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National Trust

Climate Change Adaptation Guidance – Water

Water Sourcing & Efficiency

Climate change vulnerability: high

Water sourcing & efficiency – introduction

We use water throughout our places – in toilets and cafes, watering gardens and irrigating the farmed environment. Using water appropriately and efficiently in a changing climate is a key part of our sustainable operation.

Abstraction for public consumption is viewed as the highest priority; consequently, nature often suffers as we have seen in the 2022 droughts across much of England and Wales. There is a hierarchy of water sources (depending on use) that are preferable to mains water, which is treated and transported at great cost.

The basic adaptation measure is to harvest rainwater for irrigation which can be supplemented by water from boreholes. Harvesting, however, is more successful in reducing reliance on mains water when it is done in conjunction with a strategy to reduce overall demand for water at a site.

Plants require water so it is important to look at ways to avoid reverting to mains water when supply is low. This might include future changes in planting. By helping plants to be more resilient through the development of irrigation strategies, we can help them to develop their root structures. This, together with an increase in soil organic carbon content, will mean less water is needed.

People need water too which means that mains water should be used for cooking, drinking and washing, for which it is treated. We do not need perfectly clean water for toilets and irrigation. Where water use is high, such as for toilets, further measures can reduce flush size and flushing sources by using harvested rainwater supplemented by mains water when necessary. Although demand may be high for handwashing too, rainwater is unlikely to be used because it requires treatment due to the risk of legionella, so the design of storage tanks is key.

Licensing for abstraction is given for the purpose of sustaining people's lives; it also aims to manage demands on water resources in a fair and transparent way.

Image credits:

Hagar and Ishmael, 1842, by Sir Charles Lock Eastlake (1793-1865) at Derwent Island House, Cumbria (©National Trust Images/John Hammond)

Water sourcing & efficiency — why do they matter?

Water has limited availability and is highly vulnerable to climate hazards. We need to build resilience into how we store and use water. This is to ensure that our supply can last for longer, especially when droughts and floods have the potential to challenge that resilience. If we source and use the water that is available effectively, we will be able to sustain life and operation for our gardens, people and animals. We therefore need to think differently about how we use and source water for different needs, as well as reducing demand.

Inputs and transport of mains water are very energy intensive, and include some chemical elements with pH levels that are sometimes not ideal for gardens. This means that alternative sources take on greater importance given that the National Trust is striving to create, restore and protect healthy landscapes, for which water supplies are vital.

The environment and natural habitats are legitimate users of water. **If too much is extracted, the environment and specifically the natural world loses out.** The stress of climate change and its associated hazards mean that the balance between sustainable use and what is available for nature reaches a critical state.

If water is taken out of the landscape, nature and habitats have less chance to thrive. This exacerbates other pressures (for example, less water may mean reduced water quality which can cause further problems, such as algal blooms). Chalk streams are drying up more regularly, not because of climate change, but because of over abstraction. Abstraction from water sources, as well as abstraction from groundwater, therefore places additional pressure on the resources which support the environment. By keeping water in the landscape, we will help nature thrive. Water is a habitat that provides a home for plants and animals. These inevitably provide ecosystem services and therefore benefits to people.

Water sourcing continues to present challenges. The impact of drought can be felt at different levels across the land: environmental drought (where habitats struggle a little bit), agricultural drought (where farmers start to see the impacts and are no longer allowed to abstract), public water supply drought (where restrictions affect the general population).

Subsidence in mining areas caused by shrink/swell has also affected water supply options in some circumstances. Shrink/swell increases may cause more impact on water sourcing and water infrastructure.

Image credits:

A visitor peers into a well at Dyffryn House and Gardens, Vale of Glamorgan (©National Trust Images/James Dobson)

Water sourcing & efficiency — hazards, impacts and options

Hazard	Impacts	Options
Flooding	Structural damage, contamination (biological), habitat loss	Design alterations to reservoirs (spillway upgrades, freeboard increase), introduction of treatment options (particularly private water supplies)
Drought	Low flows/shortage, less infiltration and groundwater recharge, water quality, death of aquatic life (flora and fauna)	Local water sourcing via boreholes/rainwater collection/harvesting and storage, reduce demand through education (behaviour change), reduce demand through changing requirements (planting schemes, low-flush toilets), land management changes to encourage groundwater storage (block land drains, reduce compaction, improve soil health)
Shrink/swell	Contamination	Monitoring of water supply (may need to increase), change water supply
Landslides/coastal erosion	Contamination	Preparation of emergency plans for dealing with water supply contamination/loss (impacts on nature, water sourcing for private consumption), change water supply
Heat	Algae (taste and odour issues), death of aquatic life (prolonged high temperatures and low oxygen levels)	Reduce nutrient loading to reduce chances of algae (land management changes and water quality improvements)
Repeat freeze-thaw action	Pipe damage	Set appropriate standards for burying and insulating pipework and water metering infrastructure

Water sourcing & efficiency – options and thresholds

Our historic and beautiful places have often been occupied for centuries and the previous owners often used their ingenuity to harness, store and transfer water to where it was most needed. Sometimes, the most efficient, effective and sustainable option is to revive a dormant historic feature within a site.

Specific options for effective sourcing and efficient use of water in the face of climate hazards:

Swales and ditches – rather than sending everything into drains, water can be encouraged to travel along swales and naturally percolate into the soil. These can be planted with plants tolerant to this regime. These also improve resource protection and, if designed well, reduce erosion from storm events.

Rainwater harvesting – collecting water where it falls and capturing it when it runs off large surface area structures, such as roofs, will allow the reduction of mains water demand, off-set by rainwater. Ideally, these should be set up for a big surface area so that they recharge in the light summer rainfall as well as in winter.

Wells and boreholes – many of our historic places have historic versions of these features, often with associated storage tanks and pipework, which should be investigated in the first instance. Where they are insufficient or do not exist, new wells and boreholes can be drilled (check with a rural surveyor and archaeologist first).

Reduce usage – this relates to water consumption (with an emphasis on using less through behavioural change), but also relates to requirements and whether there is any way to flex these (e.g. less water intensive planting schemes, low-flush toilets, low-flow taps), land management changes to encourage groundwater storage (block land drains, reduce compaction, improve soil health).

Monitoring – leaks are one of the biggest problems affecting water efficiency. Through observation of water usage, times of high demand and water leaks can be identified. Wastage that could be averted or significantly reduced can also be identified through auditing a site and monitoring. Behavioural change and asking users whether there are other options is a key method for reducing water use.

Private supplies – where wholesome water is required from non-mains water, the risk of contamination through rainfall events (especially flooding) means that sites should have a water safety plan. This involves an inventory, a risk analysis of the system and a plan for mitigating these risks. For example, ensure that water sourcing storage (tanks) are sealed from ingress through flooding/surface run-off. There is also a need to test the resilience of private supplies in the face of drought, particularly where groundwater is deficient.

Generally – Set appropriate standards for burying and insulating pipework, and requirements for water metering infrastructure.

Thresholds & tipping points

At what point might you diverge from your current management strategy?

What are the events/impacts that may trigger this change of approach (action/philosophy)?

- Increasing cost and requirements, and associated pressure on existing water management infrastructure
- Increased restrictions from water companies preventing desired watering regime
- If established plants are failing, this may also trigger a change in planting to more drought tolerant plants
- Identification of opportunities for adaptation through organisational review
- Development or change proposals on the site which may present an opportunity for water sourcing and efficiency

Act now to reduce water use, maintain infrastructure and increase resilience

One option is **do nothing** and another will be to **maintain** the site as it is. The most effective approach to resist climate hazards and impacts is to improve the site's adaptive capacity by **activating a regular maintenance regime**. Alongside maintenance, we should put plants on a low water regime from the start and water them less. If mature plants need watering, they are probably not suited to the site. Despite efficient rainwater capture, it is likely to run out in the summer so reducing water use is key to sustainability.

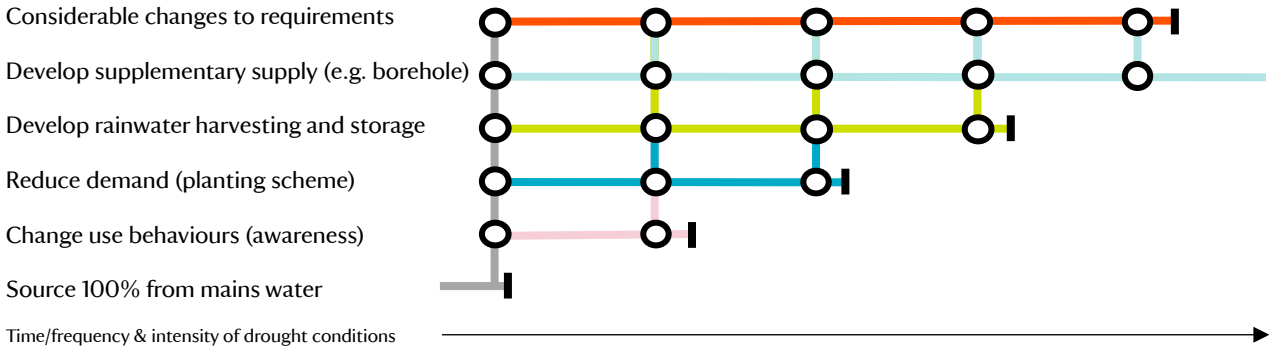
Water sourcing & efficiency — worked pathway example

This application of pathways and thresholds to a real site example shows how and when your adaptive response to climate hazards may change and evolve.

Working with a multi-disciplinary group to think about options and thresholds for a typical site is key. This cannot be done in isolation as there are significant implications for impacts on more than one aspect; for example, ecology, visitors and the farmed environment. It is more effective to bring together the right people to work on a mutually acceptable solution for a period of time between thresholds for change.

Although water sourcing is primarily a functional aspect of site management, water use can often be ornamental in the landscape and interventions can have an impact on the aesthetics of an experience. Therefore, **significance** should always inform the approach, as should public benefit.

Options must not be selected in isolation from the unique characteristics, significance, vulnerabilities and use of your specific requirements, and this may mean that different adaptive pathways apply to each site.[1] The worked example below is based on the availability of water for garden irrigation at Polesden Lacey, National Trust. This site is vulnerable to drought, heat, storms and flooding.



(Response thresholds are most likely to be based on drought levels, linked to the level of water requirements and how these two factors are balanced by site operational behaviours. The specific trigger points would need to be agreed by both the operations decision-maker and relevant consultants, and consultees such as the gardeners and rangers working at a site.)

Image credits:
Control for harvested rainwater to mains at Nymans (©National Trust Images)

[1] Dynamic Adaptive Policy Pathways approach (Haasnoot, Kwakkel, Walker & Ter Maat)

Case studies, signposting and references

These case studies show adaptation in action and the approaches that have been tried out across properties in care in the UK.

Visitor toilet refurbishments at Edinburgh Castle (Historic Environment Scotland) used sensor controlled low-flow water fittings. These water-efficient fittings have the benefits of using less water, carbon and cost reduction from heating less water and reduced risk of accidental flooding damaging building fabric.

In the east of England, farm reservoirs are used, where water is abstracted in the winter and utilised through the summer when it is needed but cannot be abstracted from alternative sources.

In Anglesey, the hazard mapping for this area and British Geological Survey predictions flag a 1-5 per cent reduction in groundwater availability by 2045.[2] Where boreholes for watering livestock are already running dry on National Trust tenanted farms, farm workers are adapting by bringing in bowsers of water at times of drought.

Rainwater harvesting at Nymans has the capacity to hold 150k litres, with three tanks and a sand filtration system. Anything requiring watering in the garden is fed by the tanks; water is collected from the glasshouse roof; an underground drainage system, which runs through the entire nursery; polytunnels and rain catchment direct into the water tanks. In pots, a plant will only take in 20 per cent of water from watering, which means around 80 per cent is going on the floor. The drainage system was installed directly underneath the potting area to capture this waste. In addition, Nymans has adopted a 'low water' regime whereby its plants learn to take up water through their roots efficiently.

Visitor facilities at Edinburgh Castle, © Historic Environment Scotland

Irrigation at plant nursery, Nymans (©National Trust Images)

Signposting & other guidance of relevance/use

The National Trust has internal guidance for water conservation and management, managing gardens during drought and general standards for gardens which can be shared upon enquiry.

Water UK provides detailed technical guidance on asset management planning in the face of climate change, among several other informative guidance topics on water efficiency. https://www.water.org.uk/guidance/asset-management-planning-climate-change/

It is very likely that large interventions to water sourcing will require planning and statutory consents. Seek advice from a planning consultant before designing or developing any changes to your site.

When considering a change of underground services and surface level facilities such as tanks and pipework, always consult a historic environment specialist such as a curator and an archaeologist to check the implications of any proposal.

[2] British Geological Survey – Groundwater Resources in the UK (https://www.bgs.ac.uk/geology-projects/groundwater-research/groundwater-resources-in-the-uk/)