposals for abstraction reform, set out in *Making the Most of Every Drop*³¹, include:

- basing abstraction on available water, linking abstraction licences to availability;
- allocation of water based on availability (through variable licences which allow for greater abstraction when water is available and with graduated ‘hands-off’ flows);
- linking groundwater abstraction licences to long-term groundwater availability;
- managing discharges so their value is recognised;
- regulating on the basis of water used, net of volumes returned to the river at a distance from the abstraction;
- introducing a charging system that reflects water use and reliability;
- charging by a combination of permitted volume and water used, scaling charges according to how often an abstractor is able to take water (higher charges for reliability of supply);
- facilitating water trading to promote efficiency and resilience;
- reviewing abstraction permissions to protect the environment in future, applying conditions to all abstractors equally, reviewing conditions by catchment;
- requiring a six-year notice period for changes.

All of these measures can be achieved either under the existing powers to set Charging Schemes or pursuant to Section 61 of the Water Act 2014 and Schedule 8, which provides for environmental permitting for abstraction.

Every abstraction licence in every river in the country should leave sufficient water in the river for wildlife. We propose that the environmental flow indicator (EFI), along with best available evidence, informs new environmental flow targets, at a site level but also at a catchment level. A ‘hands-off’ flow condition should be set at each abstraction site, as well as a set of tiered abstraction limits depending on river flow levels, with abstraction quantities reducing as flows approach the ‘hands-off’ flow.

A NEW NATIONAL STRATEGY TO CUT WATER WASTE

One third of water taken from the natural environment is wasted either through leaky pipes, losses in treatment or in the home. Cutting water waste is therefore essential to enable sustainable abstraction.

The 2016 Water UK report, *Water Resources Long-term Planning Framework*, identified household metering as an important tool to improve the resilience of our water supply system to drought and other changes³². Currently, only half the households in the country have a meter installed. To put it another way, half of the households in the country do not pay for the water they use. The percentage of metered households needs to increase significantly if we are to cut water waste in the home and empower consumers to control their own water bills.

We urge the government to introduce a national strategy to cut water waste that includes plans to implement smart metering across the country.

The move to near-universal metering provides the opportunity to introduce tariffs that better reflect the value of water and the cost (financial and environmental) of providing water to meet peak demand. So Ofwat should require water companies to develop smarter tariffs that reflect scarcity. This will help reduce demand and provide a choice to those who do not wish to pay a high cost to use water under certain circumstances.

The government must also give clear guidance regarding the development of social tariffs, with a clear role for Ofwat to ensure that eligible customers receive the support they need.



**85% OF BRITS THINK
INDIVIDUALS SHOULD DO
MORE TO REDUCE WATER
WASTAGE IN THE HOME**



Near-universal metering can also help address affordability, as a greater understanding of consumption can help target support and ensure that subsidies are going to those high user/low income households that need them.

Under current legislation, water meters cannot be introduced on a universal basis in large parts of the country, even when it is clear that they could go a long way to addressing affordability concerns and securing long-term resilience of regional and national water supplies. Broadly, water companies are only able to introduce domestic water meters universally where the Secretary of State has determined that either the whole or part of their area is an ‘area of serious water stress’. To introduce metering, the water company is also required to have planned for metering in its Water Resources Management Plan³³.

In light of the concerns highlighted above, we believe that the revised water stress designations are not fit for purpose. Given the urgent need to bring water charging in England and Wales up to date, to ensure that it is fair, socially progressive and fully addresses water poverty, action is needed. Ultimately, an amendment to the legislation is needed. But without primary legislation, the new government must take action by revising the water stress designations to take account of regional and future water stress and Water UK’s *Water Resources Long-term Planning Framework*.

The Water UK framework also concluded that significant changes in policy were needed to deliver the required reductions in demand. For example, by requiring all new homes to be water efficient (built to a standard not exceeding 105 litres per person per day); installing water-efficient devices in 65% of existing homes; providing new water-saving tariffs and incentives; and reducing leakage through active leakage control and pressure management. Waterwise has since been working with the industry to develop a *Water Efficiency Strategy for the UK*³⁴. The new government must take a leadership role in ensuring that this is delivered.

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GLOSSARY

Abstraction Incentive Mechanism

A tool to incentivise water companies to reduce their abstractions from environmentally sensitive water sources when river flows are low.

Catchment

An area of land where precipitation collects and drains off into a common outlet, such as a river, bay, or other body of water.

Environmental Flow Index

The Environmental Flow Index was developed by the Environment Agency to help manage water resources in England and Wales. It is used to indicate where abstraction pressure may start to cause harm to river habitats and species.

Environmental Limits

An environmental limit refers to the point beyond which continuing to exploit a natural resource will cause serious harm.

Environmental Permit

Allows a person or organisation to carry out activities, such as abstraction or discharging wastewater, which may have an impact on the environment and human health. The permit specifies restrictions on these activities to minimise damage to the environment and human health.

Environmental Permitting Regime

A system which coordinates activities that require an environmental permit, and ensures permit holders comply with any rules or restrictions.

Hands-off flow

A restriction on abstraction permits. It means abstraction has to stop when the river flow falls below a particular flow.

National Environment Programme

A list of environmental improvement schemes produced by the Environment Agency every five years that ensure that water companies meet European and national targets related to water.

Periodic Price Review

Every five years, water companies in England and Wales update their business plans and set out their programme of work and investment.



WWF'S TOP TIPS ON HOW TO SAVE WATER AND OUR RIVERS

1. Ring up your water company for free water saving devices such as shower timers, tap inserts, shower heads and a cistern displacement device for your toilet.
2. Ask your company to install a free water meter – knowing what you use is the first step in cutting waste, especially as a quarter of all leaks are on a householder's property. You could even save money – and if you don't you have the right to go back to your previous flat-rate charge, so nothing to lose!
3. Download a water saving app – water saving apps for your smart phone can help you choose products and calculate your water use. Just search for 'water efficiency'.
4. Turn off the tap - a running tap uses 4 litres per minute and turning off the tap while brushing your teeth could save 13 litres a day. If the entire adult population of England and Wales remembered to turn off the tap when they were brushing their teeth, we could save 180 mega litres a day – enough to supply nearly 500,000 homes and fill 180 Olympic swimming pools.
5. Take a minute off your shower – cutting a minute off your shower can save 7 litres of water every time and saves you time in the morning.
6. Stop the drip – a dripping tap can waste more than 3,000 litres of water a year. Make sure you turn off taps fully, or fix drips, and your household could save 9 litres every day.
7. Ensure the washing machine is full before putting it on – a washing machine uses 55 litres of hot water per cycle. Reducing hot water use could save 58 litres a week and up to £80 on your annual energy bill.
8. Think twice about the hosepipe – running a hosepipe for an hour uses 1,000 litres of water and using a watering can instead can save you 25 litres for every 15 minutes you spend watering the garden. At the very least, make sure your hosepipe is fitted with a trigger nozzle – many water companies also provide these for free.
9. Limit baskets and pots and consider shading and position – baskets and pots often need a lot of watering while plants in the ground benefit from groundwater.
10. Get a water butt and if you need to water, do it in the evening to reduce losses from evaporation.



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