National Trust

Climate Change Adaptation Guidance – Archaeology & Landscape

Waterlogged Archaeological Remains

Climate change vulnerability: high

Waterlogged archaeological remains – introduction

Waterlogged archaeological remains are at risk from climate hazards associated with drought and coastal processes. These risks are compounded by rapid changes in land use for farming, development, access and flood controls. Consequently, waterlogged remains are at great risk of drying out.

Waterlogged archaeological remains have been more or less constantly wet and without oxygen since their formation. This means that decay by bacteria and fungi are halted or slowed down so that organic materials such as textiles, leather and wood are preserved. The same is true for biological remains such as insects, pollen and seeds. Such conditions are prolific in areas of peat and blanket bog.

It is difficult to determine the effect of further drying on such sites, but where sites are currently boggy or wet beneath the surface, they may be susceptible to increased periods of wetting and drying in the future. The National Trust is working with other agencies, charities and universities to determine appropriate options and thresholds for adaptive measures.

Waterlogged remains have already been subjected to reductions in the water table caused by water abstraction for human consumption/industrial use and to some extent for agricultural use and flood mitigation. Climate hazards will make these impacts worse. Given the extent of potential remains across the UK, it is important to consider a strategic approach to their future and prioritise interventions accordingly.

Image credits:

Fish Trap, East Head (© National Trust Images/Peter King)

Waterlogged archaeological remains – why do they matter?

Some of the best organic archaeological remains are found in waterlogged environments where oxygen levels are so low that the usual processes of decomposition do not occur. Artefacts, such as textiles and the remains of plants and insects are preserved, which provide considerable potential to yield information about past human activity and interaction with the land.

As time passes, organic material is usually the first to be lost; for example, clothes made from linen and leather. These fabrics are lost as they decay and only occasionally evidence survives, perhaps as a barely discernible imprint.

Where waterlogged environments protect archaeological remains dating back through millennia, their potential to yield evidence about past human activity is highly significant. A significant UK example is Must Farm, a Bronze Age site in Cambridgeshire, which increased our knowledge and understanding of organic technologies and life at the time of its construction. Areas of peat and blanket bog hold the greatest potential for historic remains as they are often waterlogged with very low oxygen levels.

Given this potential and their high evidential value, the extensive drying out of wetlands, along with reductions in the water table, represent a significant threat to waterlogged archaeological remains. The year 2022 has seen extensive drought across all regions of the UK along with record temperatures. It is likely that these events will continue and recur. It is therefore a priority to consider adaptive measures for waterlogged sites with potentially vulnerable remains. Pathways for adaptation must be mapped and appropriately funded to avoid losing the opportunity to learn from the past.

The location and extent of remains are often unknown. This means that it is vital to engage local communities and interested groups to support the preservation of potential remains in situ through changes in land management and abstraction processes. Nevertheless, there is a balance to be struck between making the case for preserving unknown archaeological potential and other land use change, such as climate mitigation interventions and agricultural requirements, which may impact negatively on waterlogged remains.

Image credits:

Caer Leb, Brynsiencyn earthwork settlement enclosure (© Crown copyright: Royal Commission on the Ancient and Historical Monuments of Wales)

Waterlogged archaeological remains – hazards, impacts and options

Hazard	Impact	Options
Flooding	Exposure and washing away of remains, introduction of oxygenated/contaminated water to otherwise stable environment	Attenuation (vegetation and nature-based solutions to reduce rate of flow and level of flow affecting site), hard attenuation/diversion (intervening through groundworks and/or civil engineering to divert water away from the affected site), rescue archaeology and preservation by record, potential to target excavation at worst affected areas likely to succumb to repeat events
Drought	Drying out of remains including loss (over time) of organic material and definition of remains	Coring and sampling to investigate archaeological potential and identify hotspots for remains of significance, excavation and preservation by record, indirect impacts of adaptation strategies to retain groundwater (e.g. blocking land drains and potential periods of wetting and drought for remains which may accelerate deterioration)
Heat	Wildfire causing charring of remains from intense heat and fire above ground (will only occur where compounded by drying out)	Fire breaks in the landscape, avoid keeping fuel stores close to archaeologically sensitive sites, ban disposable BBQs from sites, ban hot works from sites during dry weather (e.g. no hot works are permitted at National Trust places at any time)
Storm damage	Erosion, scarring of protective surface layers that lead to deeper erosion and exposure of remains, loss of ground protection	Reactive maintenance whereby erosion and scarring are simply repaired quickly to avoid deeper erosion exposing remains, look at investing in geo-textiles and sward changes through land management to build resilience into ground cover, invest in peatland restoration to build protective peat layers and prevent the peat from drying out, ensure cover crops are in rotation and avoid fallow ground, if appropriate, construct earthwork runnels to divert flows away from sensitive areas
Coastal erosion/ landslide/ cliff fall	Loss or partial loss of features and sites, exposure of remains	Rescue archaeology, preservation by record, recovery of significant archaeological remains for display/ archive, opportunities for community engagement and coping with loss through cultural interventions as well as practical management pathways (options and thresholds agreed to determine at what point sites should be addressed through rescue archaeology)
Prolonged rainfall	Exposure of remains	Erosion repair, investigate drainage options, improve rainwater capture, storage and drainage of site (including groundwater storage potential and diversion of rainwater accumulation across the site), geophysical survey where remains are exposed, excavation if appropriate

Waterlogged archaeological remains – options & thresholds

Large areas of the country have been wetland or waterlogged in the past. This means that it is often the potential of such sites that is significant rather than known locations. This makes determining and prioritising places for adaptive interventions difficult though some areas have higher potential than others, due to constant waterlogging for millennia.

Specific options for adaptation measures include:

Drainage – should be investigated and either maintained or changed to help a site reach ideal water levels (blocking land drains, diverting water towards drought-prone areas) or shedding water (installing and enlarging drainage around the site through hard interventions, groundworks or natural attenuation to help direct water away from vulnerable areas or limit it from reaching the site), with synergies for nature-based solutions such as natural flood management and water storage.

Land Management – can be a compounding factor alongside climate stresses. If a site is compacted, regularly improved and over-grazed, its ability to retain water will be very poor. Alongside drainage interventions, if land management practice can be changed to reduce stocking density, reduce grazing period and ideally retain or revert sites to pasture, this will improve the site's ability to retain water.

Non-intrusive survey – can be used to help locate potential remains of interest where sites are threatened with loss, deterioration or detrimental impacts from repeat/worsening climate hazards. Geophysical survey, drone survey, analysis of aerial imagery, parch marks during drought, Light Distance and Ranging survey (LiDAR), ground penetrating radar, magnetometry, photogrammetry and even field walking can all help to target intrusive survey if warranted. Map regression analysis to understand a site through time is a key step in this process, and ensures the time depth and legibility of the site today is understood thoroughly before decision-making.

Intrusive survey – this can include, but is not limited to, coring and environmental sampling, trial trenching, test pitting, full-scale area excavation and rescue archaeology. It is very likely that permissions will be needed for this type of adaptive measure, particularly in areas of blanket bog, and should ideally only be a last resort because all such techniques are destructive to in situ remains.

Engagement and activity – telling the story of our past is crucial to learning to adapt to the future. Unlike most assets affected by climate change, archaeological remains present a good opportunity to learn about past lives, practices and places, and understand our impact on the landscape. All adaptive measures with archaeological interest provide the opportunity to engage local communities and other interested parties to share and participate in the conservation of the historic environment.

Consents and permissions

One option is to **do nothing** and another will be to **maintain** the site as it is. Sometimes, the historic environment is not well maintained and the most effective approach to resist climate hazards and impacts, and improve the site's adaptive capacity is to **activate a regular maintenance regime**. Some interventions may require scheduled monument consent, e.g. changes in land management (requiring a class consent) and any kind of development (including access). A section 42 licence under the Ancient Monuments and Archaeological Areas Act 1979 may be required for carrying out some non-intrusive survey.

Thresholds & tipping points

At what point might you diverge from your current maintenance/management strategy? What are the events/impacts that may trigger this change of approach (action/philosophy)?

- Frequency of maintenance interventions
- Quantity of water being diverted to maintain waterlogged conditions
- Competing needs (domestic/ agricultural/ nature-focused priorities)
- Extent of material being exposed
- Loss of exposed material
- Quality of survival (if a monitoring regime is in place and can be demonstrated to be deteriorating with repeat wet/drought events)
- Decrease in waterlogged extent/groundwater levels (affecting ability of the site to remain wet)
- Extent of measures to maintain (resource, impacts on natural environment, finance)
- Impact on archaeology and/or natural environment is unsustainable and negatively impacting significance

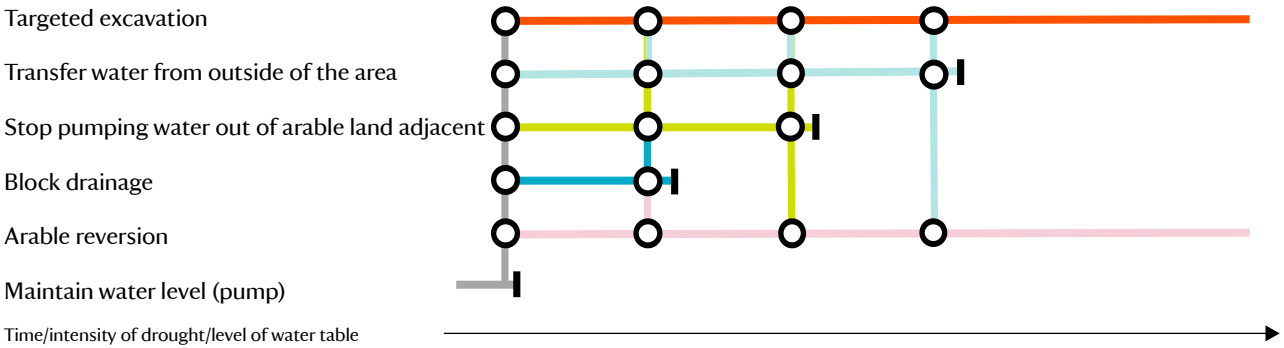
Waterlogged archaeological remains – worked pathway example

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, archaeology, ecology, aesthetics and access. It is better to bring together the right people to work on a mutually acceptable solution for a period of time between thresholds for change.

Although an area of wetland or estuary yielding archaeological remains is likely to be managed for other purposes, such as farming, recreation or nature conservation, interventions can have an impact on the significance of remains and the wider historic environment. Interventions may range from nature-based mitigation to climate action to adaptive measures to prevent loss or conserve heritage values. Therefore **significance** should always inform the approach and, where necessary, be weighed against the benefits and drawbacks of action/inaction.

These options must not be selected in isolation from the unique characteristics, significance, vulnerabilities and land use of your specific site, and this may mean that different adaptive pathways apply in each specific context. The worked example below is based on Wicken Fen, owned by the National Trust, and is a hypothetical example demonstrating potential measures and thresholds rather than an actual dynamic adaptive policy pathway. This asset is already experiencing issues with retaining water levels as it sits above the surrounding farmland meaning that water is already pumped into the site to keep it wet. The pathway below is an example of assessing just the options to conserve the waterlogged archaeological remains; to realise any of these options would require coordination with natural environment, sustainability and access considerations.



(Response thresholds are most likely to be based on the level of the water table, linked to the abstraction permissions to pump water into the site. The options and responses are based on a workshop coordinated by the Walker Institute with participants from Historic England, local authorities, local interested parties, National Trust staff and representatives from other statutory bodies (DEFRA and the Environment Agency). The specific trigger points are partially dependent on permissions from the Environment Agency, planning and other pulls on the water resources locally. It is highly unlikely, due to the sustainability of the option, that any water would be transferred from outside the area to maintain water levels in Wicken Fen, but the option was included as part of the hypothetical measures that could be taken as part of a response pathway. As with other assets, success of interventions is partially dependent on interaction, advocacy and story-telling to connect people with the area and its plight. See the How to Use this Climate Adaptation Guidance for further information on Dynamic Adaptive Policy Pathways[1] and how to choose pathways from the range of options.)

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

Case studies, signposting and references

The UK charities and agencies with properties in care have a variety of risk management strategies in place for their sites. These work best where a place is managed purely for its heritage conservation. Finding adaptive pathways with measures that take into account holistic significance to people, nature and heritage can be more complex.

Portrush, Department for Communities, Northern Ireland
An 11m long, double-ended 'Drontheim' fishing vessel from the 1800s was most likely abandoned at the bottom of the slipway in Portrush harbour in the early to mid-19th century and has been buried under the sands since then. Members of the public reported the remains of the shipwreck, revealed after a storm event, allowing it to be added to the historic environment record. This helps to protect the location from harbour development, unlicensed survey and dredging. It was decided to leave the wreck in situ and let the sand cover it again naturally to keep it protected.

Waun Fignen Felen is an important Mesolithic site, used by hunting populations exploiting the uplands. The surrounding blanket bog and upland raised bog are significant for biodiversity and palaeoenvironmental evidence. As drought worsens with climate change, peat bogs are drying out and eroding, as demonstrated by the columns of peat which identify the height of the original bog surface. The Brecon Beacons National Park Authority and the site's management forum are working to restore favourable hydrology to conserve and enhance biodiversity, and the archaeological and paleoenvironmental values of the site.[2]

Signposting & other guidance of relevance/use

Historic England has produced a detailed report after decades of monitoring and research on preserving waterlogged organic artefacts.

When considering changes that may impact waterlogged environments, particularly how water is managed (its flow, chemistry, oxygenation, level), always **consult a historic environment specialist**, such as an archaeologist, as well as a freshwater ecologist to check the implications of any proposal.

It is highly likely that the options listed above would need a variety of **consents** including, but not limited to, drainage consents, scheduled monument consent, class consents associated with land use and permissions from Natural England. Some works involving physical interventions may require planning permission and it is therefore advisable to consult a local planning adviser before designing works.

Image credits:

Portrush (© Department for Communities, Northern Ireland)

Waun Fignen Felin (© Crown copyright: Royal Commission on the Ancient and Historical Monuments of Wales)

[2] Waun Fignen Felen case study from the Historic Environment and Climate Change in Wales – Sector Adaptation Plan. https://cadw.gov.wales/advice-support/climate-change/adapting-to-climate-change