Rialtas na hÉireann
Government of Ireland

Heritage and Climate Adaptation Guidance for Local Authorities

Increasing the resilience of heritage resources to current and future climate conditions

2024

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(National Monuments Service and National Built Heritage Service)

By

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In implementing the Climate Change Sectoral Adaptation Plan for Built and Archaeological Heritage (2019), the National Monuments Service and the National Built Heritage Service of the Department of Housing, Local Government and Heritage have produced a number of resources such as guidelines and training materials that may be of assistance to those involved with built and archaeological heritage.
https://www.gov.ie/en/publication/c2038-built-and-archaeological-heritage-climate-action/

Cover image: St Mobhi's Graveyard Boundary Wall, Glasnevin – courtesy of David Maher & Associates Consulting Engineers

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Flooding Inland

A projected increase in extreme precipitation, combined with land-use changes, is likely to lead to an increase in inland flooding (fluvial, pluvial and groundwater).

Please read the following prompts and follow through to suggested solutions if relevant.

Do you have collections in your care (museums, archives, art galleries) that may be exposed to pluvial or fluvial flooding events?

No
> go to next question

Don't know
> analyse flood risk for the locations of your moveable heritage assets

Yes
> ensure that a collections disaster risk management plan is in place (see also link)
> consider if the collections can be moved or re-organised to reduce vulnerability
> train staff and prepare for an emergency response.

Do you have historic buildings and archaeological sites in your care that may be exposed to pluvial or fluvial flood events?

No
> go to next Q

Don't know
> analyse flood risk for heritage assets

Yes
> ensure that a disaster risk management plan is in place
> explore flood defences that are sustainable and low carbon, and that do not result in a loss of heritage significance or biodiversity. Landscape options may include nature based solutions such as retention of hedgerows to slow flood waters or enhancement of riparian corridors to retain more water upstream. Individual owners of historic buildings should be advised on how to prepare and respond.

Do you have historic gardens and landscapes of heritage value in your care that may be exposed to pluvial or fluvial flood events?

No
> go to next section

Don't know
> analyse flood risk for heritage assets

Yes
> evaluate the possible impact of repeated events and prioritise nature-based adaptation strategies for flooding, such as replanting with water tolerant species or creating riparian corridors and ponds.

Paul Curtis, conservator in Muckross House, and Emer Twomey, UCC archives, attempt to salvage artwork in the Glucksman Art Gallery in UCC. © Dan Linehan, Irish Examiner

Glucksman Gallery during flooding, 2009. © Dr David J. Otway (2009)

Disaster Risk Management: Lessons from the Glucksman Gallery flood, Cork City

In the early hours of Friday 20 November 2009 alarms were triggered as collection objects began to move about in the flooded stores at the Glucksman Gallery following flooding of the River Lee.

- Site-specific risk evaluations should be undertaken. The Glucksman's close proximity to the River Lee made it a flood risk. Therefore, collection storage should have been located above ground level, or additional precautions should have been put in place to prevent the risk of damage during flooding.
- Water detection and alert systems should be installed in buildings at risk of flood. The alarm was not raised until the collection started to move in the flood water within the storage area. An early alert system could have prevented the collection being submerged for 40 hours.
- An effective Emergency Response plan is vital. The existing plan was put into operation as soon as the alarm was raised, providing guidelines to the salvage team to enable an organised response.
- Knowledge transfer between custodians of collections/ buildings and emergency services is essential for preparing an effective response. The Glucksman's collection was well documented, and the staff were able to quickly identify and prioritise the order in which the collection should be salvaged and treated.
- An effective Emergency Response Team is vital. The Glucksman was able to quickly assemble an experienced team to manage building maintenance and conservation. Despite having a variety of training backgrounds they were able to quickly agree on a methodology. As a result, affected works were salvaged with speed and efficiency so that their condition could be stabilised and no artwork was irreparably damaged.

Case study courtesy of Institute of Conservators-Restorers Ireland and Irish National Committee of Blue Shield.

Coastal Flooding

Projected extreme storm surge and precipitation, combined with Sea Level Rise (SLR), is likely to lead to an increase in coastal flooding, especially in low-lying areas.

Please read the following prompts and follow through to suggested solutions if relevant.

Do you have collections in your care (museums, archives, art galleries) that may be exposed to coastal flooding?

No
- go to next question

Don't know
- analyse coastal flood risk for heritage assets

Yes
- ensure that a collections disaster risk management plan is in place (see also link)
- consider if the collections can be moved or re-organised to reduce vulnerability
- train staff and prepare for an emergency response.

Do you have historic buildings and archaeological sites in your care that may be exposed to coastal flooding?

No
- go to next Q

Don't know
- analyse coastal flood risk for heritage assets

Yes
- ensure that a disaster risk management plan is in place
- explore coastal flood defences that are sustainable, low carbon, and do not result in a loss of heritage significance or biodiversity. Options may include nature-based solutions such as beach nourishment and sand dune management
- engage with communities in making decisions about adaptation options and documentation of sites at risk, and communicate on risks of climate change and the need to make difficult decisions.

Do you have historic gardens and landscapes of heritage value in your care that may be exposed to coastal flooding?

No
- go to next section

Don't know
- analyse coastal flood risk for heritage assets

Yes
- evaluate the possible impact of coastal flood events and prioritise the development of nature-based adaptation strategies to deal with this, such as the development of wetlands to absorb saline flooding.

Above and below: Participants taking part in the First Aid for Cultural Heritage ICCROM short course held at the National Museum of Ireland, Collins Barracks, Dublin, 2018 (© INCBS)

Disaster Response for Collections

A national disaster response scheme was established in 2010 to assist galleries, libraries, archives and museums in Ireland in responding efficiently to water-related emergencies that may damage collections. Funded through the Council of National Cultural Institutions (CNCI), disaster response equipment and materials for participating institutions to borrow are held at two National Museum of Ireland sites in Counties Dublin and Mayo.

Given the projections for climate change, existing disaster-risk response measures will need to be expanded and reinforced with training at national and local levels.

Trinity College Dublin, Dublin City

The main campus of Trinity College Dublin (TCD) is located at the heart of Dublin City. Many parts of Dublin may be at risk of coastal flooding under both mid-range and high-emission scenarios. Severe coastal flooding could have adverse impacts on Dublin's buildings, structures, interior furnishings and collections. Many structures in TCD are protected structures and /or listed on the Sites and Monuments Record (SMR), such as Regent House, the Dining Hall, the Campanile, the Provost's House, and the Old Library.

In addition to the regular monitoring and maintenance of facilities such as the drainage systems, TCD has a comprehensive Emergency Response Plan to cope with natural disasters caused by flooding, extreme weather and fire, as well as emergency evacuation situations. A 24-hour service is available to report emergency situations and alert relevant teams that will cooperate with each other to ensure the safety of campus users and minimise the adverse impacts to buildings and assets within the campus (Trinity College Dublin (2016) *Estates & Facilities Emergency Procedures*).

Retrieved from https://www.tcd.ie/estatesandfacilities/security/

Storm Damage

With projections for increasingly extreme precipitation and storm events we are likely to experience an increase in storm damage, including tree fall and structural collapse.

Please read the following prompts and follow through to suggested solutions if relevant.

Do you have collections in your care (museums, archives, art galleries) that may be exposed to storm damage?

No
> go to next question

Don't know
> collections in unoccupied, structurally weak or poorly maintained buildings will be at highest risk from the effects of storm damage

Yes
> ensure a collections disaster risk management plan is in place (see also link)
> consider if the collections can be moved or re-organised to reduce vulnerability
> train staff and prepare for an emergency response.

Do you have historic buildings and archaeological sites in your care that may be exposed to storm damage?

No
> go to next Q

Don't know
> unoccupied, structurally weak, or poorly maintained buildings will be at highest risk from the effects of storm damage. Heavy vegetative growth can pull unstable structures down in high wind or after heavy rainfall, and sites or buildings in proximity to shallow rooted trees will also be at risk from tree fall

Yes
> ensure that a disaster risk management plan is in place and protocols for reporting incidents understood
> undertake regular maintenance (also link) of historic and traditional buildings, the periodic manual reduction of excessive vegetation growth, and the removal of overhanging trees with due regard for avoiding biodiversity loss. Where necessary undertake conservation repairs
> consider additional climate proofing measures, such as structural stabilisation or enlargement of rainwater goods with due regard for heritage significance.

Do you have historic gardens and landscapes of heritage value in your care that may be exposed to storm damage?

No
> go to next section

Don't know
> heavy rain and high winds can lead to tree fall. Single specimens, very tall or shallow rooted trees and those in full leaf are most at risk

Yes
> evaluate the possible impact of storm damage and develop a nature-based adaptation strategy to deal with this, such as removing diseased or damaged trees and using planting designs that are more resilient, such as a mix of species.

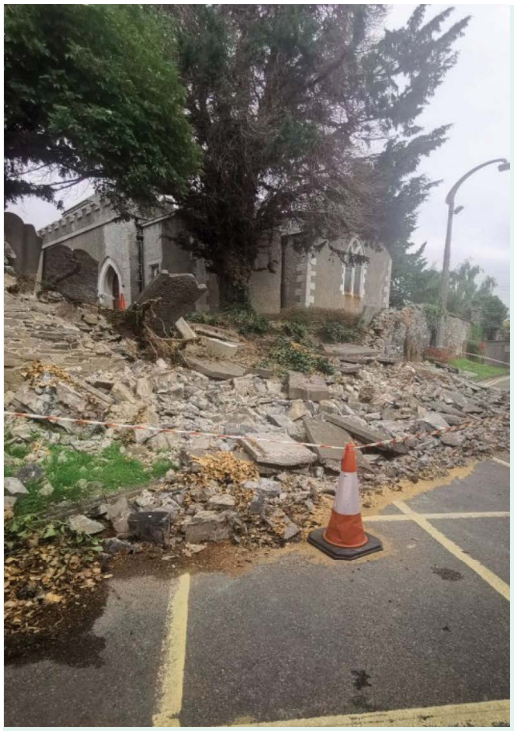
Maintenance and Stabilisation

Unroofed, fragmentary ruined structures and those constructed of materials less resistant to erosion and in saturated environments are particularly sensitive to storm damage. Projections for extended growing season will act as an added stressor as heavy vegetation can contribute to increasing structural instability and the likelihood of collapse during high winds and heavy rains.

Storms and high winds can cause extensive damage to roof finishes of buildings, particularly if the roof is vulnerable or slates are starting to slip. Debris and rubbish can be whipped up and blown onto roofs with the risk of blocking the outlets from internal valleys. External gutters, which are not well secured, may be dislodged and blow off and in falling, may cause damage or injury elsewhere. Less frequently, windblown debris can break windows.

Medieval masonry remains which have not been subject to regular maintenance and conservation are particularly vulnerable to damage and collapse during and after storm events. Specialist conservation advice and survey followed by stabilisation and repair using appropriate materials (having regard for biodiversity), are essential for preventing large scale losses. In many cases there are also increased health and safety concerns which need to be considered.

These examples show collapse at a number of such structures following a series of storms late 2013 and early 2014, in particular Storm Darwin February, 2014.



View of eastern boundary wall at St Mobhi's, Glasnevin following collapse (June 2019)

View of northern boundary wall at St Mobhi's, Glasnevin (December 2019)

St Mobhi's Graveyard Boundary Wall, Glasnevin, Dublin

Following above average heavy rainfall immediately prior, c. 15m long section of eastern graveyard boundary wall suddenly collapsed in June 2019 at St. Mobhi's in Glasnevin.

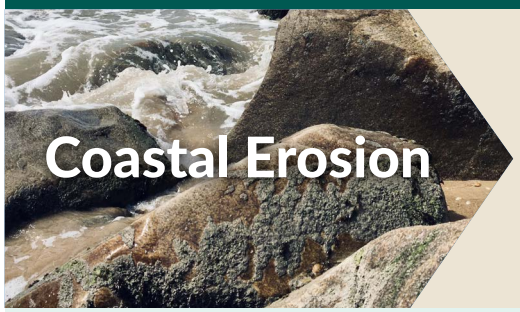
The date of the boundary walls is unknown but is similar to other calp limestone wall constructions from the early to mid 1800s.

Conservation works undertaken by the consulting engineers included an assessment of the condition of the length of wall to determine what works were required to ensure its safety together with a detailed structural assessment of the existing north boundary wall. The northern boundary wall which is up to 4m in height at its eastern end is adjacent to a pedestrian laneway under local authority ownership.

Following the site survey works, a record of the material and structural condition of the walls and adjacent structures was made by the consulting engineers. This set out the cause of the previous horizontal/ vertical movement of the walls and its ability to withstand wind loading and continued soil saturation on the graveyard side. The various surveys (including structural, archaeological and arboricultural) and a condition record provide for an accurate and targeted maintenance-based approach into the future as well a detailed scope of works to be undertaken.

The stone and headstones which collapsed and fell onto the grounds of the Bon Secours Hospital were carefully removed by a conservation contractor and placed in temporary storage and reinstated in 2020. Temporary bracing of the remaining section of wall buttress type timber supports that went in all along the eastern and northern boundary remain in-situ.

Images courtesy of David Maher & Associates Consulting Engineers



Coastal Erosion

Projections for increasingly extreme storm surge, combined with Sea Level Rise (SLR), are likely to lead to an increase in coastal erosion, especially on soft coastlines.

Please read the following prompts and follow through to suggested solutions if relevant.

Do you have collections in your care (museums, archives, art galleries) that may be exposed to coastal erosion?

No
- go to next question

Don't know
- analyse coastal erosion risk for heritage assets

Yes
- ensure a collections disaster risk management plan is in place (see also link)
- consider if the collections can be moved or re-organised to reduce vulnerability
- train staff and prepare for an emergency response.

Do you have historic buildings and archaeological sites in your care that may be exposed to coastal erosion?

No
- go to next Q

Don't know
- analyse coastal erosion risk for heritage assets and monitor impacts

Yes
- ensure that a disaster risk management plan is in place and that protocols for reporting incidents are understood
- explore coastal erosion prevention measures that are sustainable, low carbon, and that aim to conserve heritage significance, including managed retreat and nature-based solutions (see also link)
- engage with communities in making decisions about adaptation options and the documentation of sites at risk, communicate on the risks of climate change and the need to make difficult decisions, and accept loss.

Do you have historic gardens and landscapes of heritage value in your care that may be exposed to coastal erosion?

No
- go to next section

Don't know
- analyse coastal erosion risk for heritage assets

Yes
- evaluate the possible impact of coastal erosion and develop a nature-based adaptation strategy to deal with this, such as planting of marine sea grass that can attenuate wave energy and encourage sedimentation over erosion
- engage with communities in making decisions about adaptation options and managed loss
- utilise sites to communicate about climate change and the need to make difficult choices.

Kerry Graveyards Climate Risk Assessment

Kerry County Council commissioned a Climate Change Risk Assessment (CCRA) for six coastal historic graveyards protected under the National Monuments legislation, all but one of which are still in use. Through desk-based research, field work and stakeholder consultation the CCRA identified key heritage values and assessed their risks from climate-change hazards. The hazards of most concern for all sites (identified during the research process) were coastal erosion, coastal flooding, structural collapse, and vegetation growth. Two additional hazards of wildfire and maladaptation were identified at individual sites. Climate change adaptation aims to minimise the adverse consequences of climate change, and the results of the CCRA were used to identify a menu of adaptation actions for each site. In brief, the key recommendations were:

- increasing resilience through maintenance and visitor management
- interventions to improve the condition and authenticity of the built heritage
- sympathetic approaches to coastal processes (flooding and erosion)
- developing a strategy for managing loss.

Abbey Island Graveyard, Co Kerry. © Carrig Conservation

The benefits of strategic adaptation measures will be in preventing the worst impacts and avoiding wasted resources through unplanned and ineffective solutions. Supports for the capacity-building and upskilling of Local Authority staff in relation to climate change adaptation may be available nationally, and the training of skilled stonemasons to work on such monuments could perhaps be shared across Local Authority regions.

Managing Loss

In some cases, 'holding the line' will become an unsustainable strategy, and the loss of some heritage is inevitable.

Managing loss could include the following activities:

- documentation and preservation by record, for example, detailed recording including archaeological excavation
- memorialisation, for example, oral history or public artworks
- education and outreach.

Managed loss is challenging for all stakeholders including local communities, therefore structured consultation and effective communication with all involved are vital.

Soil Movement

With projections for increasingly extreme precipitation and long dry periods we are likely to experience an increase in soil movement, including subsidence and landslip.

Please read the following prompts and follow through to suggested solutions if relevant.

Do you have collections in your care that may be exposed to landslip or subsidence?

No
- go to next question

Don't know
- check landslide susceptibility for locations where collections are stored

Yes
- monitor for threshold conditions that may trigger a landslide or subsidence
- consider if the collections can be moved or re-organised to reduce vulnerability
- train staff and prepare for an emergency response.

Do you have historic buildings and archaeological sites in your care that may be exposed to landslip or subsidence?

No
- go to next question

Don't know
- check landslide susceptibility for area
- research any past incidents of landslide or subsidence including anecdotal evidence from local communities

Yes
- monitor for threshold conditions which that may trigger a landslide or subsidence
- ensure that a disaster risk management plan is in place and that protocols for reporting incidents are understood
- consider adaptive measures such as encouraging dense vegetative growth and restricting animal and human traffic in vulnerable areas.

Do you have historic gardens and landscapes of heritage value in your care that may be exposed to landslip or subsidence?

No
- go to next section

Don't know
- check landslide susceptibility for area
- research any past incidents of landslide or subsidence including anecdotal evidence from local communities
- consider that past exposure may not reflect current and future exposure; given increasing hot dry periods followed by extreme precipitation and combined with land use change (e.g. removal of hedgerows)

Yes
- monitor for threshold conditions that may trigger a landslide or subsidence
- ensure that a disaster risk management plan is in place
- consider adaptive measures such as planting dense vegetative growth and/or forestation of slopes, restoring hedges and stone walls, and restricting animal and human traffic in vulnerable areas.

Glascarrig, Co Wexford

UAV study of Glascarrig (cherishproject.eu)

Glascarrig motte and bailey is a site in private ownership located on a slight promontory overlooking the coast in Co Wexford. Dating to the 12th century, the original castle was destroyed in 1311 and possibly abandoned after this attack. The motte, a grass-covered, flat-topped mound almost 6m in height and 36m in diameter, is defined by a flat-bottomed ditch. To the south of the motte is an enclosed area or bailey that is outlined by an earthen bank.

The site is located in an area of glacial drift, making it particularly susceptible to erosion, which has already resulted in finds of pottery and animal bones. The motte and its landscape setting have been mapped three times with UAV (Unmanned Aerial Vehicle) survey (2018-2021) by the Discovery Programme, as part of the CHERISH project.

GIS analysis comparing the 2018 and 2021 survey data revealed the development of erosion on the north-facing slope, with a smaller amount of erosion identified to the east of the motte. In addition, there were some significant areas of erosion and accretions on the beach, as well as some differences in the growth of bushes and hedgerows. This analysis, although not revealing significant damage during the period, highlighted erosion on a local scale, at discrete areas of the landscape, showing the value of repeat monitoring for understanding soil movement.

Aerial view of Glascarrig motte and bailey (© CHERISH project)

Omey Island, Co Galway

Archaeological assessment of shell middens on Omey Island. © Galway Co Co

Located off the coast of Co Galway, Omey Island is rich in natural, archaeological and cultural heritage and attracts many visitors each year. The impact of climate change, in particular coastal erosion, is one of several interconnected issues facing the island, its landowners and its community. A conservation management plan for the island offers a constructive approach to addressing the varied issues in an integrated and sustainable way. Interdisciplinary audits of current conditions would inform dedicated actions for a management plan, which would also consider responsible tourism. Discussions are at a very early stage but it is clear that the key approach for Omey is for all stakeholders to work together to achieve an integrated strategic plan, this will include Galway County Council, relevant statutory authorities and the community. Initial discussions have taken place with a view to resourcing such a plan and Galway County Council has also been liaising with the community to establish their priorities. Many of the issues on Omey Island will also be reflected on other island destinations off the west coast of Ireland, such as:

- visitor carrying capacity.
- natural habitats and species – especially on commonage lands and around the lagoon.
- archaeology – in particular coastal erosion.
- culture – tangible and intangible cultural assets.
- community issues – especially impacts from tourism, coastal erosion and climate change.
- mapping – need for an integrated map or online mapping platform.
- legal issues – for example bye-laws.
- opportunities -including education awareness programmes.
- impact of marketing strategies.

The main aim is to safeguard Omey Island for future generations and make it an attractive place to work, live and visit.

The medieval ruins of St Fechin's Church. Omey Island

The Preservation of Buried Archaeological Sites and Monuments

With projections for increasingly extreme conditions, including long hot dry periods and heavy precipitation, soil conditions are likely to change.

Please read the following prompts and follow through to suggested solutions if relevant.

Do you have historic buildings or archaeological sites in your care that may be exposed to altered preservation conditions?

No

- go to next question

Don't know

- organic archaeological remains in Ireland are best preserved in peatland or sealed urban deposits where they remain wet/waterlogged and oxygen is limited. Changes to the water table, due to planned interventions (such as drainage) and/or climate events (such as the drying out of bogs and desiccation of buried organic remains in urban contexts), will pose a risk and should be monitored
- altered soil temperatures and growing seasons may also lead to land-use changes that can pose a risk to buried archaeology
- rising sea levels may lead to the intrusion of salt water into buried archaeological environments. Sea level rise may also result in increased coastal flooding, saturating buildings and other structures with salt water and potentially causing salt crystallization and decay within the fabric

Yes

- undertake monitoring and investigation of buried archaeological remains and structures at risk
- investigate if retention/restoration of peats/vegetation could stabilise soil conditions
- consider rescue excavation where preservation in situ is no longer feasible.

Changing or altering the preservation conditions and environment of buried archaeological remains/sites and monuments (such as desiccation, saline intrusion, acidification) can lead to the deterioration and even destruction of subsurface archaeological remains. Anaerobic environments associated with the excellent conservation of waterlogged artefacts and archaeobotanical evidence are especially vulnerable to changes in water levels. Changes in agricultural practices due to a predicted shift towards arable farming raise the threat of indirect effects such as an increase in plough damage or the removal of traditional field boundaries.

Dipwell monitoring at Corlea Bog, Co Longford

Corlea trackway, Co Longford

The Corlea wooden trackway is a national monument in State care*. A length of 18 metres of an Iron Age trackway was excavated and conserved and is on display in a purpose built visitor centre at the site in Keenagh Co Longford. A further large section of the trackway was left in its original position, relying on the waterlogged peatland environment, to continue to preserve the oak timbers in situ. Much of the surrounding bog has been drained and harvested and for this reason water levels at the visitor centre are maintained by a series of four artificial lakes and a water proofing membrane that encloses the site.

Office of Public Works staff manually monitor water levels from a series of dipwells. On one occasion staff detected water in typically dry channels outside the enclosed zone, alerting them to the need to repair the membrane.

On-site monitoring has already proven its value at Corlea. While water levels are regularly recorded, long term analysis and determination of threshold values could also be beneficial.

Corlea visitor centre. Exterior area of in situ trackway (left). Conserved trackway timbers (right) (© Carrig Conservation)

*A monument in State care is a national monument in the ownership or guardianship of the Minister for Housing, Local Government and Heritage managed by the Office of Public Works

Underwater Cultural Heritage

With projections for warming oceans and increased storminess we can expect several impacts on underwater cultural heritage in the coastal zone and inland waters.

Please read the following prompts and follow through to suggested solutions if relevant.

Are there wreck sites or cultural heritage assets on beaches or coastline managed by your Local Authority that may be exposed to coastal erosion, flooding, and increased storminess?

No
- go to next question

Don't know
- consult publicly available sources to create an inventory of underwater cultural heritage present on beaches, estuaries and in the sea (see Wreck Viewer and Historic Environment Viewer); see also National Museum of Ireland (NMI) Topographical Files
- analyse climate hazards for the location of known or potential underwater cultural heritage

Yes
- ensure that a disaster risk management plan is in place (see also link)
- analyse coastal erosion risk for heritage assets
- raise awareness, train staff and prepare for an emergency response
- explore coastal defences that are sustainable, low carbon, and do not result in a loss of heritage
- contact and inform relevant heritage authorities of identified threats to heritage assets.

Do you have assets in your care such as wreck sites, logboats, historic graveyards or bridge sites located along rivers, riverbanks or lakeshores that may be exposed to impacts from erosion, flooding and increased storminess?

No
- go to next question

Don't know
- consult publicly available sources to create an inventory of underwater cultural heritage present in the inland waterways, including riverbanks and lakeshores (see Wreck Viewer and Historic Environment Viewer); see also NMI Topographical Files
- analyse climate hazards for the location of known or potential wreck sites and other underwater heritage assets within inland waterways

Yes
- as above.

Do you have in your care wreck sites such as logboats, wetland archaeological sites or underwater assets in rivers or lakes that may be exposed to impacts from lowering of water levels as a result of drought conditions and prolonged dry spells?

No
- go to next section

Don't know
- consult public sources to create an inventory of underwater cultural heritage present in estuaries and in the inland waterways (see Wreck Viewer and Historic Environment Viewer); see also NMI Topographical Files
- analyse climate hazards for the location of known or potential wreck sites or maritime and freshwater heritage assets

Yes
- ensure that a disaster risk management plan is in place (see also link)
- analyse risk for heritage assets as a result of lowering of water levels
- raise awareness, train staff and prepare for an emergency response
- contact and inform relevant heritage authorities of identified threats to heritage assets.

The Historic Environment Viewer provides access to the records of the National Monuments Service "Sites and Monuments Record" (SMR) and the National Inventory of Architectural Heritage, Department of Housing, Local Government and Heritage

The Wreck Viewer facilitates access to the National Monuments Service Wreck Inventory of Ireland Database (WIID), Department of Housing, Local Government and Heritage

Underwater Cultural Heritage | CASE STUDY

Underwater cultural heritage assets are frequently impacted by climate hazards including increased storminess, sand movements, coastal erosion, lowering of water levels, causing damage or loss, and the exposure of shipwrecks, ship timbers, wreck material and archaeological objects.

The waters within and around Ireland contain a vast submerged cultural heritage resource. Over 18,000 wrecks and thousands of archaeological sites and archaeological objects are located in Ireland's coastal waters, beaches, estuaries, marine, lakes and rivers, all of which are subject to the effects of climate change. Further information can be found in the recent publication on the protection of underwater archaeology here.

Intertidal Shipwrecks at Bull Island, Dublin Bay

Newly exposed wreck on the North Bull being recorded by the Underwater Archaeology Unit in 2006

Approximately 180 shipwrecks have been recorded for North Bull Island, several of which are visible at low tide. For a period of over 20 years these wrecks have been monitored and recorded by the Underwater Archaeology Unit of the National Monuments Service (NMS) and in more recent years by the CHERISH Project. Shifting sands, coastal erosion and increased storminess have resulted in damage to many of these wrecks. For example, previously unrecorded wrecks have been revealed for the first time and subsequently damaged when sand levels decreased, and ship timbers from wrecks have been cast ashore, where they have subsequently dried out or gone missing. It is vital, therefore, that early action and intervention is taken to ensure that such wrecks and ship timbers are safeguarded.

Dublin City Council (Parks and Landscape Division) owns and manages most of the North Bull Island and has actively engaged and assisted with identifying, recording, and saving newly exposed and threatened archaeology on the foreshore. Of critical importance is the rapid reporting of heritage assets that are under threat so that the relevant heritage authorities, in collaboration with local authorities, can intervene to protect sites under threat when appropriate.

Cultural Heritage of Ireland's Waterways

Example of a logboat from Cloonacolly Lake, Co. Roscommon, which became exposed when lake levels dropped after prolonged drought conditions in 2020

Ireland's thousands of kilometres of rivers and over 12,000 lakes retain an immense wealth of underwater cultural heritage that represents human use of these critical conduits, which acted as the routeways within the interior of the country, over the course of human occupation of Ireland . Evidence of use by our ancestors may include the remains of wrecks and logboats, of harbours, quays, jetties or landing places. Fishtraps, clapper bridges and fording points can also represent this usage, as can individual artefacts that were deposited as perhaps votive offerings, lost by someone crossing the waterway or because of a battle at a strategic crossing point. All form an important part of our underwater archaeological heritage.

These sites and their environments are vulnerable to the impacts of climate change, for example flooding causing the erosion of riverbanks and lakeshores, and the exposure and drying out of fragile ancient logboats. It is important that local authorities, where responsible for the maintenance of such water bodies, have the appropriate strategies and resources in place to ensure that heritage assets impacted by climate events are safeguarded. It is therefore vital that awareness-raising campaigns, liaison with heritage authorities, emergency plans, support measures, and resources are put in place to deal with climate change impacts on these vulnerable heritage assets.

Moulds and Pests

With a warming climate and longer growing season we are likely to experience a longer mould season, more invasive species and increased biological and pest activity.

Please read the following prompts and follow through to suggested solutions if relevant.

Do you have collections in your care (museums, archives, art galleries) that are susceptible to pest attack, for example paper, wood, textiles, parchment or leather?

No
> go to next question

Don't know
> create a baseline quantification of numbers, nature and location of heritage collections

Yes
> ensure that Integrated Pest Management is in place and that staff are trained.

Do you have collections in storage or buildings that are not occupied full time or that may be unheated in winter? Do you have historic buildings with sensitive, decorative finishes such as wall paintings or untreated timber?

No
> go to next question

Don't know
> create a baseline quantification of numbers, nature and location of heritage assets

Yes
> monitor the relative humidity to check for mould growth conditions
> regularly inspect sensitive items/areas (for example paper, wall paintings, cold walls corners in buildings) for signs of mould growth
> consider appropriate interventions, including humidity control, building maintenance, object packaging, and ventilation.

Do you have historic gardens and landscapes of heritage value in your care?

No
> go to next section

Don't know
> create a baseline quantification of numbers, nature and location of heritage assets

Yes
> evaluate the possible impact of diseases such as Ash Dieback Disease, and develop a replanting and maintenance regime in conjunction with landowners to deal with potential losses, including increasing species diversity and restoring hedgerows.

Interior of Barryscourt Castle

Barryscourt Castle, Co Cork

Barryscourt Castle is a late medieval tower house in State care*. Increased rainfall in recent years highlighted several issues with the fabric of the building. These include damaged or insufficient replacement dripstones preventing rainwater from being thrown off the roof; porous limestone parapet walks allowing water to saturate the upper structure; and modern cement pointing preventing moisture from leaving the building. In addition, changes in rain patterns increased the level of driving rain into the chimney openings. Ensuing high levels of moisture in the fabric resulted in algal growth on the interior walls.

Upgrades in accordance with Ministerial Consent were undertaken to dry out the building. Repairs at parapet levels, including the installation of appropriately designed dripstones projecting a minimum of 400mm from the exterior of the building, ensured that water was being thrown off the building. Repairs to the historic chimney and a programme of grouting to consolidate voids within the fabric reduced water ingress and build-up within the walls. Full repointing also allowed the fabric to breathe. Drying out the building reduces the opportunity for microbial growth on surfaces and prevents degradation of stonework and historic render.

Cormac's Chapel, Rock of Cashel

Trial UV treatment of algal growth (Office of Public Works)

Rock of Cashel, Co Tipperary

Cormac's Chapel, Rock of Cashel, is a national monument in State care*. It was consecrated in 1134AD and houses some of the earliest wall paintings in Ireland. A failing roof, compounded by increasing plant growth, allowed rainwater ingress over many years, dissolving salts and other minerals. The moisture also caused algae and other microorganisms to grow on the interior walls, including the wall paintings.

Environmental monitoring was established to gather data on the temperature and relative humidity of both the internal and external surfaces of the chapel. Through the removal of organic growth, masonry repairs and installation of rainwater goods, water ingress was significantly reduced. The introduction of an internal ventilation system and visitor management helped to stabilise the environment internally. These actions helped to radically reduce the presence of microbiological growth. The Office of Public Works carried out ultraviolet radiation treatment to reduce the level of microbiological growth on the internal wall surfaces of the carvings and paintings. Monitoring is ongoing.

Case studies above courtesy of the Office of Public Works.

*A monument in State care is a national monument in the ownership or guardianship of the Minister for Housing, Local Government and Heritage managed by the Office of Public Works

Wildfire

With projections for prolonged dry periods, we are likely to experience an increase in vegetation/wildfires.

Please read the following prompts and follow through to suggested solutions if relevant.

Do you have collections in your care (museums, archives, art galleries) that may be exposed to wildfire?

No
- go to next question

Don't know
- collections housed in rural areas may be at increased risk, in particular if the buildings are vulnerable (eg. lack of fire suppression systems, a thatch roof, proximity to fuel source)

Yes
- ensure that a collections disaster risk management plan is in place (see also link)
- consider if the collections can be moved or re-organised to reduce vulnerability
- train staff and prepare for an emergency response.

Do you have historic buildings and archaeological sites in your care which may be exposed to wildfire?

No
- go to next question

Don't know
- buildings and sites in rural areas may be exposed, particularly if located in forests, uplands, bogland or unmanaged grassland. Being close to urban conurbations may increase this risk
- fire disturbance incidents mostly occur in the period March-June

Yes
- ensure a disaster risk management plan, that includes wildfire measures (e.g. link)
- adaptation actions could include reducing fuel load (with due regard for heritage value and biodiversity), strengthening monitoring and response systems, and community education
- plan for post-event documentation and recovery.

Do you have historic gardens and landscapes of heritage value in your care which may be exposed to wildfire?

No
- go to next section

Don't know
- fire-sensitive landscapes include forests, uplands, bogland or unmanaged grassland, although individual elements such as veteran trees may have increased vulnerability. Being close to urban conurbations may increase exposure to this risk
- fire risk is greatest from March to June when ground vegetation is dormant and dry

Yes
- adaptation actions could include reducing fuel load (with due regard for heritage value and biodiversity), strengthening monitoring and response systems, and community education
- consider supplementary planning stipulations in sensitive areas and associated financial mechanisms
- plan for burnt area rehabilitation including replanting

Landscape fires

Hotter, drier summers with consequent drying of soils and parching of vegetation will lead to an increased incidence of fires in certain areas. Landscapes that are close to urban conurbations may be particularly at risk due to recreational activities and intentional burning. Intense heat may lead to fracturing of stones and damage to archaeological deposits, affecting future scientific analysis, geo-physical survey, and preservation of remains. The burning of vegetation can lead to increased erosion over time and destabilisation of the monuments.

The Seahan Megalitic Passage Tomb is situated on the summit of Seahan Mountain, Co. Dublin, on land owned by the National Parks and Wildlife Service. The passage tomb comprises a circular, round-topped cairn from which there are extensive views of the Liffey Valley and the passage tombs at Mountpelier. Following a series of reports of threat and damage received by the National Monuments Service from members of the public about vandalism in the area, an inspection was carried out in October 2022 that revealed a large area of recent burning close to the mound caused by wildfire. The fire had not reached the upstanding remains of the monument but is likely to have impacted sub-surface archaeological remains in the surrounding area.

Burning near Seahan Passage Tomb in the Dublin Mountains

Resources

List of References

Flooding Inland

Office of Public Works 'Flood Maps' (2023). Available at: https://www.floodinfo.ie/about_floodmaps/ (Accessed May 2024)

ICMS (2010) 'Handbook on Emergency Procedures'. Available at: https://icom-armenia.mini.icom.museum/wp-content/uploads/sites/28/2020/10/HANDBOOK-ON-EMERGENCY-PROCEDURES.pdf (Accessed May 2024)

Michalski, S. and Pedersoli, J.L. (2016) 'The ABC Method: A Risk Management Approach to the Preservation of Cultural Heritage'. Available at: https://icom.museum/wp-content/uploads/2018/07/ICMS_Handbook_eng.pdf (Accessed May 2024)

Godin, M. (2021) 'The Louvre Moves Its Treasures as Climate Change Brings More Floods to Paris'. Available at: The Louvre moves its treasures as climate change brings more floods to Paris | Reuters (Accessed May 2024)

ICCROM (2023) 'A Method to Reorganize Museum Storage'. Available at: ICCROM-Infographic-A4-Leaflet-Print (Accessed May 2024)

Museum of London (2012) 'Introduction to Emergency Planning'. Available at: Introduction to Emergency Planning - Welcome to the e-learning tool (museumoflondon.org.uk) (Accessed May 2024)

Tandon, A. (2016) 'Endangered Heritage: Emergency Evacuation of Heritage Collections'. Available at: https://www.iccrom.org/publication/endangered-heritage-emergency-evacuation-heritage-collections#:~:text=Resources-,Endangered%20Heritage%3A%20Emergency%20Evacuation%20of%20Heritage%20Collections,to%20replicate%20in%20any%20context (Accessed May 2024)

LUC, AMS and TOBIN (2021) 'Fingal Cultural Heritage & Climate Change Risk Assessment'. Available at: Fingal Cultural Heritage & Climate Change Risk Assessment | Fingal County Council (Accessed May 2024)

Michalski, S., Antomarchi, C. and Pedersoli, J.L. (2016) 'A Guide to Risk Management of Cultural Heritage'. Available at: risk_management_guide_english_web.pdf (iccrom.org) (Accessed May 2024)

Viles, H. et al. (2021) 'Cultural Heritage and Nature Based Solutions'. Available at: Cultural Heritage and Nature Based Solutions (arcgis.com) (Accessed May 2024)

Cadw (2019) 'Flooding and Historic Buildings in Wales'. Available at: Flooding and Historic Buildings in Wales - Technical (gov.wales) (Accessed May 2024)

Government of Ireland. Quinlan, M. and Kelly, D. et al. (2020) 'Disaster: A Guide to Prevention And Preparedness in the Historic Built Environment'. Available at: Disaster-A-guide-to-preparedness.pdf (buildingsofireland.ie) (Accessed May 2024)

Nature Based Solutions (2023) 'NBS Case Study Platform'. Available at: Nature-based Solutions case studies (naturebasedsolutionsinitiative.org) (Accessed May 2024)

Arshad, M. et al. (2016) 'Natural and Nature-Based Flood Management: A Green Guide'. Available at: https://www.worldwildlife.org/publications/natural-and-nature-based-flood-management-a-green-guide (Accessed May 2024)

Coastal Flooding

Office of Public Works (2023) 'Flood Plans'. Available at: Flood Plans - OPW Flood Risk Management (floodinfo.ie) (Accessed May 2024)

ICMS (2010) 'Handbook on Emergency Procedures'. Available at: ICMS_Handbook_eng.pdf (icom.museum) (Accessed May 2024)

Michalski, S. and Pedersoli, J.L. (2016) 'The ABC Method: A Risk Management Approach to the Preservation of Cultural Heritage'. Available at: risk_Manual_2016-eng.pdf (canada.ca) (Accessed May 2024)

Godin, M. (2021) 'The Louvre Moves Its Treasures as Climate Change Brings More Floods to Paris'. Available at: The Louvre moves its treasures as climate change brings more floods to Paris | Reuters (Accessed May 2024)

ICCROM (2023) 'A Method to Reorganize Museum Storage'. Available at: https://www.iccrom.org/publication/re-org-method-reorganize-museum-storage#:~:text=RE%2DORG%20is%20a%20method,mentor%20sessions%20and%20online%20training (Accessed May 2024)

Museum of London (2012) 'Introduction to Emergency Planning'. Available at: https://www.museumoflondon.org.uk/Resources/e-learning/emergency-planning-tool/ (Accessed May 2024)

Tandon, A. (2016) 'Endangered Heritage: Emergency Evacuation of Heritage Collections'. Available at: Endangered Heritage: Emergency Evacuation of Heritage Collections | ICCROM (Accessed May 2024)

Dawson, T., Hambly, J. and Boyd, S. (2023) 'SCAPE'. Available at: Home - The SCAPE Trust (Accessed May 2024)

Michalski, S., Antomarchi, C. and Pedersoli, J.L. (2016) 'A Guide to Risk Management of Cultural Heritage'. Available at: risk_management_guide_english_web.pdf (iccrom.org) (Accessed May 2024)

Viles, H. et al. (2021) 'Cultural Heritage and Nature Based Solutions'. Available at: Cultural Heritage and Nature Based Solutions (arcgis.com) (Accessed May 2024)

National Park Service (2023) 'Climate Change Communication Toolkit'. Available at: https://www.nps.gov/subjects/climatechange/toolkit.htm#:~:text=The%20toolkit%20is%_20intended%20to,your%20park%20or%20protected%20area (Accessed May 2024)

National Trust (2023) 'Living with change: Our Shifting Shores'. Available at: Shifting shores | Climate change | National Trust (Accessed May 2024)

Natural Resources Wales (2022) 'Nature-Based Solutions for Coastal Management'. Available at: Natural Resources Wales / Nature-based solutions for coastal management (Accessed May 2024)

Baker, T. (2022) 'Saltmarsh Recreation by Managed Realignment, Hesketh Out Marsh – UK'. Available at: Saltmarsh recreation by managed realignment, Hesketh Out Marsh – UK — Discover the key services, thematic features and tools of Climate-ADAPT (europa.eu) (Accessed May 2024)

Storm Damage

ICMS (2010) 'Handbook on Emergency Procedures'. Available at: ICMS_Handbook_eng.pdf (icom.museum) (Accessed May 2024)

Michalski, S. and Pedersoli, J.L. (2016) 'The ABC Method: A Risk Management Approach to The Preservation of Cultural Heritage'. Available at: https://www.canada.ca/content/dam/cci-icc/documents/services/risk-management-heritage-collections/abc-method-risk-management-approach/risk_Manual_2016-eng.pdf (Accessed May 2024)

Godin, M. (2021) 'The Louvre Moves Its Treasures as Climate Change Brings More Floods to Paris'. Available at: The Louvre moves its treasures as climate change brings more floods to Paris | Reuters (Accessed May 2024)

ICCROM (2023) 'A Method to Reorganize Museum Storage'. Available at: https://www.iccrom.org/publication/re-org-method-reorganize-museum-storage (Accessed May 2024)

Museum of London (2012) 'Introduction to Emergency Planning'. Available at: https://www.museumoflondon.org.uk/Resources/e-learning/emergency-planning-tool/ (Accessed May 2024)

Tandon, A. (2016) 'Endangered Heritage: Emergency Evacuation of Heritage Collections'. Available at: Endangered Heritage: Emergency Evacuation of Heritage Collections | ICCROM (Accessed May 2024)

Government of Ireland. Quinlan, M. and Kelly, D. et al. (2020) 'Disaster: A Guide to Prevention And Preparedness in the Historic Built Environment'. Available at: https://www.buildingsofireland.ie/app/uploads/2020/12/Disaster-A-guide-to-preparedness.pdf (Accessed May 2024)

Government of Ireland. National Monuments Service (2023) 'Monument Protection'. Available at: https://www.archaeology.ie/monument-protection (Accessed May 2024)

Heritage Council (2020) 'An Action of The Heritage Council's Traditional Building Skills Initiative and SPAB Ireland'. Available at: Maintenance-Sheets-A4-8pg-v4.pdf (heritagecouncil.ie) (Accessed May 2024)

Government of Ireland. Donnelly, J. (2007) 'Maintenance A Guide to the Care of Older Buildings'. Available at: https:// www.buildingsofireland.ie/app/uploads/2019/10/Maintenance-A-Guide-to-the-Care-of-Older-Buildings-2007.pdf (Accessed May 2024)

Government of Ireland. National Monument Service (2004) 'The Care and Conservation of Graveyards'. Available at: care-and-conservation-of-graveyards.pdf (archaeology.ie) (Accessed May 2024)

Government of Ireland. Quinlan, M. et al. (2010) 'Ruins: The Conservation and Repair of Masonry Ruins'. Available at: IRON (buildingsofireland.ie) (Accessed May 2024)

National Trust (2022) 'Rainwater Goods'. Available at: https://www.into.org/app/uploads/2022/10/10-Buildings-Rainwater-Goods.pdf (Accessed May 2024)

Natural England (2020) 'Climate Change Adaptation Manual (NE751)'. Available at: Climate Change Adaptation Manual - NE751 (naturalengland.org.uk) (Accessed May 2024)

Wunderlich, E. (2021) 'After the Storm: Repair and Care for Damaged Trees'. Available at: https://extension.illinois.edu/news-releases/after-storm-repair-and-care-damaged-trees (Accessed May 2024)

Coastal Erosion

Office of Public Works (2020) 'Irish Coastal Protection Strategy Study (ICPSS)'. Available at: https://www.gov.ie/en/publication/eed0fb-irish-coastal-protection-strategy-study-icpss/# (Accessed May 2024)

ICMS (2010) 'Handbook on Emergency Procedures'. Available at: ICMS_Handbook_eng.pdf (icom.museum) (Accessed May 2024)

Michalski, S. and Pedersoli, J.L. (2016) 'The ABC Method: A Risk Management Approach to The Preservation of Cultural Heritage'. Available at: https://www.canada.ca/content/dam/cci-icc/documents/services/risk-management-heritage-collections/abc-method-risk-management-approach/risk_Manual_2016-eng.pdf (Accessed May 2024)

Godin, M. (2021) 'The Louvre Moves Its Treasures as Climate Change Brings More Floods to Paris'. Available at: The Louvre moves its treasures as climate change brings more floods to Paris | Reuters (Accessed May 2024)

ICCROM (2023) 'A Method to Reorganize Museum Storage'. Available at: RE-ORG: A Method to Reorganize Museum Storage | ICCROM (Accessed May 2024)

Museum of London (2012) 'Introduction to Emergency Planning'. Available at: Introduction to Emergency Planning - Welcome to the e-learning tool (museumoflondon.org.uk) (Accessed May 2024)

Tandon, A. (2016) 'Endangered Heritage: Emergency Evacuation of Heritage Collections'. Available at: Endangered Heritage: Emergency Evacuation of Heritage Collections | ICCROM (Accessed May 2024)

CHERISH (2023) Project 'Toolkit'. Available at: https://cherishproject.eu/en/tool-kit/ (Accessed May 2024)

Michalski, S., Antomarchi, C. and Pedersoli, J.L. (2016) 'A Guide to Risk Management of Cultural Heritage'. Available at: risk_management_guide_english_web.pdf (iccrom.org) (Accessed May 2024)

Government of Ireland. National Monuments Service (2023) 'Monument Protection'. Available at: https://www.archaeology.ie/monument-protection (Accessed May 2024)

Coastal Management EU (2023) 'Example: Relocation of Clavell Tower, Dorset (UK)'. Available at: EXAMPLE: Relocation of Clavell Tower, Dorset (UK) | Coastal Management Webguide - RISC KIT (coastal-management.eu) (Accessed May 2024)

Nature Based Solutions (2023) 'NBS Case Study Platform'. Available at: https://casestudies.naturebasedsolutionsinitiative.org/ (Accessed May 2024)

Natural Resources Wales (2022) 'Nature-Based Solutions for Coastal Management'. Available at: Natural Resources Wales / Nature-based solutions for coastal management (Accessed May 2024)

Dawson, T., Hambly, J. and Boyd, S. (2023) 'SCAPE'. Available at: https://scapetrust.org/ (Accessed May 2024)

National Park Service (2023) 'Climate Change Communication Toolkit'. Available at: Climate Change Communication Toolkit - Climate Change (U.S. National Park Service) (nps.gov) (Accessed May 2024)

Venture, T. (2021) 'Articulating Loss: Understanding and Communicating the Loss of Coastal Heritage'. Available at: Articulating Loss: Understanding and Communicating the Loss of Coastal Heritage | Historic England (Accessed May 2024)

National Trust (2023) 'Climate Change and Sustainability'. Available at: Climate change and sustainability | National Trust (Accessed May 2024)

Soil Movement

Geological Survey Ireland (2023) 'Landslide Susceptibility Mapping'. Available at: Landslide Susceptibility Mapping (gsi.ie) (Accessed May 2024)

Martinovic, K., Musial, A. and Dimet, C. (2016) 'Analysis and Monitoring Strategy of Irish Landslides Geological Survey of Ireland'. Available at: https://www.gsi.ie/documents/03_2015-sc-005_Doherty_FinalReportWeb.pdf (Accessed May 2024)

Godin, M. (2021) 'The Louvre Moves Its Treasures as Climate Change Brings More Floods to Paris'. Available at: The Louvre moves its treasures as climate change brings more floods to Paris | Reuters (Accessed May 2024)

ICCROM (2023) 'A Method to Reorganize Museum Storage'. Available at: https://www.iccrom.org/publication/re-org-method-reorganize-museum-storage (Accessed May 2024)

Museum of London (2012) 'Introduction to Emergency Planning'. Available at: https://www.museumoflondon.org.uk/Resources/e-learning/emergency-planning-tool/ (Accessed May 2024)

Tandon, A. (2016) 'Endangered Heritage: Emergency Evacuation of Heritage Collections'. Available at: Endangered Heritage: Emergency Evacuation of Heritage Collections | ICCROM (Accessed May 2024)

Michalski, S., Antomarchi, C. and Pedersoli, J.L. (2016) 'A Guide to Risk Management of Cultural Heritage'. Available at: risk_management_guide_english_web.pdf (iccrom.org) (Accessed May 2024)

Climate Adaptation Platform (2021) 'Landslide and Disaster Preparedness in Japan'. Available at: Landslide and Disaster Preparedness in Japan - Climate Adaptation Platform (Accessed May 2024)

Government of Ireland. National Monuments Service (2023) 'Monument Protection'. Available at: https://www.archaeology.ie/monument-protection (Accessed May 2024)

Sandri, A. (2018) 'Nature-Based Measures against Rockfalls over Forests in the Engadin Region, Switzerland'. Available at: https://climate-adapt.eea.europa.eu/en/metadata/case-studies/nature-based-measures-against-rockfalls-over-forests-in-the-engadin-region-switzerland (Accessed May 2024)

National Trust (2022) 'Archaeological Earthworks'. Available at: https://www.into.org/app/uploads/2022/10/8-Archaeology-Landscape-Archaeological-Earthworks.pdf (Accessed May 2024)

Ente Parco Nazionale delle Cinque Terre (2021) 'Using Dry-Stone Walls as a Multi-purpose Climate Change Adaptation tool (STONEWALLSFORLIFE)'. Available at: https://climate-adapt.eea.europa.eu/en/metadata/projects/using-dry-stone-walls-as-a-multi-purpose-climate-change-adaptation-tool-1 (Accessed May 2024)

The Preservation Of Buried Archaeological Sites And Monuments

National Trust (2022) 'Waterlogged Archaeological Remains'. Available at: https://www.into.org/app/uploads/2022/10/8-Archaeology-Waterlogged-Remains.pdf (Accessed May 2024)

Irish Peatland Conservation Council (2023) 'Peatland Restoration Monitoring'. Available at: Peatland Restoration MonitoringIrish Peatland Conservation Council (ipcc.ie) (Accessed May 2024)

Historic England (2016) 'Preserving Archaeological Remains: Appendix 4 – Water Monitoring for Archaeological Sites'. Available at: historicengland.org.uk/images-books/publications/preserving-archaeological-remains/heag100e-appendix4-water-monitoring-for-archaeological-sites/ (Accessed May 2024)

National Trust (2022) 'Buried Archaeological Remains'. Available at: https://www.into.org/app/uploads/2022/10/8-Archaeology-Landscape-Buried-Remains-2_LR.pdf (Accessed May 2024)

Historic England (2016) 'Preserving Archaeological Remains: Appendix 1 – Case studies'. Available at: historicengland.org.uk/images-books/publications/preserving-archaeological-remains/heag100b-appendix1-case-studies/ (Accessed May 2024)

Historic England (2016) 'Preserving Archaeological Remains: Decision-taking for Sites under Development'. Available at: historicengland.org.uk/images-books/publications/preserving-archaeological-remains/heag100a-preserving-archaeological-remains/ (Accessed May 2024)

Underwater Cultural Heritage

Government of Ireland. National Monuments Service Historic Environment Viewer (2023). Available at: Historic Environment Viewer (arcgis.com)

Government of Ireland. National Monuments Service Wreck Viewer (2023). Available at: Wreck Viewer | National Monuments Service (archaeology.ie)

Irish Coastal Protection Strategy Study (ICPSS) (2020). Available at: gov - Irish Coastal Protection Strategy Study (ICPSS) (www.gov.ie) (ICPSS) (www.gov.ie)

Michalski, S. and Pedersoli, J.L. (2016) 'The ABC Method: A Risk Management Approach to the Preservation of Cultural Heritage'. Available at: https://www.canada.ca/content/dam/cci-icc/documents/services/risk-management-heritage-collections/abc-method-risk-management-approach/risk_Manual_2016-eng.pdf (Accessed May 2024)

Museum of London (2012) 'Introduction to Emergency Planning'. Available at: https://www.museumoflondon.org.uk/Resources/e-learning/emergency-planning-tool/ (Accessed May 2024)

Moulds and Pests

English Heritage (2021) 'English Heritage (EH) Guideline for Insect Pest Management (IPM) in English Heritage Historic Properties'. Available at:https://www.english-heritage.org.uk/siteassets/home/learn/conservation/collections-advice--guidance/eh-guideline-for-insect-pest-management-ipm-in-eh-historic-properties---website-version.pdf

Museum of London (2013) 'Introduction to Museum Pests'. Available at: Introduction to Museum Pests - Welcome to the e-learning tool (museumoflondon.org.uk) (Accessed May 2024)

Guild, S. and MacDonald, M. (2004) 'Requirements for Growth', edited by Strang, T. and Guild, S. Available at: Mould Prevention and Collection Recovery: Guidelines for Heritage Collections – Technical Bulletin 26 - Canada.ca (Accessed May 2024)

National Park Service (2007) 'Mold: Prevention of Growth in Museum Collections'. Available at: Conserve O Gram Volume 3 Issue 4: Mold: Prevention Of Growth In Museum Collections (nps.gov) (Accessed May 2024)

Woodland Trust 'Eastern Claylands (2023) 'Creating A Resilient Landscape'. Available at: https://www.woodlandtrust.org.uk/about-us/where-we-work/england/eastern-claylands/ (Accessed May 2024)

Wildfire

ICMS (2010) 'Handbook on Emergency Procedures' Available at: ICMS_Handbook_eng.pdf (icom.museum) (Accessed May 2024)

Michalski, S. and Pedersoli, J.L. (2016) 'The ABC Method: a Risk Management Approach to The Preservation of Cultur-al Heritage' Available at: https://www.canada.ca/content/dam/cci-icc/documents/services/risk-management-heritage-collections/abc-method-risk-management-approach/risk_Manual_2016-eng.pdf (Accessed May 2024)

Godin, M. (2021) 'The Louvre Moves Its Treasures as Climate Change Brings More Floods to Paris' Available at: The Louvre moves its treasures as climate change brings more floods to Paris | Reuters (Accessed May 2024)

ICCROM 'A Method to Reorganize Museum Storage' Available at: RE-ORG: A Method to Reorganize Museum Storage | ICCROM (Accessed May 2024)

Museum of London, (2012) 'Introduction to Emergency Planning' Available at: Introduction to Emergency Planning - Welcome to the e-learning tool (museumoflondon.org.uk) (Accessed May 2024)

Tandon, A. (2016) 'Endangered Heritage: Emergency Evacuation of Heritage Collections' Available at: Endangered Heritage: Emergency Evacuation of Heritage Collections | ICCROM (Accessed May 2024)

Climate Ireland (2020) 'Ireland's Climate Status Report' Available at: EPA Climate Ireland | Climate Status Report for Ireland 2020 (Accessed May 2024)

Michalski, S., Antomarchi, C. and Pedersoli, J.L. (2016) 'A Guide to Risk Management of Cultural Heritage' Available at: risk_management_guide_english_web.pdf (iccrom.org) (Accessed May 2024)

National Park Service 'Cultural Resources and Fire Planning' Available at: https://www.nps.gov/articles/cr_and_fire_planning.htm (Accessed May 2024)

Climate Adapt (2020) 'Adaptation of Fire Management Plans' Available at: https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/adaptation-of-fire-management-plans (Accessed May 2024)

National Park Service (2020) 'Exploring the Fire and Archaeology Interface' Available at: Exploring the Fire and Archeology Interface (U.S. National Park Service) (nps.gov) (Accessed May 2024)

Oláh, A.M. (2020) 'Tatabánya, Hungary, Addressing the Impacts Of Urban Heatwaves And Forest Fires With Alert Measures' Available at: https://climate-adapt.eea.europa.eu/en/metadata/case-studies/tatabanya-hungary-addressing-the-impacts-of-urban-heat-waves-and-forest-fires-with-alert-measures/#adapt_options_anchor (Accessed May 2024)

National Park Service (2021) 'Cultural Resources and Post-Wildland Fire Programs' Available at: Cultural Resources and Post-Wildland Fire Programs (U.S. National Park Service) (nps.gov) (Accessed May 2024)

Attwell, P. (2020) 'Financial contributions of planning applications to prevention of heathland fires in Dorset, UK' Available at: https://climate-adapt.eea.europa.eu/en/metadata/case-studies/financial-contributions-of-planning-applications-to-prevention-of-heathland-fires-in-dorset-uk (Accessed May 2024)

National Park Service (2018) 'Post Wildland Fire Programs' Available at: https://www.nps.gov/subjects/fire/post-wildland-fire-programs.htm (Accessed May 2024)

Department of Geography / School of Chemistry / Environmental Research, UCC. 'The Science of Wildfires' The science of wildfires | University College Cork (ucc.ie)

Government of Ireland, Department of Agriculture Food and the Marine (2024) 'Fire Management' gov - Fire Management (www.gov.ie)

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