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RRS

Workflows and hazard data for climate change risk assessment of heritage assets

JBA Consulting

Climate Change / Policy & Evidence

RRS

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Summary

This project identifies the steps that heritage managers or owners can take to understand their site's exposure to climate change-related risks and to determine whether their site is likely to be vulnerable to climate hazards.

The project undertook a desk-based rapid review of the 'identifying climate hazard data and tools' project completed in 2024.[1] The catalogue of data and tools from that project has been updated to reflect recent updates to climate hazard datasets, tools, and climate change risk assessment (CCRA) approaches.[2]

The climate change risk assessment (CCRA) workflow was designed based on standards and guidance including ISO 14090 and drawing on practice in other CCRA approaches. Three CCRA workflows were developed to reflect the varied levels of resources, expertise, time, and funding available to heritage managers. This was done in collaboration with Historic England and English Heritage. A list of potential follow-on surveys was created for use when high likelihood and/or magnitude risks are identified, helping managers gain a clearer understanding of the risks and potential adaptation options. An example application of the workflow was written to illustrate how the different levels of the workflow could be applied. The three levels illustrate the progressive increase in complexity and depth of content. Recommendations for progressing the workflows into guidance and detailed methodology are made.

Contributors

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Front cover image: Grade II Listed Wharfe Bridge, Commercial Street, Tadcaster, in October 2023 during a flood event.[3] © Oliver Cooper, JBA Consulting

Archive location

Key report outputs are issued to HE and there are no project archive elements requiring retention in a public archive. Project specific business files are retained by JBA.

Date of survey/research/investigation

Research was carried out between December 2024 and March 2025. The report was written in March 2025.

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Introduction and Aims

This project seeks to identify the steps that heritage managers or owners could take to understand their site's exposure to climate change-related risks and whether their site is likely to be vulnerable to climate hazards. This includes identifying appropriate data sources for different geographical scales and providing information on metrics that assess exposure and vulnerability. Another key component of this project is the development of a standard workflow for a climate change risk assessment for use by owners and managers, as well as a list of surveys that will further their understanding of their climate risk.

In particular, the aims of this project are to:

- Develop a database and report identifying existing (paid for and free) datasets on climate hazards relevant to carrying out climate change risk assessments.
- Produce an example process or workflow that could be used by Historic England, and owners and managers of heritage assets when procuring such surveys.

This project will help Historic England to develop its capability to model the long-term impacts of climate change on cultural heritage associated with a range of hazards. It will support Historic England in sharing research to improve understanding of the climate-related threats and risks to heritage and, through a thorough understanding of risk, to assist the development of adaptation options. Furthermore, it will provide information on climate hazards to identify which aspects of heritage are most vulnerable to climate change, thereby increasing people's understanding. This aligns with Historic England's Climate Change Strategy,[4] Corporate Plan,[5] and the Third National Adaptation Programme.[6]

Methodology

Hazard data collection - desk-based review

The project started with a desk-based rapid review of the 'identifying climate hazard data and tools' project completed in 2024.[7] The catalogue of data and tools completed for that project was updated in line with recent updates to climate hazard datasets, tools, and climate change risk assessment (CCRA) approaches.[8]

The 2024 project focussed mainly on publicly available data but also undertook a brief review of commercial data. This project built on this review, engaging with commercial data providers to determine the potential relevance of their datasets for use in heritage-focused CCRAs. For this, a survey was sent to the following data providers:

- British Geological Survey
- Arup and Argos Analytics
- RMS, a Moody's Analytics Company
- Willis Towers Watson
- JBA Risk Management
- EcoAct
- Mitiga Solutions
- HaskoningDHV
- SaferPlaces

Questions covered what hazard data they provide, projections, timescales, risk, commercial model, spatial scale, geographical extent, data download, and data updates, amongst others. A copy of this survey is included in Appendix 1. This information was used to update the datasets catalogue of a longlist of hazard datasets and their key characteristics, strengths, and weaknesses.

Review of existing methodologies

To inform the development of CCRA workflow options, several existing CCRA methodologies and literature on approaches were examined, including:

- Impacts of Climate Change on the Historic Built Environment by Ulster Architectural Heritage for the Department for Communities Northern Ireland [9]
- Climate Change Risk Assessment from Historic Environment Scotland [10]

- Climate Change Risk Assessment for Stonehenge and Avebury [11]
- A Framework for Measuring and Reporting of Climate-related Physical Risks to Built Assets from the UK Green Building Council [12]
- Assessing risks and planning adaptation from the Adapt Northern Heritage Toolkit [13]
- Climate change risk assessments for Baconsthorpe Castle and Tintagel Castle by English Heritage [14]
- Towards a National Heritage Climate Change Risk Assessment from English Heritage [15]
- Approaches to Heritage Climate Change Risk Assessment: an integrative literature review from Harlow Consulting and Historic England [16]
- Environmental Impact Assessment Guide to: Climate Change Resilience & Adaptation, IEMA [17]
- ISO 14090:2021, Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment [18]
- Climate Vulnerability Index (CVI) Assessment for the Old and New Towns of Edinburgh World Heritage Site, Historic Environment Scotland [19]
- National Trust Climate change adaptation guidance [20]

Initial workflows - internal workshop and first steering group meeting

An internal workshop was held on 15 January 2025, in which members of the project team presented the key stages of the above methodologies, along with the data used and potential next steps. The team then reviewed these methodologies and started developing different workflows. During this workshop, three main CCRA workflow options were developed, based on the underlying principles of:

- the Adapt Northern Heritage approach
- ISO 14090 and the Ulster Architectural Heritage/ Department for Communities Northern Ireland guidance
- The EIA, IEMA guidance.

Following the internal workshop, we refined and presented the three high level options to the Historic England Steering Group, who indicated their preferences and communicated what they thought should be included. This feedback was then taken into the next stage, where a single draft CCRA workflow was designed based on the outcomes of the workshop.

Development of the CCRA workflow and second steering group meeting

The next phase of the project involved designing a CCRA workflow, drawing on standards and guidance including ISO 14090 and the principles of Adapt Northern Heritage. This drew on the feedback received in Steering Group meeting 1 and the outcomes of the review of existing methodologies. Following the design of a prototype CCRA workflow process, a list of potential follow-on surveys that could be undertaken following a CCRA was generated, with contributions from experts across JBA.

A preferred workflow option with three tiers of complexity (based on level of expertise and resource) was presented to the Historic England Steering Group in a virtual workshop on 13 February 2025. Feedback on the CCRA workflow was collected, and updates were made to each these outputs in accordance with this feedback.

For the purposes of designing the workflow, the definitions in Table 1 were used, based on IPCC terminologies, in line with Historic England practice.[21]

Table 1. Key climate terminology

Terminology	**Definition**
Risk	The potential for adverse consequences for human or ecological systems, recognizing the diversity of values and objectives associated with such systems. In the context of climate change, risks can arise from potential impacts of climate change as well as human responses to climate change. Relevant adverse consequences include those on lives, livelihoods, health and well-being, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species.[22]
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.[23]
Hazard	The potential occurrence of a natural or human induced physical event or trend that may cause loss of life, injury or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.[24] Exposure refers to the presence of assets in areas that could be affected by hazards.
Impact	The consequence of realised risks on natural and human systems, where risks result from the interactions of climate related hazards (including extreme weather and climate events), exposure, and vulnerability. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.[25]

Adaptation	In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.[26]
Adaptation options	The array of strategies and measures that are available and appropriate for addressing adaptation. They include a wide range of actions that can be categorised as structural, institutional, ecological or behavioural.[27]

Application of the workflow

Following the second steering group meeting, an outline of how the workflow could be applied was developed. The example was undertaken for a hypothetical site agreed with Historic England. The example was approached in a way that contextualises the workflow stages, rather than undertaking a full assessment of the site.

Hazard database

The updated hazard database will be uploaded to Zenodo, alongside the 2024 database.[28]

Of the nine paid-for data providers surveyed, we received information from four detailing how their data could help to add detail to CCRAs (summarised in Table 2). The full outcomes of the survey can be viewed in the updated hazard database, which will be published online in due course.[29] The price of all of the paid data/tools identified is negotiable and some licenced data may be accessed for free if the buyer is a charity or not for profit organisation – free access to data/tools can be explored when identifying data to be used in risk assessments.

It is expected that paid data will only be relevant for certain sites and circumstances, for example at sites with complex interactions of in-combination hazards, where a specific hazard is judged to present a particularly high risk, or at internationally important sites where an advanced climate risk assessment is required. For example, the BGS recommends that GeoClimate UKCP18 Open is suitable if changes in clay shrink-swell susceptibly are improbable, and that the Premium version is only necessary if susceptibility is likely to change through time.[30] Furthermore, at sites where there is limited funding for data and/or subsequent expert analysis and application, unpaid/open licence data is normally sufficiently detailed to undertake a risk assessment. Unpaid/open licence data will therefore be suitable for most risk assessments.

Table 2. Summary of paid datasets/tools

Data provider	**Dataset/ tool**	**Hazards**	**Climate change scenarios used**	**Paid/licensed**
GECOsistema srl	SaferPlaces	Flood Risk	RCP 4.5; RCP 8.5; RCP 2.6; Other - for example, CMIP6 SSPs (Shared Socioeconomic Pathways); Global Warming Levels (GWLs) (e.g., 2˚C, and 4˚C);	Subscription – negotiable costs
Mitiga Solutions	EarthScan	Flooding (Riverine & Coastal), Wildfire, Heath stress, Drought,	RCP 2.6; RCP 4.5; RCP 8.5; Other - for example, CMIP6 SSPs (Shared	Subscription – negotiable costs

		Wind risk, Precipitation risk	Socioeconomic Pathways);	
JBA Risk Management Ltd	JBA Vision, JBA's catastrophe model and JBA's CC maps	Most flood perils (river, surface water and coastal).	Other - for example, CMIP6 SSPs (Shared Socioeconomic Pathways); Global Warming Levels (GWLs) (e.g., 2˚C, and 4˚C); RCP 8.5; RCP 4.5; RCP 2.6; RCP 6;	Price negotiable depending on product
BGS	GeoClimate UKCP18 Premium	Clay shrink-swell	RCP 8.5	Negotiable cost – they prepare a quote based on area of coverage
BGS	Groundwater flooding	Groundwater flooding	Not applicable	Data licensing – negotiable costs

Step by step CCRA workflows

Three CCRA workflows have been developed to reflect the varied levels of resources, time, and funding available to heritage managers. “Heritage managers” refers to any individual, group, or organisation with responsibility for a historic site or collection, including homeowners, volunteers, facilities managers, or a large organisation with a team with broad expertise. It is recognised that for some heritage managers a basic assessment of climate change risks for their site will be proportionate or feasible in the context of expertise and resources. In contrast, an advanced assessment may be more appropriate or desirable for larger, more complex sites or collections. Stakeholder engagement is recommended throughout each workflow. The three levels of CCRA workflow developed are summarised in Table 3 below and detailed in the following three sections.

Throughout the workflow, “historic site” is used to refer to any historic site which may comprise a single asset or contain several assets. Assets could include historic buildings, historic landscapes, buried archaeology, or historic collections.

Table 3. CCRA workflow summary of three approaches

CCRA workflow level	Complexity	Suitable for?
Basic	A simple workflow that can be readily undertaken.	Single site/collection heritage managers with constrained resources and time.
Standard	A detailed workflow that can be undertaken with some effort and expertise.	Heritage managers who have the resources and time to undertake a CCRA and require a more detailed assessment.
Advanced	A highly detailed workflow that can be undertaken with considerable effort and expertise.	Heritage managers who have the requisite resources, time, and expertise and require a highly detailed assessment.

Basic Level

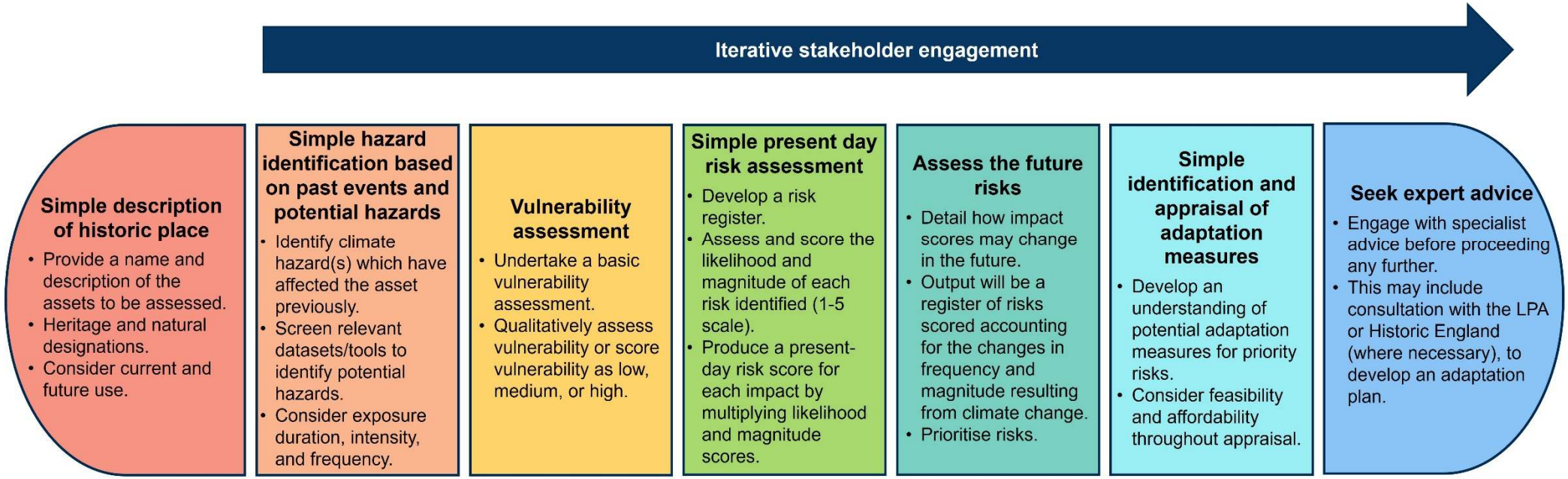

Figure 1. A flow diagram of the Basic Level CCRA workflow

Table 4. Basic Level CCRA workflow

Stage	Details
Simple description of historic place	Provide a simple description of the historic place to be assessed. This should include:

	• Name and description of the assets to be assessed (reference Forum on Information Standards in Heritage (FISH), Monument Types Thesaurus). • Heritage designations (reference Historic England National Heritage List and Local Planning Authority (LPA) Conservation Areas) or Historic Environment Record identifiers (reference HERs/Heritage Gateway). • Natural designations such as National Parks, Areas of Outstanding Natural Beauty, Marine Conservation Zones, Sites of Special Scientific Interest, Special Areas of Conservation, Special Protection Areas, and Ramsar wetland sites (reference "designations" group in Defra's Magic Map). • Location information (address, grid reference (or what3words) and/or map showing extents). • Simple description of the assets e.g. form, period, materials etc. and their heritage significance. If applicable, this can be based on the site description from Historic England's National Heritage List for England (NHLE) or a conservation management plan/statement of significance (if in place). The FISH thesauri can also be used as a resource to support developing this description. • Consider whether component assets of the historic place should be assessed separately or as a group. For example, a site could contain a historic building, a historic landscape, historic collections, and buried archaeology. The workflow can be followed several times for different assets within a site. ○ The components should be selected where there is a clear difference in vulnerability and/or exposures to climate hazards. • Consider current and future use (e.g., is a site occupied, is restoration planned). Understanding current and future use helps inform if an asset is exposed or vulnerable to hazards.

Simple hazard identification based on past events and potential hazards	Create a Climate Impact Profile: identify and list the climate hazard(s) which have affected the asset previously and consider the impacts the hazards have had. This can be achieved by using a methodology similar to that of a Local Climate Impacts Profile (LCLIP).[31]
	• In addition to reviewing past events, undertake a basic screening of relevant datasets and tools to identify potential hazards. The range of datasets will be based on the complexity of different elements of the site and potential hazards relating to its location, form and use.
	• For example, via publicly available resources
	  ○ The Flood Map for Planning (Environment Agency) to assess flood risk,
	  ○ The Met Office Local Authority Climate Explorer for projected climate trends,

	○ The UK Climate Risk Indicators Portal for insights into changing climatic conditions ○ Historic England's catalogue of data and tools contains a full list of relevant resources.[32] • For each hazard identified, include information relating to the exposure duration (how long the hazard occurred for), the intensity (how pronounced was the hazard), and the frequency (how often the hazard occurs).
Vulnerability assessment	Undertake a basic vulnerability assessment to consider how susceptible the asset is to climate hazards. • Vulnerability could be scored as high, medium, low (no expectation for the score to be numerical). • Stakeholder engagement could enhance this exercise.
Simple present day risk assessment	Making use of the climate hazards identified and the outcomes of the vulnerability assessment, undertake a simple risk assessment. • Consider whether the climate hazard(s) identified have changed since it was first observed. • Develop a risk register based on existing risk management procedures (if they exist). Define risks based on impacts and consequences which are material to the asset and its current use. • Assess the likelihood and magnitude of each risk in the register. Likelihood is the chance of an impact occurring as the result of a hazard. Whilst the magnitude represents the scale of deterioration, damage, or other metric such as cost of injury. • Scales for scoring risks should be based on existing criteria for the asset (if they exist) – it's important the scores e.g. from 1 to 5 reflect the risk tolerance of the asset and be quantitative where possible e.g. cost of damage, scale and number of injuries to visitors • The scores for likelihood and magnitude should be multiplied together to give a present-day risk score for each impact.
Assess the future risks	Detail how the impacts scored may change in future (e.g., what is the anticipated magnitude and likelihood of impacts in the future) • Make use of the Met Office's Local Authority Climate Explorer understand how the local climate might change in the future. • When assessing how climate risks may evolve, consider the current and future use of the assets. • The output will be a register of risks scored accounting for the changes in frequency and magnitude resulting from climate change. • These risks should be prioritised and those deemed particularly material taken forward for adaptation option identification and appraisal. Other risks should be monitored. • Stakeholder engagement with relevant stakeholders to the historic place would enhance this exercise to help understand, qualitatively, what some of the anticipated impacts of climate change may be for the historic place.

Simple identification and appraisal of adaptation measures	• Priority risks should be taken forward for adaptation option identification and appraisal.
	• Develop an understanding of potential adaptation measures to manage the impacts to the asset
	• Appraise what can be done in response – identifying new or modified controls/ mitigation measures.
	• Make use of available online tools and resources, such as the Local Climate Adaptation Toolkit, the OpenClim Adaptation Inventory, and Historic England and National Trust adaptation guidance.
	• Consider feasibility and affordability throughout appraisal.
	  ○ Can it be realistically implemented given site constraints?
	  ○ Is it within an acceptable budget?
	• These exercises could be undertaken or enhanced by stakeholder engagement with relevant stakeholders.

Seek expert advice	Engage with specialist advice before proceeding any further. This may include consultation with the LPA or Historic England (where necessary), to develop an adaptation plan and understand how the adaptations identified could be put into place.

Standard level

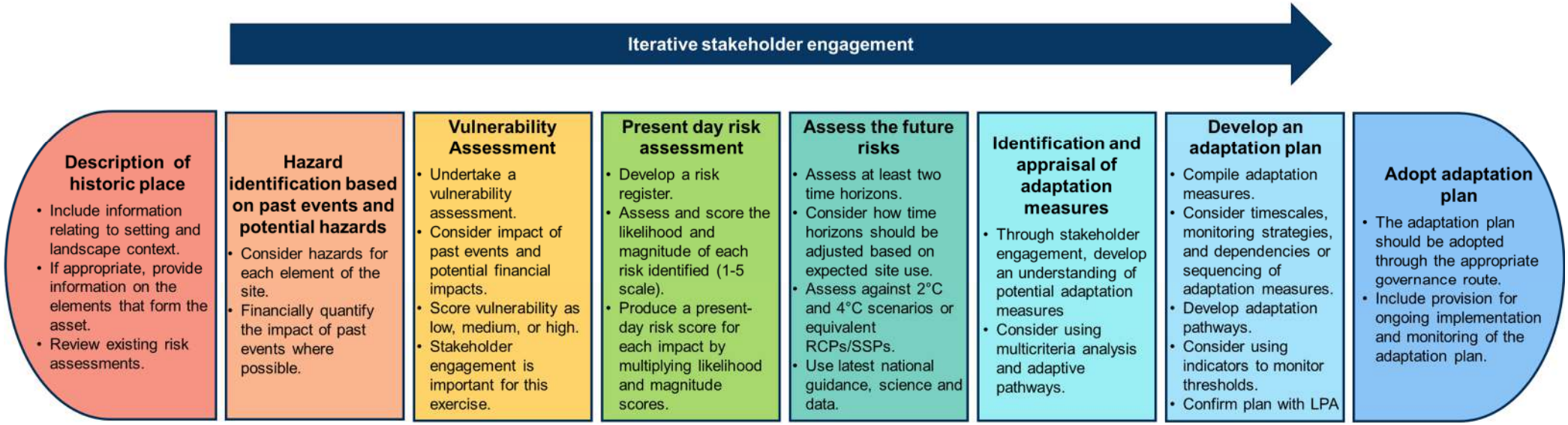

Figure 2. A flow diagram of the Standard Level CCRA workflow.

Table 5. Standard Level CCRA workflow

Stage	Details
Description of historic place	Provide a description of the historic place to be assessed. This should include: • Name and description of the assets to be assessed (reference Forum on Information Standards in Heritage (FISH), Monument Types Thesaurus)

	• Heritage designations (reference Historic England National Heritage List and LPA Conservation Areas) or Historic Environment Record identifier (reference HERs/Heritage Gateway). • Natural designations such as National Parks, Areas of Outstanding Natural Beauty, Marine Conservation Zones, Sites of Special Scientific Interest, Special Areas of Conservation, Special Protection Areas, and Ramsar wetland sites (reference "designations" group in Defra's Magic Map). • Location information (address, grid reference (or what3words) and/or map showing extents). • Description of the assets e.g. form, period, materials etc. and their heritage significance. **Include information relating to setting and landscape context.** If applicable, this can be based on the site description from Historic England's National Heritage List for England (NHLE) or a conservation management plan/statement of significance (if in place). Use standard terminology from FISH thesauri as necessary. • Consider whether component assets of the historic place should be assessed separately or as a group. For example, a site could contain a historic building, a historic landscape, historic collections, and buried archaeology. The workflow can be followed several times for different assets within a site. ○ The components should be selected where there is a clear difference in vulnerability and/or exposures to climate hazards. • **If the asset consists of multiple elements, provide information on the elements that form the asset. For example, a ruined castle could be made up of ruined stone walls, exposed timber, soft capped stone walls, earthworks, modern interventions and amenity areas.** • Consider current and future use (e.g., is a site occupied, is restoration planned). Understanding current and future use helps inform if an asset is exposed or vulnerable to hazards. • **Review existing risk assessments and risk management process already in place. It's useful to align climate change risk assessments with existing risk assessments – as climate change usually exacerbates existing issues. This can help refine the scope of the risk assessment which can include damage to site as well as impacts on visitors, costs and revenue, health and safety, nearby biodiversity and environmental impacts**.
Hazard identification based on past events and potential hazards	Create a Climate Impact Profile: identify and list the climate hazard(s) which have affected the asset previously and consider the impacts the hazards have had. This can be achieved by using a methodology similar to that of a Local Climate Impacts Profile (LCLIP).[33]

	• In addition to reviewing past events, undertake a screening of relevant datasets and tools to identify potential hazards. The range of datasets will be based on the complexity of different elements of the site and potential hazards relating to its location, form and use.
	• For example, via publicly available resources and paid datasets
	  ○ **British Geological Survey (BGS) data** for identifying risks such as soil heave, shrink-swell, and subsidence, particularly for sites with vulnerable foundations or historic masonry. Note: Full access to BGS datasets requires a paid license, but publicly available tools, summaries and reports may still provide useful insights where subsidence is a concern.
	  ○ Environment Agency flood risk mapping, including the Flood Map for Planning **and future projections from NaFRA2 (National Flood Risk Assessment 2) and NCERM2 (National Coastal Erosion Risk Mapping 2)**. These resources are freely available and therefore relatively coarse; where they show high risk of flooding, a paid-for site-based assessment by an appropriate professional is recommended.
	  ○ Met Office Local Authority Climate Explorer for projected climate trends, including temperature, precipitation, and extreme weather events.
	  ○ UK Climate Risk Indicators Portal for broader insights into changing climatic conditions affecting heritage sites. Identify the previous impact(s) of the of the climate hazard.
	  ○ Historic England's catalogue of data and tools contains a full list of relevant resources.[34]
	• For each hazard identified, include information relating to the exposure duration (how long the hazard occurred for), the intensity (how pronounced was the hazard), and the frequency (how often the hazard occurs).
	• **Financially quantify the impact of past events where possible. Engage with site staff and users to understand hazards and past impacts more fully is possible. Look to gather information on impacts such as:**
	  ○ **Known repair costs**
	  ○ **Increased maintenance costs (as a result of either more elements of the site requiring attention or increased frequency of existing maintenance measures)**
	  ○ **Previous loss of revenue**
	  ○ **Changes to insurance premiums and/ or cover**

Vulnerability assessment	Undertake a vulnerability assessment to consider how susceptible the asset is to climate hazards. **Consider the impacts of past events and potential financial impacts.**

	• Vulnerability could be scored as high, medium, low **or could be semi-quantitative**. • Stakeholder engagement **is important** for this exercise.
Present day risk assessment	Making use of the climate hazards identified and the outcomes of the vulnerability assessment, undertake a risk assessment. • Consider whether the climate hazard(s) identified have changed since it was first observed. • Develop a risk register based on existing risk management procedures (if they exist). Define risks based on impacts and consequences which are material to the asset and its current use. • Assess the likelihood and magnitude of each risk in the register. Likelihood is the chance of an impact occurring as the result of a hazard. Whilst the magnitude represents the scale of deterioration, damage, or other metric such as cost of injury. • Scales for scoring risks should be based on existing criteria for the asset (if they exist) – it's important the scores e.g. from 1 to 5 reflect the risk tolerance of the asset and be quantitative where possible e.g. cost of damage, scale and number of injuries to visitors. • The scores for likelihood and magnitude should be multiplied together to give a present-day risk score for each impact.
Assess the future risks - At least two time horizons assessed, suggested for 2°C and 4°C Global Warming Levels (or equivalent)	Assess the impact of the climate change hazards on the risk scoring **for two time horizons; it is suggested that assessment is against 2050 and 2080** • **Consider how these time horizons should be adjusted based on the site's expected use. Some assets might benefit from a nearer term horizon e.g. residential use.** • **Assess against average global warming temperature scenarios of 2°C and 4°C, or equivalent Representative Concentration Pathways (RCPs), such as RCP 4.5 for 2°C and RCP 8.5 for 4°C or equivalent Shared Socioeconomic Pathways (SSPs).** • **Use latest national guidance, science and data. For example, UK Climate Risk Indicators, the Met Office's Local Authority Climate Explorer, the Met Office Data Portal, and/or climate change allowances from the Environment Agency (EA) where relevant.** • The output will be a register of risks scored accounting for the changes in frequency and magnitude resulting from climate change. • These risks should be prioritised and those deemed particularly material taken forward for **more detailed (financial) quantification** and adaptation option identification and appraisal. Other risks should be monitored.

	• Stakeholder engagement with relevant stakeholders **is important** at this stage to help understand, qualitatively, the anticipated impacts of climate change.
Identification and appraisal of adaptation measures, including economic, environmental and social effects via multi-criteria analysis	Priority risks should be taken forward for adaptation option identification and appraisal. • **Through stakeholder engagement (typically a workshop),** develop an understanding of potential adaptation measures to manage the impacts to the asset. • **Document current risk mitigation measure/control, including maintenance practices and assess if these are sufficient given the revised risk scores (which take climate change into account).** • Appraise what can be done in response – identifying new or modified controls/ mitigation measures. • Make use of available online tools and resources, such as the Local Climate Adaptation Toolkit, the OpenClim Adaptation Inventory, and Historic England and National Trust adaptation guidance. • **A Multi-Criteria Analysis (MCA) may be a useful way to evaluate and prioritise different adaptation measures based on multiple criteria. The measures can be rated on criteria relevant to the asset e.g. cost, effectiveness, wider co-benefits e.g. for reducing carbon emissions, raising the public profile of the asset, or wider stakeholder acceptability.** • **Consider using dynamic adaptive planning approaches (adaptive pathways): The timing and sequencing of actions should be considered so that adaptive pathways can be developed.** • These exercises **should** be conducted with engagement with relevant stakeholders.
Develop an adaptation plan	**Compile adaptation measures into an adaptation plan. At a minimum, the adaptation plan should consider:** ○ **priority of the adaptation measures identified** ○ **who will own each adaptation measure** ○ **how adaptations will be monitored** ○ **what success for each adaptation looks like** ○ **what the effect of the adaptation is on the risk score** ○ **The timing and timescale for each adaptation measure, when does it need to be started and completed by.** ○ **Any dependencies and sequencing of adaptation** • **The adaptation plan should be treated as a 'live document'.** • **Following development of the adaptation plan, adaptation pathways can be developed for the asset.**

	• **Consider using indicators to track when an adaptation measure should be implemented or reassessed. Define clear indicators that signal when a threshold or trigger point is being reached. Identify who will own tracking/reporting on indicators.** • **Engage with the LPA or Historic England (where necessary) to confirm the adaptation plan and understand how the adaptations identified could be put into place.**
Adopt adaptation plan	• **The developed adaptation plan and supporting CCRA should be adopted through whichever governance route is appropriate for the historic place.** • **The adoption should include provision for the ongoing implementation and monitoring of the adaptation plan, including periodic review and updating to address changing climate or site conditions.**

Advanced Level

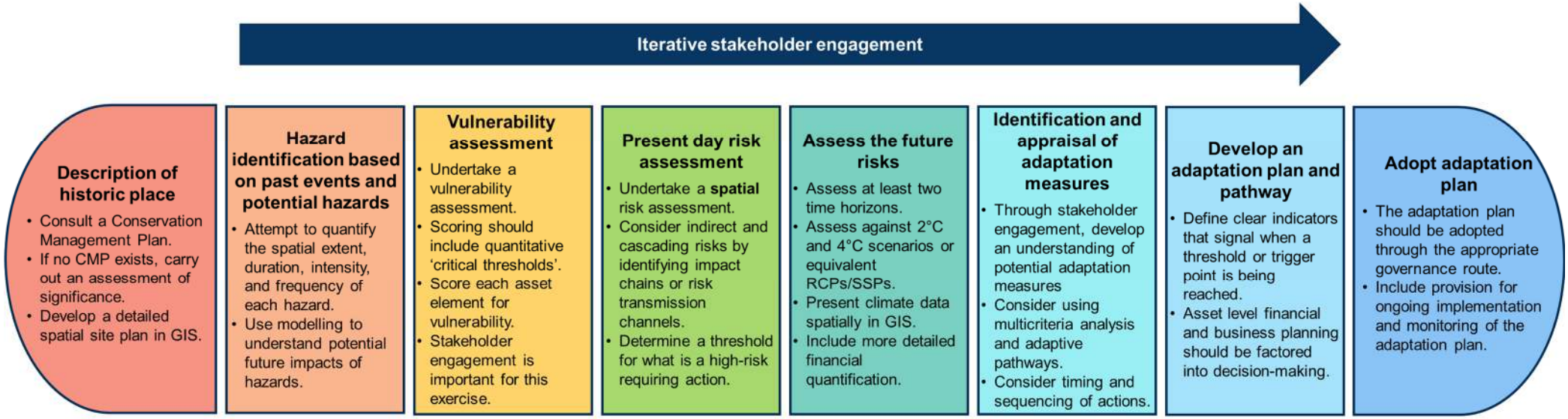

Figure 3. A flow diagram of the Advanced Level CCRA workflow.

Table 6. Advanced Level CCRA workflow

Stage	Details
Description of historic place	Provide a description of the historic place to be assessed. This should include: • Name and description of the assets to be assessed (reference Forum on Information Standards in Heritage (FISH), Monument Types Thesaurus)

	• Heritage designations (reference Historic England National Heritage List and LPA Conservation Areas) or Historic Environment Record identifier (reference HERs/Heritage Gateway). • Natural designations such as National Parks, Areas of Outstanding Natural Beauty, Marine Conservation Zones, Sites of Special Scientific Interest, Special Areas of Conservation, Special Protection Areas, Ramsar wetland sites, and other non-statutory designations (reference "designations" group in Defra's Magic Map). • Location information (address, grid reference (or what3words) and/or map showing extents). • Description of the assets e.g. form, period, materials etc. and their heritage significance. Include information relating to setting and landscape context. If applicable, this can use the site description from Historic England's National Heritage List for England (NHLE) or a conservation management plan/statement of significance (if in place). Use standard terminology from FISH thesauri as necessary. • Consider whether component assets of the historic place should be assessed separately or as a group. For example, a site could contain a historic building, a historic landscape, historic collections, and buried archaeology. The workflow can be followed several times for different assets within a site. ○ The components should be selected where there is a clear difference in vulnerability and/or exposures to climate hazards. • If the asset consists of multiple elements, provide information on the elements that form the asset. For example, a ruined castle could be made up of ruined stone walls, exposed timber, soft capped stone walls, earthworks, modern interventions and amenity areas. • **The description of assets and their significance should be based on existing information such as Conservation Management Plans (CMP) and any existing heritage assessments or surveys (held by the owner or the Historic Environment Record).** • **If no CMP exists, or if further detail is needed, carry out an assessment of significance following Historic England's guidance on Statements of Heritage Significance[35]** • Consider current and future use (e.g., is a site occupied, is restoration planned). Understanding current and future use helps inform if an asset is exposed or vulnerable to hazards. • **Produce a geographic information system (GIS) map of the historic place in the form of a detailed spatial site plan, incorporating the information collected in the previous steps.** • Review existing risk assessments and risk management process already in place. It's useful to align climate change risk assessments with existing risk assessments – as climate change usually exacerbates existing issues. This can help refine

	the scope of the risk assessment which can include damage to site as well as impacts on visitors, costs and revenue, health and safety, nearby biodiversity and environmental impacts.

Hazard identification based on past events and potential hazards	• Create a Climate Impact Profile: identify and list the climate hazard(s) which have affected the asset previously and consider the impacts the hazards have had. This can be achieved by using a methodology similar to that of a Local Climate Impacts Profile (LCLIP).[36]
	• In addition to reviewing past events, undertake a screening of relevant datasets and tools to identify potential hazards. The range of datasets will be based on the complexity of different elements of the site and potential hazards relating to its location, form and use.
	• For example, via publicly available resources and paid datasets such as:
	  ○ British Geological Survey (BGS) data for identifying risks such as soil heave, shrink-swell, and subsidence, particularly for sites with vulnerable foundations or historic masonry. Note: Full access to BGS datasets requires a paid license, but publicly available tools, summaries and reports may still provide useful insights where subsidence is a concern.
	  ○ Environment Agency flood risk mapping, including the Flood Map for Planning and future projections from NaFRA2 (National Flood Risk Assessment 2) and NCERM2 (National Coastal Erosion Risk Mapping 2). These resources are freely available and therefore relatively coarse; where they show high risk of flooding, a paid-for site-based assessment by an appropriate professional is recommended.
	  ○ Met Office Local Authority Climate Explorer for projected climate trends, including temperature, precipitation, and extreme weather events.
	  ○ UK Climate Risk Indicators Portal for broader insights into changing climatic conditions affecting heritage sites. Identify the previous impact(s) of the of the climate hazard.
	  ○ Historic England's catalogue of data and tools contains a full list of relevant resources.[37]
	• For each hazard identified, include information relating to the exposure duration (how long the hazard occurred for), the intensity (how pronounced was the hazard), and the frequency (how often the hazard occurs).
	• **Attempt to quantify this information as far as possible. Consider the spatial extent of the hazard, the duration, the intensity, and the frequency. Ideally this information should be quantified to an extent that it can be presented spatially, although it is acknowledged that for some hazards this may not be appropriate.**
	• Financially quantify the impact of past events where possible. Engage with site staff and users to understand hazards and past impacts more fully. Gather information on impacts such as:

	○ Known repair costs ○ Increased maintenance costs (as a result of either more elements of the site requiring attention or increased frequency of existing maintenance measures) ○ Previous loss of revenue ○ Changes to insurance premiums and/ or cover • **Make use of modelling to understand potential future impacts of hazards. For example, using natural catastrophe modelling techniques and the Multi-Coloured Manual (MCM) for economic appraisal of flood impacts.**[38]
Vulnerability assessment	Undertake a vulnerability assessment to consider how susceptible the asset is to climate hazards. Consider the impacts of past events **and the outcome of any modelling of future potential hazards.** • At this level, vulnerability scoring could be semi-quantitative and **where possible include quantitative 'critical thresholds' i.e. where a climate variable or hazard has a substantial impact**. • **If the asset is made up of multiple different elements, then each element should be scored for vulnerability.** • Stakeholder engagement is important for this exercise.
Present day risk assessment	Making use of the climate hazard(s) identified and the outcomes of the vulnerability assessment, undertake a **spatial risk assessment.** • Consider whether the climate hazard(s) identified have changed since it was first observed. • Develop a risk register based on existing risk management procedures (if they exist). Define risks based on impacts and consequences which are material to the asset and its current use. • Assess the likelihood and magnitude of each risk in the register. Likelihood is the chance of an impact occurring as the result of a hazard. Whilst the magnitude represents the scale of deterioration, damage or other metric such as cost of injury. • Scales for scoring risks should be based on existing criteria for the asset (if they exist) – it's important the scores e.g. from 1 to 5 reflect the risk tolerance of the asset and be quantitative where possible e.g. cost of damage, scale and number of injuries to visitors. • The scores for likelihood and magnitude can be multiplied together to give a present-day risk score for each impact. • **Consider indirect and cascading risks by identifying impact chains or risk transmission channels** (as seen in ISO 14090 (Adaptation to climate change — Principles, requirements and guidelines).[39]

	• **Determine a threshold for what is a high-risk requiring action** – once climate change has been factored in, these risks should be prioritised for further (financial) quantification and adaptation appraisal.

Assess the future risks - At least two time horizons assessed, suggested for 2°C and 4°C Global Warming Levels (or equivalent)	Assess the impact of the climate change hazards on the risk scoring for two time horizons; it is suggested that assessment is against 2050 and 2080.
	• Consider how these time horizons should be adjusted based on the site's expected use. Some assets might benefit from a nearer term horizon e.g. residential use.
	• Assess against average global warming temperature scenarios of 2°C and 4°C, or equivalent Representative Concentration Pathways (RCPs), such as RCP 4.5 for 2°C and RCP 8.5 for 4°C or equivalent Shared Socioeconomic Pathways (SSPs)
	• If possible, **data should be presented spatially in GIS** (and added to the **spatial risk assessment from the previous step)**
	• Use latest national guidance, science and data. For example, UK Climate Risk Indicators, the Met Office's Local Authority Climate Explorer, the Met Office Data Portal, and/or climate change allowances from the Environment Agency (EA) where relevant.
	• The output will be a refined spatial assessment and register of risks scored accounting for the changes in frequency and magnitude resulting from climate change.
	• These risks should be prioritised and those deemed particularly material taken forward for more detailed (financial) quantification and adaptation option identification and appraisal. Other risks should be monitored.
	• **More detailed (financial) quantification could include:**
	  ○ **Long-term cost escalation (e.g., rising costs of materials and labour for heritage conservation).**
	  ○ **Increased maintenance burdens from more frequent extreme weather events.**
	  ○ **Potential financial thresholds where adaptation investment becomes cost-prohibitive or essential.**
	• Stakeholder engagement with relevant stakeholders is important at this stage to help understand, qualitatively, the anticipated impacts of climate change.

Identification and appraisal of adaptation measures, including	Priority risks should be taken forward for adaptation option identification and appraisal. • Through stakeholder engagement (typically a workshop), develop an understanding of potential adaptation measures to manage the impacts to the asset.

economic, environmental and social effects via multi-criteria analysis	• Document current risk mitigation measures/ controls, including maintenance practices and assess if these are sufficient given the revised risk scores (which take climate change into account). • Appraise what can be done in response – identifying new or modified controls/ mitigation measures. • Make use of available online tools and resources, such as the Local Climate Adaptation Toolkit, the OpenClim Adaptation Inventory, and Historic England and National Trust adaptation guidance. • A Multi-Criteria Analysis (MCA) may be a useful way to evaluate and prioritise different adaptation measures based on multiple criteria. The measures can be rated on criteria relevant to the asset e.g. cost, effectiveness, wider co-benefits e.g. for reducing carbon emissions, raising the public profile of the asset, or wider stakeholder acceptability. • Consider using dynamic adaptive planning approaches (adaptive pathways): The timing and sequencing of actions should be considered. **For example, an 'informational adaptation measure' (i.e. a more detailed study into a particular risk) could precede and inform a later CAPEX (capital expenditure) or OPEX (operational expenditure) investment.** This is important for developing adaptation pathways. • These exercises should be conducted with engagement with relevant stakeholders.
Develop an adaptation plan **and pathway**	Compile adaptation measures into an adaptation plan. At a minimum, the adaptation plan should consider: o priority of the adaptation measures identified o who will own each adaptation measure o how adaptations will be monitored o what success for each adaptation looks like o what the effect of the adaptation is on the risk score o the timescale for each adaptation measure, when does it need to be started and completed by o the sequence of actions, dependencies **and trigger points for actions (to help develop an adaptation pathway)** • The adaptation plan should be treated as a 'live document' • Following development of the adaptation plan, adaptation pathways **should** be developed for the asset. • To track when an adaptation measure should be implemented or reassessed, define clear indicators that signal when a threshold or trigger point is being reached. Identify who will own tracking/reporting on indicators. • **Asset level financial and business planning should be factored into decision-making within adaptation pathways.**

	• Engage with relevant stakeholders, including the LPA or Historic England (where necessary) to confirm the adaptation measures, thresholds, how the selected measures could be implemented and monitored over time.
Adopt adaptation plan	• The developed adaptation plan and supporting CCRA should be adopted through whichever governance route is appropriate for the historic place. • The adoption should include provision for the ongoing implementation and monitoring of the adaptation plan, including periodic review and updating to address changing climate or site conditions.

Follow-on surveys

If high likelihood and/or magnitude risks are identified in the advanced workflow, further follow-on surveys could be undertaken to better understand the risks and potential adaptation options. A non-exhaustive list of potential follow-on surveys has been collated, with surveys organised by hazard type (Table 7).

Table 7. Potential follow-on surveys

Typical hazards	**Additional Specialist Surveys (Assets)**	**Additional Specialist Surveys (Landscape)**
Storm surge Coastal erosion Sea level rise Coastal flooding	Coastal vulnerability mapping Record assets at risk Coastal erosion surveys Geotechnical assessments Emergency response planning	Geomorphological surveys Long term relative sea level rise assessment Sediment transport assessments and modelling Emergency response planning
Shrink-swell Freeze-thaw cycles Landslide	Structural surveys Condition assessments Thermal imaging surveys Geotechnical assessments	Landscape management strategies Geotechnical assessments Impact assessments
Average precipitation Wind-driven rain Heavy precipitation	Structural surveys Condition assessments Hydrogeological surveys Inspection Maintenance and repair of rainwater systems Hydrological studies	Hydrogeological surveys Palaeoenvironmental assessment
Pluvial flood Fluvial flood	Property flood resilience survey Flood risk assessments Emergency response planning	Stream outfall improvement Hydrological and hydrogeomorphological surveys, modelling and assessment Emergency response planning
Average temperature High temperature events Drought Fire weather	Thermal comfort assessment Groundwater monitoring Occupancy feedback Temperature monitoring Fire risk assessment Emergency response planning	Landscape management strategies Habitat condition assessment Heat stress analysis Geoarchaeology surveys Fire risk assessment Emergency response planning
Average wind speed Extreme wind speeds	Tree risk assessment Structural surveys	Tree risk assessment Emergency response planning

	Emergency response planning	
Average humidity Humidity fluctuations Biological growth	Structural surveys Condition assessments e.g. historic fabric condition surveys Humidity monitoring Mould surveys Object condition assessment	N/A

Application of workflow

Scenario background

This is a simplified hypothetical site to illustrate how the different levels of the workflow could be applied. The three levels illustrate the progressive increase in complexity and depth of content.

Willow-wood Manor is a historic manor house set within extensive formal gardens, located in a gently sloping valley, bordered by ancient woodlands and a river. The privately-owned manor house dates back to the 16th century and retains original architectural features. The formal gardens feature 18th-century landscaping, with kitchen gardens, lawns, and earlier archaeological evidence. Archaeological evidence suggests the presence of an early Saxon settlement. The manor is currently occupied as a private residence, and the gardens are partially open to the public for heritage tours.

The manor house is recorded in the National Heritage List for England (NHLE) as a Grade II* listed building. The gardens and buried archaeological remains are non-designated heritage assets recorded in the Historic Environment Record. The site is not subject to any environmental designations. The site has no Conservation Management Plan (CMP). The site is not currently on the Heritage at Risk Register. The manor house and gardens are generally in good repair and well maintained. There are health and safety management plans and business continuity plans in place.

In the past, it has experienced the following climate impacts:

- Heatwaves – temperatures exceeding 30°C for over 5 days at a time, with increasing frequency in 2019, 2022 and 2023;
- River flooding – events lasting 5-10 days each in 2014, 2018 and 2022;
- Ongoing soil subsidence since 2015; and
- A multi-year dry period between 2018 and 2020.

Description of historic place

Workflow level	Items for inclusion/consideration
Basic	Undertake site overview, including asset description, referring to the Historic England National Heritage List and LPA Conservation Areas, and current site use. For example: Identify location using what3words: ///manor.oak.heritage and grid reference TL 1234 5678 (manor house). Identify elements of the historic environment and landscape utilising their National Heritage List and Historic Environment Record identifiers. Consider which FISH thesaurus elements apply. For example: • Manor House ("MANOR HOUSE") • Formal Garden ("FORMAL GARDEN") • Archaeological Site ("SETTLEMENT" – potential subcategory "SAXON SETTLEMENT") In addition to the current use, future plans include restoration of the formal gardens to their original 18th-century layout, possible excavation of the Saxon settlement for research and public engagement and expansion of visitor facilities e.g. café and shop. The Manor House and Formal Garden assessed both as a single entity due to their historical continuity and shared significance, but also separately where particular hazards are specifically relevant or will affect the built heritage and the landscape differently. The archaeological site (possible Saxon settlement) is assessed separately due to its distinct historical period and buried remains.
Standard	**Basic level items, plus:** Provide further contextual information relating to the setting and landscape of the site, such as the relationship between the manor house, earlier settlement, topography and influence of key views and vegetation. Include further information on the asset's elements, such as the kitchen gardens, lawns, planting or different architectural phases of the manor house. Review the health and safety management plans and business continuity plans.
Advanced	**Basic and standard items, plus:** Identify whether there is a Conservation Management Plan in place for the site. In this case, there is not one in place. Complete an assessment of significance, for this site the assessment focuses on architectural, historical and archaeological values.

	A GIS map was produced incorporating; the footprint of the manor house and formal gardens, the buried archaeological site identified from HER record and geophysical survey data and landscape elements such as the river, ancient woodlands, and access paths.

Hazard identification based on past events and future potential hazards

Workflow level	Items for inclusion/consideration
Basic	Create a climate impact profile drawing on datasets such as those signposted in the hazard identification step of the workflows: • The Flood Map for Planning (Environment Agency) to assess flood risk, • The Met Office Local Authority Climate Explorer for projected climate trends, • The UK Climate Risk Indicators Portal for insights into changing climatic conditions • Historic England's catalogue of data and tools contains a full list of relevant resources. For example, at this site, the profile may include a list of past flood events, days where rainfall rates exceeded 50mm/day, days where temperatures exceeded 35°C, prolonged periods of low rainfall, indicating drought conditions and recorded cracking in historic gardens' walls indicating soil subsidence. Identify how long each of these hazard events lasted and how frequently they have taken place, for example, there have been three major flood events in the last 10 years, lasting for 5-10 days. Identify how severe the event was, for example, the most recent flood event was moderate with waterlogged gardens and minor erosion. If known, record indicative flood depths for the event. Identify the locations impacted by the hazard. For example, during the most recent flood event, low-lying estate areas near the river were impacted. Potential hazards can be identified using publicly available resources. For example, the Flood Map for Planning classified the manor's lower grounds as Flood Zone 2, indicating moderate flood risk, and the Met Office's Local Authority Climate Explorer showed increasing summer temperatures and changing precipitation patterns.
Standard	**Basic level items, plus:** Using additional data sets such as British Geological Survey data which identified risks of soil shrink-swell and subsidence due to clay-heavy ground. NaFRA2 adds further explanation to flood risk, for example, increased peak flows due to climate change could increase the likelihood of river flooding.

	Gather information to quantify how much it cost to return to normal conditions after the past events, such as flood damage repair costs and loss of revenue due to flood events.
Advanced	**Basic and standard items, plus:** Where relevant, produce maps of previous hazard extents and intensity, and consider the implications of duration and frequency compared to historical events. For example, flood maps of past events can be produced displaying the extent and intensity of different events for comparison. Quantify how much it cost to return to normal conditions after the past events. For example, flood damage repair after the 2022 flood event cost £20,000 in landscape restoration and erosion control, and there was a loss of revenue of £5,000 whilst closed for a week. The Multi-Coloured Manual (MCM) supported the economic appraisal of flood impacts.[40]

Vulnerability assessment

Workflow level	Items for inclusion/consideration
Basic	Assess overall site vulnerability. In this case the overall vulnerability is medium, as climate hazards are increasingly affecting the site, but ongoing maintenance mitigates severe risks. Also consider the *potential* impact of other hazards which have not (yet) impacted the site but could increasingly become an issue e.g. wildfire and drought.
Standard	**Basic level items, plus:** Include the impacts of past events and the potential financial impacts in the assessment to refine the vulnerability assessment. Considering factors like sensitivity and adaptive capacity can build a semi-quantitative assessment of vulnerability. Stakeholders to engage with include the LPA, property owner and manager, and volunteers. Element-based vulnerability assessment can include statements such as: • Manor House: High (occupants and visitors susceptible to overheating due to poor ventilation and limited passive cooling options). • Formal Garden: High (severe water stress and irrigation challenges).
Advanced	**Basic and standard items, plus:** Future potential hazard modelling will enhance the vulnerability assessment, such as including the consideration that climate change is likely to result in more rainfall and exacerbate existing flood risk. If desired, vulnerability scoring could be semi-quantitative and would require defining

	quantitative ‘critical thresholds’ i.e. the point at which the soil subsidence, heatwave, or flood risk will have a substantial impact.

Present day risk assessment

Workflow level	Items for inclusion/consideration
Basic	Score each risk out of five for likelihood and magnitude, and multiply together to generate a risk score. For example, heatwaves are currently more frequent than in the past (4) and could have major consequences on people who occupy and visit the manor house (4), therefore the risk score would be high (16), indicating major risk level. Changes since first observed include increased frequency and severity of flooding in recent years due to changing rainfall patterns and rising summer temperatures impacting occupants and visitors.
Standard	**Basic level items, plus:** No additional detail required, but criteria for assigning likelihood and magnitude scores may be more nuanced or quantitative.
Advanced	**Basic and standard items, plus:** Undertake a spatial risk assessment based on the climate hazards identified and the vulnerability assessment outcomes. Develop impact chains that visualise the cause/effect relationships between climate hazards, vulnerabilities, and exposures that lead to specific risks. A threshold could be set based upon the present day risk score, future risk score, and whether project financial impacts exceed £50,000. For example, heatwaves have a major risk score of 16. This score needs to be scaled up for the impacts of climate change in 2050 to 18 and to 22 in 2080. Considering the costs of responding to and mitigating the hazard, it could cost up to £50,000, therefore action is required soon.

Assessment of future risks

Workflow level	Items for inclusion/consideration
Basic	Climate change is likely to exacerbate existing hazards. For example, using UK Met Office projections, average summer temperatures in the region are expected to rise, leading to prolonged heatwaves and increased soil shrinkage. Winter rainfall is projected to increase, exacerbating flood risks. Considering the risks that have been highlighted in the previous steps, build a risk register which is scored based on anticipated severity in future climate scenarios.

	Climate change is likely to have an impact on the use of the site. For example, as visitor numbers fluctuate seasonally, overheating risks may impact summer tourism, while increased flooding may reduce winter accessibility. Consider engagement with the stakeholders to validate findings and structure adaptation efforts.
Standard	**Basic level items, plus:** Provide additional information about climate projections, such as by 2050 (RCP4.5, 2°C warming scenario), increased flood frequency and heatwaves are expected. By 2080 (RCP8.5, 4°C warming scenario), extreme weather events may become significantly more disruptive, requiring major adaptation investments. For Willow-wood Manor, visitor comfort and conservation priorities suggest that planning for 2040-2050 is most relevant. However, long-term preservation efforts must also account for 2080 projections. Financial quantification is added to the risk register, supporting the prioritisation of risks. For example, it would cost £5000 more a year for cooling measures under RCP8.5 compared to RCP4.5. Stakeholder engagement undertaken to validate findings and structure adaptation efforts.
Advanced	**Basic and standard items, plus:** Include the Shared Socioeconomic Pathways in the assessment. This would be SSP2-4.5 for RCP4.5, and SSP5-8.5 for RCP8.5. Compare the changes between the scenarios and reflect this in the risk register scoring. For example, under RCP8.5 there is a projected 20% increase in peak flood events, whereas under SSP5-8.5, it is projected to be a 30% increase. Provide spatial representation of future impacts, building on the spatial risk assessment from the previous steps. This could include overlaying projected flood risk data with the historical flood extents, and then the present day risk to visually represent the changes. Further financial quantification could include details such as conservation costs rising by 30–50% due to increased stone deterioration, timber decay, and water damage repairs with worsening climate impacts.

Appraisal of adaptation measures

Workflow level	Items for inclusion/consideration
Basic	Identify which risks are a priority to mitigate. In this case, heatwaves and flooding are examples used in previous steps. For heatwaves, potential adaptation measures include passive cooling techniques such as

	temporary shading and improvements in air circulation. Control measures include installing a reliable backup power source to ensure that air conditioning and cooling systems remain operational during power outages caused by heatwaves. Consider whether stakeholder engagement would be useful for refining the appraisal.
Standard	**Basic level items, plus:** Hold stakeholder workshops to refine the adaptation measures. Review current management strategies – such as the health and safety and business continuity plans – and assess whether they will be sufficient for the risk scores provided in previous steps. Decide what criteria will be useful for appraising the adaptation measures; MCA and the development of adaptative pathways are options at this stage. Appraisal of adaptation measures should include consideration of the timing of actions, and prioritisation. For example, heatwave measures could be considered first as they are quicker to implement, while flood mitigation measures will require more time.
Advanced	**Basic and standard items, plus:** Consideration of which risks require further information or surveys to adaptation measures. For example, flood mitigation will require a more detailed study before capital expenditure or operational expenditure investments could be decided upon.

Develop an adaptation plan

Workflow level	**Items for inclusion/consideration**
Basic	**Seek expert advice before proceeding with this stage.**
Standard	Develop an adaptation plan which is a live document considering the priority, monitoring, timing, success and impact of the adaptation measures. For example, drainage and flood mitigation will be beneficial for responding to flood events: • It has a high priority, based on previous steps. • Depending on the scale of measures these may be the responsibility of the estate or require collaboration with the LPA, Environment Agency, and/or neighbouring land owners. • A flood monitoring system can be implemented. • Success criteria include reduced flood damage. • It can moderately reduce the magnitude of the risk score. • This could start being scoped relatively soon. Include information on dependencies. For example, flood risk assessments should be completed first to guide the drainage designs. Also, consider the

	future use of the site in plans, for example landscape modifications included in the restoration of the formal gardens, such as tree planting, should not obstruct the drainage flow. Where appropriate, engage with the LPA to understand how the identified adaptation measures could be put into place. Identify suitable measures to reflect heritage significance and designation requirements and which measures are unlikely to be suitable due to heritage significance. Identify Listed Building Consent requirements for any measures.
Advanced	**Standard items, plus:** Develop adaptation pathways for the priority risks. An adaptation pathway for drainage and flood mitigation could look like: • Phase 1 (Short-Term): Improve existing drainage systems and conduct flood risk mapping. • Phase 2 (Medium-Term): Introduce permeable surfaces, rain gardens, and natural water retention areas. • Phase 3 (Long-Term): Implement large-scale flood mitigation, such as riverbank reinforcement and water diversion strategies. Cost-benefit analysis should be conducted throughout the adaptation pathway to align with asset-level financial and business planning. Funding opportunities should be explored for the flood defences. This could include seeing whether there are heritage conservation grants for sustainable flood mitigation. This could also include considering whether operational budget forecasting could phase investments over multiple years. Example thresholds for the reassessment of flood mitigation measures include: • Water pooling persists for over 48 hours after heavy rainfall, indicating insufficient drainage capacity. • Floodwaters exceed the projected values with climate change. • Erosion near foundations and pathways increases by >10% over a monitoring period. • Insurance premiums increase due to flood risk classification changes, requiring enhanced defences.

Adopt adaptation plan

Workflow level	Items for inclusion/consideration
Basic	**Seek expert advice before proceeding with this stage.**
Standard	The adaptation plan and Climate Change Risk Assessment (CCRA) should be adopted through the appropriate governance route. This ensures alignment with local heritage policies, integration into estate management plans, and approval from conservation authorities. Ongoing implementation and monitoring should be established. Responsibilities should be assigned to estate managers and conservation

	specialists, with a structured review cycle (e.g., every five years) and the use of monitoring tools such as flood mapping and temperature tracking. The plan should be periodically reviewed and updated to reflect changing climate conditions. This includes integrating the latest climate projections, reassessing financial needs, and adjusting strategies based on stakeholder feedback and real-world data.
Advanced	No additional detail required.

Recommendations for progressing the workflows to guidance and detailed methodology

In developing the workflows, several recommendations for actions that could be taken when advancing the workflows to a full methodology and guidance document have been identified. The recommendations are not exhaustive and represent identified actions that would be useful but are outside the scope of the workflow development. The recommendations are organised by theme in Table 8.

Table 8. Recommendations for progressing the workflows to guidance and detailed methodology

Theme	**Recommendation**
Definitions	• Create or confirm Historic England definitions of adaptation, maintenance, vulnerability, significance, and importance. • Consider defining exactly what is meant by adaptation in relation to maintenance. • Consider defining exactly what is meant by vulnerability in relation to the significance and importance of an asset.
Sources and links	• Develop the list of sources and links for hazard data/tools within the workflows in a more comprehensive manner. • Fully identify and provide links to external guidance that supports adaptation plans.
Integration with wider Historic England initiatives	• Integrate the workflow project and guidance into the climate change toolkit on the Historic England website (ongoing project). • Integrate with the Historic England adaptation options project.
Detailed guidance	• Develop additional explanatory guidance text. • Create templates for basic, standard, and potentially advanced CCRA (though the templates for the advanced workflow may be more effectively adapted from the standard template by those completing the CCRA for specific circumstances). • Consider how to account for unknown vulnerability of a site during the vulnerability assessment step and produce guidance to support users with this. • Develop more detailed worked examples or case studies.
Training	• Develop training resources (webinars, e-learning, worked examples etc.) for dissemination.
Consultation	• Consult with other heritage bodies and stakeholders for feedback on the workflow process and guidance to inform development. For example, engage with volunteers to ascertain level of understanding around climate change and risk assessment, so that guidance and support can be developed accordingly.

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