Historic Environment and Climate Change in Wales

Sector Adaptation Plan Monitoring

Interim Report of Activity: Year 2, 2021

Historic Environment Group
Climate Change Subgroup

May 2022

The Historic Environment Group (HEG) is a high-level forum set up by the Welsh Ministers in 2004 to take a strategic overview of issues and opportunities in the historic environment and to promote common approaches. The group is made up of representatives from the major organisations in Wales with historic environment interests.

The HEG Climate Change Subgroup is charged with assessing and reporting to HEG on how the historic environment sector in Wales should address the challenge of climate change.

Cover photograph: Diving the Bronze Bell protected shipwreck. Divers from MSDS marine undertaking an archaeological and environmental assessment.

Contents

1. Introduction 3
2. Indicators and Actions 5
3. Call for evidence 6
4. Progress against Sector Adaptation Plan actions 7
5. Case studies 19
6. Conclusions 30
7. Abbreviations 31
8. Links to Resources 33

1. Introduction

In 2020, the Historic Environment Group (HEG) published *Historic Environment and Climate Change in Wales Sector Adaptation Plan* (SAP), building on the high-level strategic actions identified in the Welsh Government's adaptation plan *Prosperity for All: A Climate Conscious Wales*.

You can download the Historic Environment and Climate Change in Wales Sector Adaptation Plan, published in 2020, from the Cadw website

You can download the Prosperity for All: A Climate Conscious Wales, published in 2019, from the Welsh Government website

The SAP identifies the risks and opportunities of climate change for the historic environment of Wales and sets out the headline actions needed to adapt to the impact of these changes. The actions are arranged around the three overarching and linked objectives of increasing our knowledge, increasing our capacity, and building our resilience.

The *SAP Monitoring and Evaluation Framework* sets out the process for evaluating progress against the published SAP actions and the Welsh Government indicators in *A Climate Conscious Wales*. It also sets out a four-year timeline for reporting activity and a formal monitoring and evaluation report in advance of updating the SAP in 2025.

Year	Outcome	Timeline	Status
0	Historic Environment Group (HEG) published the Historic Environment and Climate Change in Wales Sector Adaptation Plan	2020	Complete
1	2020 Sector Adaptation Plan Actions and Activities #1 consultation survey	2020-21	Complete
1	2020 interim report of activity	2020-21	Published Summer 2022
2	2021 Sector Adaptation Plan Actions and Activities #2 consultation survey	2021-22	Complete
2	2021 Interim report of activity (this report)	2021-22	Published Summer 2022
3	2022 Sector Adaptation Plan Actions and Activities #3 consultation survey	2022-23	
3	2022 Interim report of activity	2022-23	
4	Full monitoring and evaluation report	2023-24	
5	Updated SAP	2024-25	

You can download the SAP Monitoring and Evaluation Framework, published in 2021, from the Cadw website

The HEG Climate Change Subgroup is charged with formally requesting and collating evidence of activity to help evaluate progress against the published actions, and to identify gaps and priority areas that require further attention.

This is the second interim report of activity covering the year 2021, as set out in the Monitoring and Evaluation Framework. It will help inform the formal monitoring and evaluation report that will be submitted to the Welsh Ministers in 2024.

This report describes the call for evidence and reviews it against the SAP action plan and *A Climate Conscious Wales* indicators (see section 2 for details of the indicators and actions). Selected case studies are included to illustrate a range of historic assets and adaptation activity that has been used to combat the risks of climate change. These are intended as examples of various projects; other equally important work is still ongoing.

You can download the Sector Adaptation Plan Monitoring: Interim Report of Activity: Year 1, 2020, from the Cadw Website.

2. Indicators and Actions

Indicators in Prosperity for All: A Climate Conscious Wales

Caring for the historic environment

HE1. Knowledge: Complete and publish the Historic Environment and Climate Change Sector Adaptation Plan.

HE2. Knowledge: Improve understanding of the threats and opportunities for the historic environment from a changing climate.

HE3. Capacity: Develop the methodologies, tools and guidance needed to build adaptive capacity.

HE4. Resilience: Increase resilience of the historic environment by implementing actions to respond and adapt to the risks.

Protecting our coasts and seas

MC1. Resilience: Improve the resilience of habitats and heritage in Wales's coastal zones from the impacts of climate change.

MC4. Knowledge: Carry out research to better understand the impact of climate change on marine ecosystems, ecosystem services and marine heritage.

Actions identified in the Historic Environment and Climate Change in Wales Sector Adaptation Plan

The headline actions in the SAP are grouped into seven themes under three overarching and linked objectives. Full details of the outputs and broad outcomes for each action are listed in the SAP table in section 4.

Knowledge: Increase our knowledge and understanding of the threats and opportunities for the historic environment from a changing climate

1. Knowledge exchange/collaboration

2. Mapping and monitoring the resource

3. Research priorities

Capacity: Develop the methodologies, tools and guidance to work with others and build adaptive capacity

4. Dissemination and promotion

5. Collaborative working

6. Training and guidance

Resilience: Increase resilience of the historic environment by implementing actions to respond and adapt to the risks

7. Taking action

3. Call for evidence

The HEG Climate Change Subgroup called for evidence for this report over a 4-week period between 21 January – 18 February 2022. This was an open invitation consultation, shared with a wide range of range of organisations including HEG and other delivery partners. Information was circulated via email and over social media, guiding people to the bilingual consultation, hosted on the Cadw website. Information included a PDF introducing the published SAP action table with examples of relevant activities captured in 2020, plus instructions on how to submit new evidence. An online survey form was provided for the submission of evidence.

Analysis of the survey responses shows that:

- 16 individuals associated with 17 organisations, groups and projects working in Wales responded.
- a mixture of public, private and third sector organisations, including universities, National Parks, large public bodies and charitable trusts submitted evidence
- respondents included those from officer to more senior levels within an organisation
- respondents included those operating at a national, regional and local level
- the responses provided evidence of activities across all 7 priority action areas as follows:
  1 Knowledge exchange/collaboration: 20 activities
  2 Mapping and monitoring the resource: 20 activities
  3 Research priorities: 21 activities
  4 Dissemination and promotion: 2 activities
  5 Collaborative working: 10 activities
  6 Training and guidance: 27 activities
  7 Taking action: 27 activities
- activities cover a broad spectrum of historic environment assets, landscapes and environments, resulting in new case studies from across Wales and the sector (see section 5).

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4. Progress against Sector Adaptation Plan actions

The table at the end of this section sets out the headline actions needed to adapt to the impacts of climate change on the historic environment of Wales. The activity column in the table captures individual activities undertaken in 2021 against these headline actions. Progress against each action is summarised below.

Knowledge exchange and collaboration

1.1: The publication of the SAP *Monitoring and Evaluation Framework* during 2021 has been significant. It has introduced focus and a framework for monitoring the progress of the SAP actions, as evidenced through the interim reports of activity for 2020 and 2021. These have not only helped assess SAP related actions and activities, but they have also provided an ongoing opportunity to raise awareness of the SAP. From this we see that the SAP is increasingly being incorporated into other organisation and project level plans, for example, the National Lottery Heritage Fund Environmental Sustainability Guidance.

Academic and professional dissemination also continues, notably through publishing in a peer reviewed journal (Barker *et al.* 2021) and through conference presentations. Whilst promotion and engagement remains limited by the capacity and resources of the HEG Climate Change Subgroup members, membership of this group has almost doubled, thus building capacity to a degree. Additional financial resources for the HEG Climate Change Subgroup to progress specialist areas, such as communications, would enable more beneficial activity to reach a wider and more diverse audience.

1.2 and 1.3: The use of existing active networks, partnerships, working groups and committees continues and is effective, with COP26 providing an important focus for collaborative activity during the year. Important progress to maximise knowledge and resources is continuing through Cadw's partnership work with Historic Environment Scotland, Historic England, English Heritage, National Trust and Communities Northern Ireland. The group's ongoing work in relation to Hazard Mapping (see Case Study 2) now fulfils the role of a spatial mapping group. The coordination of the Archaeology of Wales's Research Framework on Climate Change Adaptation, due for delivery during 2022 by the HEG Climate Change Subgroup, will bring multiple, mutual benefits for the SAP actions and research priorities.

More work now needs to be done to identify future research and funding opportunities, and the HEG Climate Change Subgroup has identified a need to engage more with the University Sector.

Mapping and monitoring

2.1: 2021 saw the continuation of projects focussed around improving baseline data, as evidenced in the 2020 interim report of activity, for example, CHERISH, the Carneddau Landscape Partnership Scheme and the Hazard Mapping project, which expanded during the year to include all UK government funded heritage agencies. The Welsh Archaeological Trusts also continued their work on the Cadw-funded survey of historic features associated with rivers and other fresh-water sources. (see Case Study 1).

New projects were also initiated, with the Royal Commission and the Glamorgan Gwent Archaeological Trust focussing their efforts in the coastal zone, and Snowdonia National Park Authority across areas of the park. Published reports by National Trust on Visitor and Climate Change and a research publication from Sheffield and York University (Cook *et al*. 2021) on a Landscape Vulnerability Framework using the Dysynni Valley in Gwynedd as a case study, contribute new evidence and understanding.

2.2: A number of targeted monitoring projects continued in 2021, for example, CHERISH and the Carneddau Landscape Partnership Scheme utilising the latest technologies to undertake monitoring,. Volunteer condition monitoring also continued across the National Parks in Wales. New targeted projects were initiated by Snowdonia National Park Authority on Conservation Areas within the Park and by the National Trust on mould monitoring in its historic collections.

Research priorities

3.1 and 3.2: An encouraging number of projects are continuing and underway looking at climate risk factors, and monitoring, recording and management of climate change loss across a range of heritage asset types and environments. Examples include work by CHERISH (see Case Study 3) and the Pembrokeshire Coast National Park in the marine and coastal zone; the built environment by the Cadw-hosted Welsh Government Climate Resilience Embedded Researcher (see Case Study 4); marginal and upland landscapes by the Carneddau project and the Brecon Beacon National Park volunteers, and designed landscapes, parks and gardens by a MA student from the University Wales: Trinity St Davids. Such focussed research remains a priority and there is a need to ensure that other types of historic assets and environments are covered e.g., farmland and woodland, and that university work is more adequately captured in evidence gathering.

3.3: The Carneddau project and other work in the Snowdonia National Park Authority will help improve our understanding of the positive and negative effects of a longer growing season on the maintenance and management of the historic environment.

3.4: Cadw's partnership work looking at hazard mapping, risk profiling and adaptation; the woodland planting by the Snowdonia National Park Authority, and the National Trust's Visitor

and Climate Change report provide evidence of how UKCP18 projections can be used to identify opportunities for the historic environment and the economy.

Dissemination and promotion

4.1. During 2021, the SAP *Monitoring and Evaluation Framework* was published and established that HEG acts as the steering group for work relating to climate change adaptation in the sector. It also set out the role and responsibility of the HEG Climate Change Subgroup, which includes collecting evidence on activities (the interim reports of activity), identifying areas of priority, establishing working groups and reporting back to HEG. The Framework also aligns with that of the Welsh Government's national adaptation plan *Prosperity for All: A Climate Conscious Wales.*

4.2. During 2021, the creation of a dedicated Climate Change Manager or equivalent for the historic environment sector in Wales continued to be an outstanding issue. However, during the year the National Trust initiated a climate adaptation core programme team, with the intention to roll out workshops across the National Trust in early 2022.

Collaborative working

5.1: Partnership working is evidenced in many activities against the headline actions. Work initiated by the HEG Climate Change Subgroup during 2021 (for completion in 2022) to develop a Communication Strategy will help this further. More work needs to be undertaken to help coordinate and encourage stakeholder engagement and partnership working.

5.2: The SAP is embedded in the Historic Environment section of the Welsh Government climate adaptation plan *Prosperity for All: A Climate Conscious Wales*, and Cadw continues in its role as heritage sector lead in the Welsh Government Core Internal Adaptation Group. Work by the Dyfed and Gwynedd Archaeological Trusts ensured that the SAP was also embedded in the Shoreline Management Plan refresh.

5.3: HEG Climate Change Subgroup members and other stakeholders continue to provide case studies, a selection of which are published as part of the interim report of activity for 2020 and this one for 2021 (see section 5). In 2022 these will all be made available through the Cadw website.

Training and guidance

6.1: Training has taken a number of forms over 2021; from larger publicly accessible conferences, including the Royal Commission's Digital Past conference and the CHERISH Coastal Cultural Heritage and Climate Change conference, to specific training delivered within, and for, HEG group members (Peat and the Historic Environment). Work is also underway to incorporate evidence from the Cadw-hosted Welsh Government Climate Resilience Embedded Researcher into training standards and guidance. More workshops and training are planned for 2022 including the National Trust's Climate adaptation core programme team. Activities during COP26 helped to raise the awareness of climate change issues more widely, however, this is still

an emerging area and work is needed to embed climate change considerations into all areas of historic environment work.

6.2: Evidence provided by HEG Climate Change Subgroup members showcased a range of events, which highlighted climate change adaptation to both government decision-makers and across other sectors. Examples included Cadw's involvement in the COP26 Climate Resilience Heritage Summit, and workshops for Welsh Government Housing Information Group and policy teams; as well as climate change themed conferences and archaeology days, such as the Pembrokeshire Coast National Park Archaeology Day, the Royal Commission's Digital Past conference and the Coastal Cultural Heritage and Climate Change conference organised by CHERISH.

Members are also routinely providing information and advice regarding the historic environment into policies and management plans, such as the Royal Commission's marine planning advice and the Brecon Beacons National Park Authority advice on land management strategies. Structured training has also been carried out with community groups and individuals to equip them with the skills to monitor historic environment assets, and accredited training is in development as part of the Carneddau project. Work is also underway to develop training standards and guidance specifically for the built environment through the Cadw-hosted Welsh Government Climate Resilience Embedded Researcher and the National Trust's adaptation programme.

6.3: Historic environment advice is evidenced over a variety of consultations, for example, the Shoreline Management Plan refresh, whilst new guidance is also in development through Cadw and the CHERISH project. Publication of new research by the National Trust, Natural Resources Wales and Sheffield/York University help increase the knowledge, understanding and resilience of the historic environment to climate change.

This is an evolving field which will need further input and resourcing to ensure that opportunities are taken to improve collaboration and ensure that the historic environment is embedded with other sectors.

Taking action

7.1: A number of emergency/adaptation plans were evidenced that include climate change impacts as part of the assessment at both a landscape and site-based scale. It is likely that many more plans and emergency actions are being put in place in response to risks and impacts that could also be regarded as adaptation. Key to the success of this action will be raising awareness of the need to embed climate change adaptation in all conservation management planning, as well as encouraging more reporting and sharing of good practice and difficulties encountered for broader learning across the sector. One step towards this in 2021 was work by the Department of Communities (Northern Ireland), which funded the creation of templates for an adaptation manual to be shared widely by the National Trust.

7.2: Three new place-based character assessments were published in 2021 covering the Dysynni Valley, Cwmbran and the Clwydian Range and Dee Valley Area of Outstanding Natural Beauty, whilst the Snowdonia National Park Authority continued with and initiated new landscape and urban conservation area assessments.

7.3: A wide range of activity was reported relating to historic assets at risk that include monitoring, excavation, mapping and research, assessment, repair and project work. This is an activity area that links closely with mapping, monitoring and research priorities, and delivers well on the overarching themes of increasing our knowledge and building our resilience.

7.4: Despite the pandemic, stakeholder and community groups were well considered and included within the projects reported by the three National Parks and CHERISH.

7.5: Improved management and resilience of trees as part of the historic environment and landscape was evidenced through continued work by the Carneddau project.

7.6: Adapting to new ways of working evidenced during 2020 continued in 2021, for example, reduced travel to meetings had benefits for the sector's carbon footprint by reducing emissions. Changing internal operational practices reflect the awareness and concern for future environmental sustainability as exampled by the continuing work of the Royal Commission's Future Generations Group.

Headline action table and evidence of activity for 2021

Details of any abbreviations and links to resources in the text can be found at the end of this report, sections 7 and 8.

Knowledge: Increase our knowledge and understanding of the threats and opportunities for the historic environment from a changing climate					
	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2021	CCW Indicator
1. Knowledge exchange/collaboration					
1.1	Dissemination, promotion and stakeholder engagement of the Historic Environment and Climate Change Sector Adaptation Plan. For example: • Communication Strategy. • Stakeholder engagement with politicians and senior decision-makers. • Monitor and evaluate strategy.	• Publication of the Historic Environment and Climate Change Sector Adaptation Plan. • Secured resources and practical actions to deliver the plan.	• Raised awareness of the challenges posed by climate change on the historic environment. • Direct action to improve our knowledge, build capacity and increase the resilience of the historic environment to climate change. • Provision of a strategic framework to take forward adaptation actions.	• HEGS – SAP Monitoring and Evaluation Framework published June 2021 (see 4.1, 5.1). • HEGS – SAP Action Plan activity survey for 2020 initiated and closed January 2021. • HEGS – SAP Action Plan activity survey 2020 interim report drafted with new case studies written. To be published Spring 2022. • HEGS – Paper published in an international journal. Barker, L., Bullen, J., Davidson, A., Fairweather J., & Laws, K. (2021): Climate Change and the Historic Environment in Wales. Developing and Delivering a Sector Adaptation Plan, The Historic Environment: Policy & Practice, DOI: 10.1080/17567505.2021.1944574 • HEGS – Work initiated on a Communication Strategy. To be published 2022. (see 5.1-2) • HEGS – Membership grew from 6 to 11 organisations - Cadw, NRW, RCAHMW, GAT, NT, PCNPA, SNPA, GGAT, DAT, CPAT, AC-NMW. • RCAHMW – Contribution to delivery of the SAP incorporated into Operation Plan and reported against. • RCAHMW and partners – CHERISH project. Contribution to delivery of the SAP incorporated into project initiatives and workplan. • RCAHMW and partners – CHERISH project e-conference May 2021. HEGS invited and SAP was a topic for presentation. Available here. • BBNP – Inclusion of SAP within draft Historic Environment Action Plan. • NLHF – SAP is signposted in the NLHF Environmental Guidance, updated Feb 2021	• HE1
1.2	Establish a knowledge exchange group(s) for researchers and practitioners to share ideas, information and good practice, and to help identify future research and funding opportunities in Wales. For example: • Establish a climate and heritage management group. • Establish a spatial mapping group.	• Knowledge exchange group(s) established and active. • Identification of future research priorities for Wales.	• A coordinated approach, maximising knowledge and resources, leading to capacity building and more successful adaptation.	• HEGS, WATs, Cadw – Exchange group initiated, and meetings held to discuss Cadw funded WAT projects. • HEGS – Initiated the establishment of a Peatland Working Group, led by Cadw. • HEGS – agreed to coordinate Climate Change Adaptation theme for the Research framework for the Archaeology of Wales which will identify future research priorities, to be progressed 2022. • SNPA – Welsh Peatlands Sustainable Management Scheme funded full time Research Hub Coordinator (Swansea University) to build research capacity and identify research priorities (see 3.1). *Continuation from 2020 activity* • SNPA – Participation in ECOTWIN (EU Green Deal) application via Living Wales scheme (assessing climate change impacts on Natura 2000 sites via modelling using remote sensing data). *Continuation from 2020 activity.*	• HE2 • MC4
1.3	Participation from Wales in established UK and wider climate heritage groups and networks. For example: • Fit for the Future network. • Historic Environment Adaptation working group. • Climate Heritage Network.	• Welsh attendance at climate heritage groups and networks.	• Collaborative working maximising knowledge and resources, leading to capacity building and more successful adaptation.	• Cadw – Continues to build on its partnership with HES, HE, EH, NT and Communities NI. Completed or on-going activities including COP26 Summit (see 6.1) Hazard Mapping (see 2.1, 3.4)), Risk Profiling and Adaption Manual. • Cadw – joined the Climate Heritage Network • RCAHMW – continue as members of the Fit for the Future and Climate Heritage Network • RCAHMW and partners – CHERISH project participated and liaised with other networks and bodies in relation to climate change and coastal heritage e.g., SCAPE, CITiZAN, FPAN. Events in 2021 included a range of events and films for COP26 e.g. #ClimateHeritage Stories. CHERISH work was also featured in a Channel 4 News special report and ITV Wales Coast and Country.	• HE2 • MC4

	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2021	CCW Indicator
2. Mapping and monitoring of the resource					
2.1	Improving baseline data. Develop standardised methodologies and assessment tools to both identify historic assets and prioritise those at risk. For example: • Wales spatial mapping work including environment/asset specific mapping and analysis. • Data enhancement programmes. • Use of soil moisture indexes to target aerial reconnaissance during dry periods.	• Improved baseline data sets. • Improved consistency and comparability of data. • Publicly available and regularly updated central repository of spatial mapping datasets.	• Improved understanding of the threats and opportunities for the historic environment from a changing climate. • Improved evidence base for monitoring, statutory protection, decision-making and adaptation strategies.	• RCAHMW – Ensuring that the maritime and coastal elements of the national monuments record are up to date and continuing to be enhanced. • RCAHMW – Met Office soil moisture indexes purchased annually for targeted aerial reconnaissance programme. • Cadw – Continues to build on its partnership with HES, HE, EH, NT and DoC (NI). Completed or on-going activities including Hazard Mapping (see 2.1, 3.4), Risk Profiling and Adaption Manual.(see 1.3) • DAT, GAT, CPAT – Initiation of Cadw funded rivers and riparian environments -historic environment record enhancement project. • GGAT – Coastline data historic environment record enhancement and GIS project covering area between Wye and Usk rivers to assist management recommendations going forward. • SU, YU – Research publication with case study Dysynni Valley, Gwynedd: by Isabel Cook, Robert Johnston & Katherine Selby (2021) Climate Change and Cultural Heritage: A Landscape Vulnerability Framework, The Journal of Island and Coastal Archaeology, 16:2-4, 553-571, DOI: 10.1080/15564894.2019.1605430 (see 2.2, 6.3, 7.2) • RCAHMW and partners – CHERISH project continues. Targeting specific study areas in coast zone (includes seabed, intertidal, island and coast edge environments) to improve baseline data through technologies such as lidar, UAVs, GNSS, terrestrial laser scanning, marine survey for baseline and condition/change monitoring of coast zone. Includes data enhancement and archiving of freely available data and event reporting of project work to NMRW as central repository of data. (see 2.2, 3.1-2, 6.3, 7.3-4) • SNPA – Carbon Scrutiny group has been established to evaluate strategic policies. Alongside other Welsh NPs a system for establishing Carbon emission baselines is being implemented and a Carbon Strategy is planned. • SNPA – Started a new project to manage and enhance Snowdonia's 14 Conservation Areas. The project will ensure sustainable conservation can enhance Conservation Areas to the future (see 2.2, 7.2). • SNPA – Carneddau Landscape Partnership Scheme continues. Using innovative methods to map, monitor and reveal historic environment assets e.g., LiDAR and Lost farmsteads Project (see 2.2, 3.1-3, 6.2, 7.1-5). • NT – Visitor and Climate Change report, summary published on NT website 2021 (see 3.4, 6.3).	• HE2 • MC4
2.2	Establish and implement targeted monitoring regimes on identified historic assets. For example: • Develop and publish case studies to outline different monitoring approaches to ensure consistency of data and approach. • Establish online/mobile application to record incidents/ impacts e.g. of pests and disease. • Establish a link to scheduled monuments and listed buildings at risk monitoring work.	• Targeted monitoring programme and condition data. • Best-practice guidance document/technical notes for monitoring assets at risk drawing on case studies.	• Improved understanding of the threats for the historic environment from a changing climate. • Provision of data for historic assets to assist the development of management strategies and prioritisation.	• PCNPA – Continues to monitor the condition of scheduled monuments within the National Park using volunteers (system set up in 2020). (see 3.1-2, 7.4) • PCNPA – Continuation of Changing Coasts project using fixed point photography. Communities/public submit photographs at specific coastal path points to monitor change and erosion (see 3.1-2, 7.3-.4). • RCAHMW – Inter-tidal zone focussed work. Developing methodologies to allow us to monitor sites (see 7.3). • BBNP – Continuation of volunteer condition monitoring programme ongoing (see 3.1-2, 7.4) • SU, YU – Research publication with case study Dysynni Valley, Gwynedd: by Isabel Cook, Robert Johnston & Katherine Selby (2021) Climate Change and Cultural Heritage: A Landscape Vulnerability Framework, The Journal of Island and Coastal Archaeology, 16:2-4, 553-571, DOI: 10.1080/15564894.2019.1605430 (see 2.1, 6.3, 7.2) • RCAHMW and partners – CHERISH project continues. Repeat monitoring of case-study sites, installation of permeant survey markers (aligned and working with WCMC methodologies) and procedures for comparison of datasets to improve consistency and comparability of data (see also 2.1, 3.1-2, 6.3, 7.3-4). • SNPA – Started a new project to manage and enhance Snowdonia's 14 Conservation Areas. The project will ensure sustainable conservation can enhance Conservation Areas to the future (see 2.1, 7.2). • SNPA – Carneddau Landscape Partnership Scheme continues. Includes monitoring of assets with volunteers and general public (e.g. fixed point monitoring) (see 2.1, 3.1-3, 6.2, 7.1-5). • NT – Framework established to record and monitor mold in historic collections against local and regional environments, and against recorded climate changes as part of the Taking Control of Mold project.	• HE2 • MC4

	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2021	CCW Indicator
3. Research priorities					
3.1	Improve understanding of the interacting and cascading relationships, and cumulative impacts of climate risk factors. For example: • Building condition, location and socio-economic factors. • Changing land use and redundancy of agricultural buildings resulting in a cumulative loss of historic landscape features and changed settings. • Increases in invasive species that may impact on historic assets. • Acidification of seawater and increase in marine species which pose potential threats to wrecks/timber structures in marine conditions. • Measures to address chronic and acute pollution from historic mining. • Risks to building fabric from increased humidity, moisture, wind and driving rain, and the knock-on impact on indoor air quality and the health of building occupants. • Cumulative impact of successive extreme weather events on historic assets. • The frequency, range and potential regional variations of extreme weather events and their impact on the historic environment.	• Reports and recommendations.	• Adaptive actions take inter-relationships and cumulative impacts into account, thereby minimising the potential for maladaptation, leading to improved management of historic assets and the creation of best-practice guidance.	• PCNPA – Monitoring the condition of scheduled monuments within the National Park using volunteers (system set up in 2020). (see 2.2, 7.4, 3.2) • PCNPA – Continuation of Changing Coasts project using fixed point photography. Communities/public submit photographs at specific coastal path points to monitor change and erosion (see 2.2, 3..2, 7..3-.4).. • UWTSD – Michael Norman (MA Student) studying the management of climate change loss in Welsh historic parks and gardens. • Cadw – Hosting Welsh Government funded Climate Resilience Embedded Researcher investigating the risks and adaptation of buildings. Findings have helped inform the new WHQS, as well as training standards and emerging guidance (see 6.1-3). • Private Company – Specialist supply and consultancy in historic and vernacular buildings, working with the dual challenges of upgrading thermal performance of buildings, whilst not compromising their capacity to deal with climate changes - in particular warmer and wetter futures. • BBNP – Continuation of volunteer condition monitoring programme (see 2.2, 3..2, 7.4). • RCAHMW and partners – CHERISH project continues. Targeting specific study areas in coast zone (includes seabed, intertidal, island and coast edge environments) to improve baseline data and monitor sites through technologies such as lidar, UAVs, GNSS, terrestrial laser scanning, marine survey for baseline and condition/change monitoring (see 2.1-2, 3.2, 6.3, 7.3-4). • SNPA – Life Celtic Rainforests Project leading on methods to tackle invasive species. • SNPA – Carneddau Landscape Partnership Scheme continues. Using innovative methods to map, monitor and reveal historic environment assets e.g. 2020 LiDAR and Lost farmsteads Project (see 2.2, 3.2-3, 6.2, 7.1-5). • SNPA – Importance of palaeoenvironmental record and ecofacts vulnerable to climate change/conditions. HLF funded Cyfoeth Ein Corsydd and Carneddau Peatland Science project (see 1.2). *Continuation from 2020*	• HE2 • MC4
3.2	Research to improve knowledge of past and present climate change impacts on historic assets e.g. decay/erosion/accretion.	• Research results, case studies and recommendations.	• Increased understanding of stages, timescales and outcomes leading to improved management and adaptation interventions to build resilience.	• PCNPA – Monitoring the condition of scheduled monuments within the National Park using volunteers (system set up in 2020). (see 2.2, 7.4, 3..1). • PCNPA – Continuation of Changing Coasts project using fixed point photography. Communities/public submit photographs at specific coastal path points to monitor change and erosion (see 2.2, 3..1, 7..3-.4). • BBNP – Continuation of volunteer condition monitoring programme ongoing (see 2.2, 3..1, 7.4). • RCAHMW and partners – CHERISH project continues. Includes core sampling and dating (OSL and C14) to providing information on past changing climates and environments, map regression and documentary research highlighting recent impacts (see 2.1-2, 3.1, 6.3, 7.3-4). • SNPA – Carneddau Landscape Partnership Scheme continues. Skylines project raises awareness of montane heath, prehistoric cairns and the relationship between climate change, landscape, vegetation and human impact across millennia.	• HE2 • MC4
3.3	Improve understanding of the positive and negative effects of a longer growing season on the maintenance and management of the historic environment.	• Report and recommendations.	• Improved long-term adaptation and maintenance programmes.	• SNPA – Carneddau Landscape Partnership Scheme continues. Skylines project strand (see 3.2). • SNPA – Opportunities to contribute and feed results of Carneddau vegetation management and monument condition monitoring into studies. *Continuation from 2020 activity.* • SNPA – Opportunities for partnership working e.g. our contacts with Henfaes research farm, Bangor Univ., and their medium and long term research on aspects of diverse aspects of land management including climate impacts. *Continuation from 2020 activity.*	• HE2 • MC4

3.4	Work with UKCP18 projections to identify opportunities for the historic environment and the economy e.g. planting of woodland and forestry; establishment of new industries relating to adaptation; changing leisure opportunities; increased use of UK coastal resorts.	• Identification of opportunities.	• A combined beneficial response to adaptation will encourage uptake and identification of new opportunities, including tourism investment.	• Cadw – Continues to build on its partnership with HES, HE, EH, NT and Communities NI. Completed or on-going activities including Hazard Mapping (see 2.1, 3.4), Risk Profiling and Adaption Manual (see 1.3). • SNPA – Facilitating woodland planting by identifying areas of little risk to heritage assets and suitable in relation to historic landscape character. *Continuation from 2020 activity.* • NT – Visitor and Climate Change report, summary published on NT website 2021 (see 2.1, 6.3)	• HE2

Capacity: Develop the methodologies, tools and guidance to work with others and build adaptive capacity CCW Indicator					
	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2021	CCW Indicator
4 Dissemination and promotion					
4.1	Creation of a steering group to oversee the delivery of the HEG SAP and to monitor and review progress. The steering group will establish and coordinate working/subgroups as necessary.	• Steering group formed from representatives within Wales.	• The provision of a strategic framework through which the action plan is delivered.	• HEGS – SAP Monitoring and Evaluation Framework published June 2021 (see 1.1, 5.1).	• HE3
4.2	Creation of a dedicated (full-time equivalent) Climate Change Manager post for the historic environment sector in Wales.	• Climate Change Manager in post.	• Direct action to help steer and guide the delivery of the HEG SAP and to play a central role in raising the profile of the climate change work across the historic environment sector in Wales.	• NT – Climate adaptation core programme team initiated 2021, workshops rolling out across NT Jan 2022 onwards. (see 6.1 -2).	• HE3

	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2021	CCW Indicator
5. Collaborative working					
5.1	The steering group to coordinate and encourage stakeholder engagement and promote partnership working to ensure efficient use of resources across sectors.	• Cross-sector partnerships and coordinated working will ensure resources are targeted effectively and efficiently.	• Effective delivery of the HEG SAP actions. • Raised awareness of the historic environment across the wider sector which will help prevent secondary damage and maladaptation to the historic environment. • Improved cross-sector working.	• HEGS –Work initiated on a Communication Strategy. To be published 2022. (see 1.1, 5.2) • HEGS – SAP Monitoring and Evaluation Framework published June 2021 (see 1.1, 4.1). • RCAHMW and partners – CHERISH project works cross-sector and with a variety of stakeholders and partners. • Cadw – Continues to build on its partnership with HES, HE, EH, NT and Communities NI.	• HE3
5.2	The steering group/working group to work with officials across Wales to embed the HEG SAP in national and local government policy statements, plans and codes	• The historic environment will feature in the Welsh Government Climate Change Adaptation Plan for Wales. • The HEG SAP considerations will be linked and noted in, for example: – Shoreline Management Plans. – Relevant Planning Policy Wales supplements.	• Help prevent secondary damage and maladaptation to the historic environment.	• Cadw/WG – the SAP is embedded in the WG adaptation plan, Prosperity for all: A climate conscious Wales. Cadw continues in its role as heritage sector lead in the WG Core Internal Adaptation Group. Activities include reporting progress against the actions in the SAP and WG adaptation plan, and promoting cross-sector engagement and collaborative working across WG policy teams. • HEGS – Work initiated on a Communication Strategy. To be published 2022 (see 1.1, 5.1). • DAT & GAT contributed to the Shoreline Management Plan (SMP) refresh in 2021– ensuring SAP referenced in SMPs. (see 6.3) •	• HE3
5.3	Provide, promote and maintain a publicly available case study resource to illustrate climate change risks and impacts affecting the historic environment and examples of adaptation. All should be able to contribute to this resource.	• Case study resource.	• Raised awareness of the challenges posed by climate change and adaptation on the historic environment. • Demonstration of a range of practices and evidence of direct action.	• HEGS – Case studies resulting from 2020 activity survey written due to be published 2022. • RCAHMW and partners – CHERISH project study sites provide case study resources showcased on website, leaflets, through talks, blogs, CHERISH on-line 'chats', the travelling exhibition and films. • NT – Climate change adaptation case studies for coast (Dinas Dinlle, Gwynedd) and buildings (Porthdinllaen, Gwynedd) produced.	• HE3

	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2021	CCW Indicator
6. Training and guidance					
6.1	Identify and support the training of historic environment practitioners specialising in the impacts of climate change and adaptation of the historic environment.	• Trained climate change historic environment practitioners.	• Raising standards to embed climate change considerations in the historic environment.	• Cadw – Hosting Welsh Government funded Climate Resilience Embedded Researcher investigating the risks and adaptation of buildings. Findings have helped inform the new WHQS, as well as training standards and emerging guidance (see 3.1, 6.2-3). • Cadw – Continues to build on its partnership with HES, HE, EH, NT and Communities NI. Completed or on-going activities including COP26 Summit (see 6.1) Hazard Mapping (see 2.1, 3.4), Risk Profiling and Adaption Manual. (see 1.3). • NRW – Delivered an introductory training session on peat and historic environment (including impacts climate change) to Cadw, WATs and NP archaeologists. • GGAT – Staff have attended various training events and conferences. • RCAHMW – Digital Past online conference 8-12 February 2021. Themes covered 'Digital Heritage, the Environment and Climate Change". Available here (see 6.2). • RCAHMW and partners – CHERISH project's online e-conference on Coastal Cultural Heritage and Climate Change 12 May 2021. Available here (see 6.2). • NT – Climate adaptation core programme team initiated 2021, workshops rolling out across NT Jan 2022 onwards. (see 4.2, 6.2).	• HE3
6.2	Climate change historic environment practitioners to provide training and support within and across sectors in the impacts of climate change and adaptation of the historic environment. For example: • Produce an e-learning module on the historic environment and climate change. • Organise slots at meetings, training events and workshops with other sectors.	• Planners and developers can advise authoritatively through pre-application advice e.g. on the design and implementation of adaptation proposals. • Grant officers can ensure changes and adaptation actions are sensitive to the historic environment. • Owners can identify and implement management and adaptation opportunities. • Community groups established to develop programmes to identify, monitor and record historic assets at risk.	• Raised standards to embed climate change considerations in the historic environment. • Improved cross-sector working, knowledge and understanding, decision-making and the quality of adaptation actions.	• PCNPA and PLANED delivered Archaeology Day 2021 virtually and this included climate change themed content, such as talks about the St Patrick's Chapel and Caerfai Promontory Fort excavations and CHERISH videos. Available here. • RCAHMW – Provision of Marine Planning Advice for Marine Development to ensure that coastal/offshore development does not cause further impact on our cultural heritage. (see 6.3). • Cadw – Hosting Welsh Government funded Climate Resilience Embedded Researcher investigating the risks and adaptation of buildings. Findings have helped inform the new WHQS, as well as training standards and emerging guidance. Stakeholder dissemination and engagement activities included a cross-sector seminar and two workshops, and presentations to the Climate Resilience Heritage Summit, WG Housing Information Group and various key WG policy teams.. (see 3.1, 6.1, 6.3). • Cadw – Continues to build on its partnership with HES, HE, EH, NT and Communities NI. Completed or on-going activities including COP26 Summit (see 6.1) Hazard Mapping (see 2.1, 3.4), Risk Profiling and Adaption Manual.(see 1.3) • RCAHMW – Digital Past online conference 8-12 February 2021. Themes covered 'Digital Heritage, the Environment and Climate Change". Available here (see 6.1). • BBNP – Response and input to consultations for developing land management strategies, woodland creation, riparian improvements, peatland restoration (see 6.3). • RCAHMW and partners – CHERISH project work with community groups and individuals to monitor and records assets at risk (see 7.4). • SNPA – Carneddau Landscape Partnership Scheme continues. Plans for accredited training in recording and monitoring of historic assets e.g., with Agored Cymru and Conwy Culture Centre. Establishment of community heritage volunteer groups and opportunity to share good practice to seminars/conferences with e-resources (see 2.1-2, 3.1-3, 7.1-5). • NT – Climate adaptation core programme team initiated 2021, workshops rolling out across NT Jan 2022 onwards. (see 4.2, 6.1).	• HE3
6.3	Work collaboratively across sectors to develop and disseminate joint guidance/ advisory notes that increase the knowledge, understanding and resilience of the historic environment to climate change.	• Guidance/advisory notes produced and promoted. • Inclusion of climate change adaptation into all aspects of heritage management. • Heritage management and business plans with climate change adaptation embedded.	• Improved cross-sector working, knowledge and understanding, decision-making and the quality of adaptation actions. • Prevention of secondary damage and maladaptation to the historic environment. • Improved management of the historic environment.	• RCAHMW – Provision of Marine Planning Advice for Marine Development to ensure that coastal/offshore development does not cause further impact on our cultural heritage. (see 6.2). • BBNP – Response and input to consultations for developing land management strategies, woodland creation, riparian improvements, peatland restoration (see 6.2). • Cadw – Hosting Welsh Government funded Climate Resilience Embedded Researcher investigating the risks and adaptation of buildings. Findings have helped inform the new WHQS, as well as training standards and emerging guidance (see 3.1, 6.1-2). • DAT & GAT contributed to the Shoreline Management Plan refresh in 2021– ensuring SAP referenced in SMPs. (see 5.2)	• HE3

		• Management practices undertaken that showcase climate change adaptation.	• A well-managed and appropriate programme of adaptation measures.	• NT – Visitor and Climate Change report, summary published on NT website 2021 (see 2.1, 3.4). • NRW – South West Area Statement historic and natural environment completed and published. Working with DAT and Cadw this includes section on climate change related risks. • SU, YU – Research publication with case study Dysynni Valley, Gwynedd: by Isabel Cook, Robert Johnston & Katherine Selby (2021) Climate Change and Cultural Heritage: A Landscape Vulnerability Framework, The Journal of Island and Coastal Archaeology, 16:2-4, 553-571, DOI: 10.1080/15564894.2019.1605430 (see 2.1, 7.2). • RCAHMW and partners – CHERISH project best practice guidance documents on monitoring change in the coastal zone to be published 2022 (see 6.3 see 2.1-2, 3.1-2, 7.3-4). *Update to 2020 response.* • SNPA – raise the importance of cross-referencing with natural heritage too. Cynllun Eryri is taking a 'place plan approach' to assessments, including natural, historical and intangible. • NLHF – Environmental sustainability guidance published May 2020, updated Feb 2021 notes both SAP and Cadw flooding guidance.	

Resilience: Increase resilience of the historic environment by implementing actions to respond and adapt to the risks					
	Description of the action	Output(s) from the action	Broad outcome/impact	Activity 2021	CCW Indicator
7. Taking action					
7.1	Prepare and implement emergency/adaptation plans (utilising the principles and methods developed for conservation management plans) for vulnerable areas or sites as identified in 2.1 and 2.2. Plans to include multiple work streams if several agencies have identified the need for adaptation measures.	• Identification of significance, threat, vulnerability and adaptive action. • Partnership working with all agencies.	• The prioritisation and effective management of resources.	• RCAHMW and partners – CHERISH project management plans for principal study sites in progress. • RCAHMW – Has a priority recording and at-risk recording programme/strategy to respond to emergency. • SNPA – Carneddau Landscape Partnership Scheme continues. Landscape Conservation Action Plan (5 years) 23 partners, includes vegetation management programme focused on heritage assets (see 2.1-2, 3.1-3, 6.2, 7.2-5). • NT – Climate change adaptation ambitions embedded in NT Climate and Environmental Management System for in hand buildings and land (working towards external accreditation ISO 14090). • DfC (NI) – funded the creation of the templates for an adaptation manual which will be on NT website as a list of chapters (e.g. archaeology), with sections on how climate impacts this area, and key themes around need for adaptation to be developed and updated into the future.	• HE4
7.2	Undertake programme of landscape and urban characterisation to inform management of change in both rural and urban areas.	• Produce characterisation reports for areas at risk, and feed results into conservation management plans	• Improved conservation and management of change.	• CRDV AONB & NRW – Landscape and Nature Recovery in a Changing Climate Guide completed and published. • RCAHMW – Cwmbran characterisation report published available as a free download. • SU, YU – Research publication with case study Dysynni Valley, Gwynedd: by Isabel Cook, Robert Johnston & Katherine Selby (2021) Climate Change and Cultural Heritage: A Landscape Vulnerability Framework, The Journal of Island and Coastal Archaeology, 16:2-4, 553-571, DOI: 10.1080/15564894.2019.1605430 (see 2.1, 6.3). • SNPA – Started a new project to manage and enhance Snowdonia's 14 Conservation Areas. The project will ensure sustainable conservation can enhance Conservation Areas to the future (see 2.1-2). • SNPA – Carneddau Landscape Partnership Scheme continues. Landscape Character Assessments produced informing Landscape Conservation Action Plan (see 2.1-2, 3.1-3, 6.2, 7.1-5).	• HE4
7.3	Prioritised work programmes relating to historic assets at risk such as those identified through 7.1, spatial mapping work (2.1), baseline monitoring (2.2) and through other local and national adaptation plans e.g. shoreline management plans. Where possible to be preceded by a management plan. Direct actions could range from survey, record and monitoring through to maintenance and conservation measures, erosion control or moving significant vulnerable assets to a place of safety.	• Work programmes underway. • Improved protection and preservation of historic assets. • Improved management of historic assets.	• Mitigation and improved resilience of the historic environment. • Acceptance of inevitable change. • Partnership working and cross sector coordinated response.	• RCAHMW and partners – CHERISH project. Alongside survey and monitoring, work undertaken at several 'at risk' coastal sites, e.g. excavation at Dinas Dinlle, Gwynedd with GAT, NT and Cadw, and Caerfai Promontory Fort, Pembrokeshire with DigVentures, NT, PCNP and a wreck dive on the Bronze Bell with MSDS marine (7.2 see 2.1-2, 3.1-2, 6.3,7.4). • DAT, PCNPA and partners Ancient Connections Project – excavation at St Patricks Chapel, Pembrokeshire • DAT – Excavation of Porth y Rhaw Promontory Fort, Pembrokeshire with Cadw funding and PCNP support. • PCNPA – Continuation of Changing Coasts project using fixed point photography. Communities/public submit photographs at specific coastal path points to monitor change and erosion (see 2.2, 3.1-2, 7.4). • RCAHMW – Inter-tidal zone focussed work. Developing methodologies and undertaking work to allow us to monitor sites (see 2.2). • BBNP – Active conservation management at a number of historic sites to manage and improve condition e.g. Peatlands Programme Historic Environment Assessment. Continuation of restoration work at Waun Fignen	• HE4 • MC1

				Felin, commissioning a palaeoenvironment assessment to improve understanding of evidence baseline & published environmental record pertaining to the park. • SNPA – Carneddau Landscape Partnership Scheme continues (see 2.1-2, 3.1-3, 6.2, 7.1-5).	
7.4	Establish stakeholder/community groups able to monitor assets and respond to significant events such as wild fires and storms to maximise the potential for the discovery of new historic assets and the recording and monitoring of them.	• Stakeholder/community groups established. • Monitoring regimes in place.	• Improved knowledge, management and resilience of the historic environment. • Raised awareness and appreciation of the historic environment.	• PCNPA – Monitoring the condition of scheduled monuments within the National Park using volunteers (system set up in 2020) (see 2.2, 3..1-2). • PCNPA – Continuation of Changing Coasts project using fixed point photography. Communities/public submit photographs at specific coastal path points to monitor change and erosion (see 2.2, 3..1-2, 7..3). • BBNP – Continuation of volunteer condition monitoring programme ongoing (see 2.2, 3..1-2). • RCAHMW and partners – CHERISH project work with community groups and individuals to monitor and records assets at risk (see 6.2). • SNPA – Ardudwy community groups, community engagement in Dolgellau monitoring fulling mills on the Aran. • SNPA – Carneddau Landscape Partnership Scheme continues to help people discover, record, celebrate and care for the cultural and natural heritage of the Carneddau (see 7.1, 7.2, 7.3).	• HE4 • MC1
7.5	Encourage and implement new planting regimes where trees and hedgerows form a key component of the historic environment to reduce the impact of the spread of disease and increased storminess.	• New planting regimes that are responsive to plant health trends and are of suitable provenance. • The preservation of traditional field boundaries.	• Reduced impact of the spread of diseases and storms. • Improved management and resilience of trees in the historic environment. • Retention and survival of historic character and integrity.	• SNPA – Carneddau Landscape Partnership Scheme continues. Carneddau Connectivity National Grid Landscape Enhancement Initiative for more hedges and trees in better condition to cope with change and disease appropriate to the historic landscape, heritage assets and traditional local styles. • SNPA – Carneddau Landscape Partnership Scheme continues. Carneddau uplands riparian and scattered tree planting to help slow down water flow. Peatland repair. Reducing flooding along watercourses near assets.	• HE4
7.6	Build a resilient recovery from the COVID-19 pandemic.	• Organisational climate and sustainability plans, policies and actions.	• New ways of working that reduce emissions and prepare for climate change.	• RCAHMW – Established a Future Generations Group and an Environmental Policy Statement May 2020, work here continues.	• HE4

5. Case studies

The following selection of case studies present evidence that adaption activity was already well underway during the review period at a variety of historic assets in Wales. We intend to feature further case studies in future reports.

You will be able to download SAP monitoring and evaluation reports and case studies from the Cadw website

Each case study sets out the risk or opportunity and the adaptation activity. The codes refer to the risks identified in the SAP (Tables 1 and 2, pages 8-11), the headline adaption actions in the SAP and the indicators in *A Climate Conscious Wales*, as set out in Section 2 of this report.

We hope these examples will inspire all stakeholders in our historic environment to review and implement appropriate adaptation action in response to the threats and opportunities posed by climate change.

CASE STUDY 1: Rivers, Canals, Freshwater

Heritage Management of Rivers- Enhancing the Historic Environment Record

Risks

- More flooding events, increased ground moisture and precipitation, FL1
- Frequent high winds, storms and heat/cold events, EX1
- Rise in sea level, SL1, SL2

Management of the historic environment, both predictive and reactive, is reliant upon our knowledge of the extent of the archaeological resource. This resource is made accessible through the Historic Environment Records maintained by the Welsh Archaeological Trusts. Features associated with rivers and canals reflect many aspects of previous history, relating to water and land transport, energy, weirs, fish traps, mills and water extraction. These features are crucial to our understanding of the historic environment, and damage to, or loss of, these features affects the integrity of entire historic landscapes. Effective management is made difficult by the lack of inclusion of many of these features within the Historic Environment Record.

Adaptation Action

- Knowledge: 2 Mapping and monitoring of the resource, HE2
- Capacity: 5 Collaborative working, HE3
- Resilience: 7 Taking action, HE4

The four Welsh Archaeological Trusts are carrying out a joint programme of work funded by Cadw, to identify and map features associated with rivers, and those that could be impacted upon by flooding events and associated remedial action. The results of these projects will be added to the Historic Environment Records, which will contribute to improved management of the resource. The Trusts will be working across several sectors, including local authorities, Rivers Trusts, Cadw and other organisations to ensure full collaboration. This cross-sectoral work will be further enhanced through the results of archaeological assessments undertaken in advance of flood defence works and other development. The mapping of the resource will ensure appropriate advice can be provided in advance of any works, and that further programmes of more intensive survey and recording can be targeted.

A small weir designed to create a pool associated with an adjoining fulling mill. Partially damaged by river cleaning, and not immediately obvious, but its inclusion as a site on the Historic Environment Record means its presence will be recognised during future works (top).

Although the 18th century bridge is a Listed Building, less well known is a ford which runs alongside, and which led to a Roman fortlet and later medieval *llys* or court. Finds of Roman date have been found associated with the ford. Both ford and associated trackways are significant elements within the early landscape (bottom).

CASE STUDY 2: The Historic Environment

Climate Hazard Mapping

Risks

- Any of the predicted outcomes of climate change on the historic environment

The National Trust knows that the effects of climate change will impact on their land and properties. To adapt, the Trust needs to understand the present and consider the future to identify the potential climate hazards that it could be facing. These hazards translate into the vulnerabilities and possible impacts not only to the Trust's land and properties, but also on its own activities and those of others who use the National Trust's sites and resources. Climate hazards are many and interconnected.

Adaptation Activity

- Knowledge: 1 Knowledge exchange and collaboration, 2 Mapping and monitoring the resource, 3 Research priorities, HE1, MC4
- Capacity: 5 Collaborative working, 6 Training and guidance, HE3
- Resilience: 7 Taking action, HE4, MC1

To achieve this insight to the future, the National Trust has identified a need to bring together derived climate hazard data products, including climate risk data derived from the Met office Climate projection data UKCP18.

The challenge is that many of these data products, for example Centre for Ecology & Hydrology Flood uplift data or British Geological Society GeoSure data, are developed independently of each other and not designed to be viewed through a single portal. For heritage managers, understanding the threats these climate hazards and combined hazards pose to a site is critical in order to make informed adaptation choices.

Working with consultants, the Trust has brought together a set of climate change spatial data sets including the Met office UKCP18 and the British Geological Society GeoSure data. The methodology is based on the approach of Adaptation Scotland's Five steps to Managing your Climate Risks.

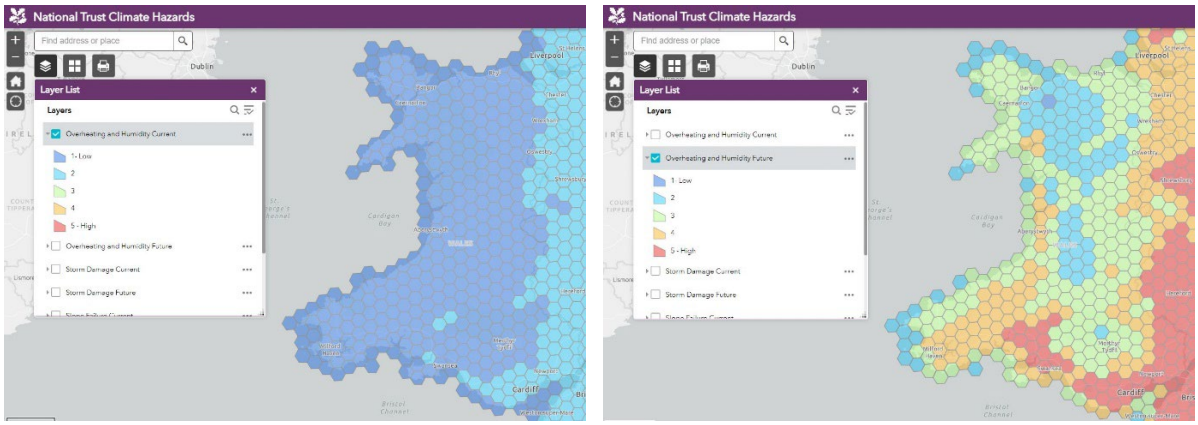
You can download Five Steps to Managing your Climate Risks. A Guide for Public Bodies in Scotland here.

The output from this approach is not a decision tool. Instead, it provides a flag to decision-makers to identify those areas that are most threatened by these changes in climate factors, for example, landslides, soil heave, etc. which require more investigation. Each site, with its many features and assets, is unique and factors such as condition and significance need to be considered in any decision-making approach to achieve the appropriate adaptation response.

The mapping approach is based on 'difference' mapping: it starts with the question, 'what are climate factors like today in 2020?' and 'what will those factors look like in 2060 in a worst-case scenario?' The initial work is being enhanced through partnership working with the UK heritage regulators and other partners. Cadw, for example, has been building on the base maps for Wales by adding 16 hazards to the suite already compiled. The National Trust also worked with Historic Environment Scotland to ensure the hazard map could be read across all four nations, making the map useful for all caretakers of historic places throughout the UK.

This approach is unique in the UK because it is designed essentially from a site manager's perspective to see what could happen in the future; appropriate adaptation options can then be developed.

You can [view the National Trust hazard mapping project on the National Trust Climate Hazards webmap]



The National Trust Climate Hazards Map. This example shows the likelihood of an overheating and humidity hazard event, now (2020 - left) versus 2060 (right). The event is distributed across 5km hexagonal grids which are ranked from 1-5 (1 = low hazard likelihood, 5 = high hazard likelihood). An overheating and humidity hazard event occurs when daily maximum temperatures exceed 30 degrees Celsius, or average internal humidity falls outside of the 40-60% range, as observed by the Met Office. © National Trust

CASE STUDY 3: Marine and Coastal

Diving the Bronze Bell

Risks

- Migration and proliferation of pests, diseases and invasive species, PD2
- Frequent high winds, storms and heat/cold events, EX1

With increased storminess, the higher energy in oceans brings more turbulence. As well as increased physical disruption to the foreshore and intertidal sites, changing currents and increased energy underwater will have an impact on submerged archaeology. Changes in water pH, mostly acidification, caused by rising carbon dioxide levels may also affect the long-term stability of underwater cultural heritage, for example, the increased attrition of metal objects, and warmer waters around the UK have facilitated the northward spread of Shipworm (*Lyrodus pedicellatus*) a wood-boring species that can cause structural damage to submerged wooden wrecks and artefacts.

To find out more about the change impacts on UK coasts and seas you can download the Marine Climate Change Impacts report card 2020, from the Marine Climate Change Impacts Partnership website

Adaptation Action

- Knowledge: 1 Knowledge exchange/collaboration, 3 Research, MC4
- Capacity: 5 Collaborative working, 6 Training and guidance, HE3
- Resilience: 7 Taking action, HE4, MC1

The impact of climate change on the maritime environment has been a focus of study for the EU-funded CHERISH: Climate Change and Coastal Heritage Project (2017-2023). Alongside marine survey to raise awareness and improve our knowledge and understanding of offshore heritage assets, the 'Bronze Bell wreck', discovered in 1978 and subsequently designated under the Protection of Wrecks Act, was selected for archaeological assessment. The wreck lies in about 8 metres of water on the Sarn Padrig reef, some 450 metres off Benar Beach near Talybont in Gwynedd. It had previously been monitored by other archaeological dive contractors, Licensees, and avocational divers, with the last inspection by Wessex Archaeology, in 2004. The new archaeological assessment would therefore add valuable data to identify potential changes to the wreck.

MSDS Marine were appointed by CHERISH to undertake the archaeological assessment, which took place over five days in September 2021. The scope of work included:

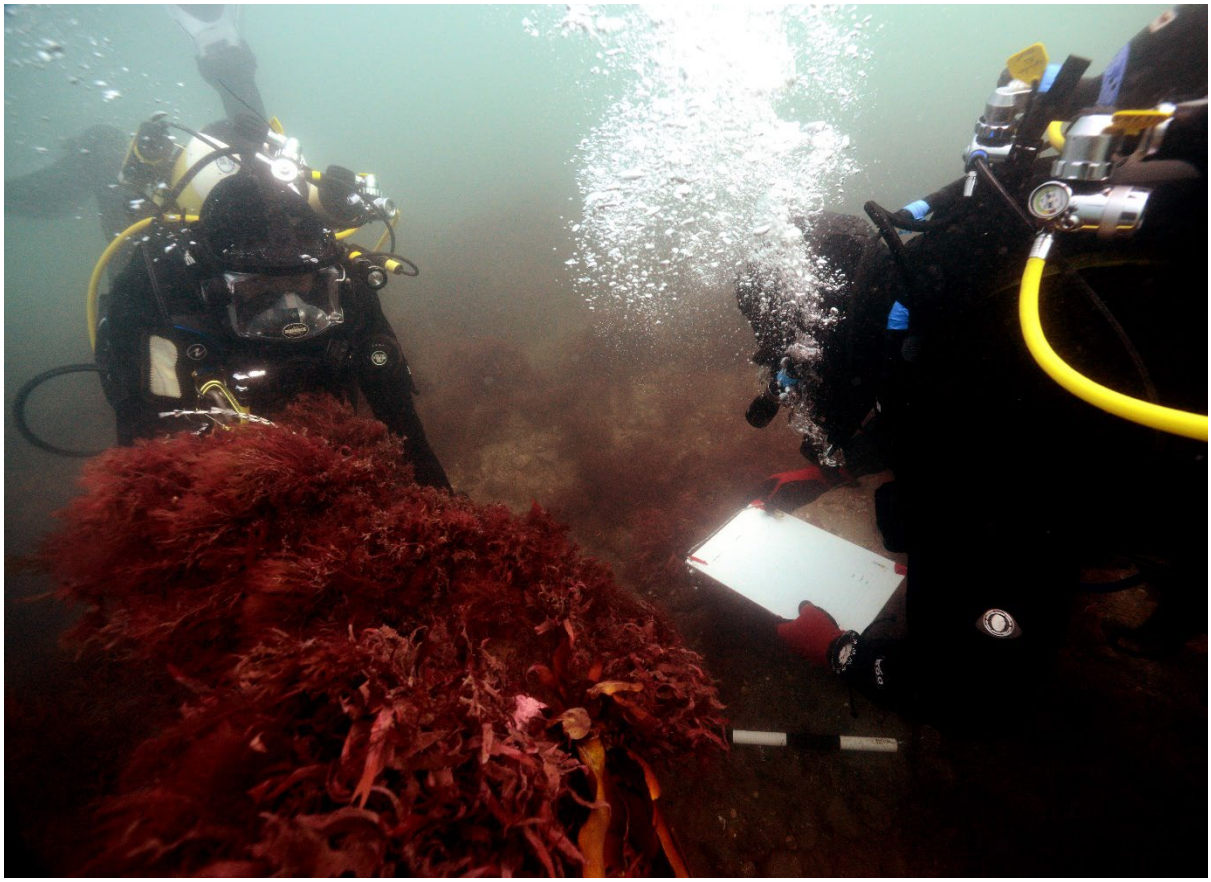
- The production of an updated georeferenced site plan. This involved ground-truthing the 2020 CHERISH multibeam survey. Comparison of this site plan with the one from 2004 indicated new archaeological features had been exposed.
- A photogrammetric survey of the site to map the full extent of remains. This comprised 7,572 images and resulted in the creation of a digital elevation model.
  You can view the digital elevation model on Sketchfab here.
- A repeat photographic survey. Photographs were taken from the same location and position as the 2004 survey to allow for comparison. Visibility on site in 2004 had been in excess of 10 metres, however, by comparison visibility was just 1 – 2 metres in 2021.
- The gathering of environmental data. This provided the baseline survey for the site and will now enable the effects of climate change on the wreck to be monitored into the future. The survey used the Gathering Information via Recreational and Technical (GIRT) Scientific Divers12 methodology (https://www.girtsd.org/about) and comprised a species audit covering fish, crustacea and mollusca, porifera, cnidaria and chordata, and algae. Daily pH monitoring from the surface and seabed was also undertaken.

- Public engagement. This included a visit to a local primary school, providing hands on STEM sessions with all KS1 and KS2 children, and the presence of a dedicated marine outreach trailer known as the Heritage Hive at Pwllheli Marina for the duration of the fieldwork. The team also posted regular social media updates and took part in a podcast and delivered a public lecture.
  You can view the dive diaries on the CHERISH Project YouTube channel.

A five-minute feature on the dive, and the wider CHERISH project, was broadcast on Channel 4 news on 21 September 2021.

You can view the news report on the Channel 4 News website.

The work on the 'Bronze Bell wreck' sets a benchmark for marine survey work, which could be applied to all similarly significant historic wreck sites in similar environmental contexts. Once we know more about the potential impacts we can work to ensure that underwater cultural heritage considerations are included in relevant plans and policies, such as the Wales National Marine Plan.



Divers taking measurements for a new site plan of the Bronze Bell wreck. The wreck is likely to be the remains of a Genoese merchant vessel lost in 1709 carrying a large cargo of substantial marble blocks. The site comprises a central mound of stacked marble blocks and is surrounded by a scatter of iron cannon and anchors.

CASE STUDY 4: Buildings and Settlements
Climate vulnerability modelling of domestic dwellings in Wales

Risks

- Frequent high winds, storms and heat/cold events, EX1, EX2

Improving energy efficiency in traditionally constructed dwellings is essential to achieving a more sustainable environment. Nevertheless, meeting our climate targets through retrofit, whilst maintaining healthy living environments, is a major challenge. Climate change is increasing the risks to building fabric and the health of building occupants from changes in indoor air quality. The quality, design and operation of buildings across the UK must therefore be improved to address the challenges, specifically higher temperatures and fluctuating precipitation patterns. This is particularly pertinent in Wales, which has a high proportion of older housing. A holistic policy approach to climate change decision making is urgently needed whereby necessary risk-based adaptation decisions have equal standing with carbon reduction targets.

Adaptation Activity

- Knowledge: 1 Knowledge exchange and collaboration, 2 Mapping and monitoring the resource, 3 Research priorities, HE1, MC4
- Capacity: 5 Collaborative working, 6 Training and guidance, HE3
- Resilience: 7 Taking action, HE4, MC1

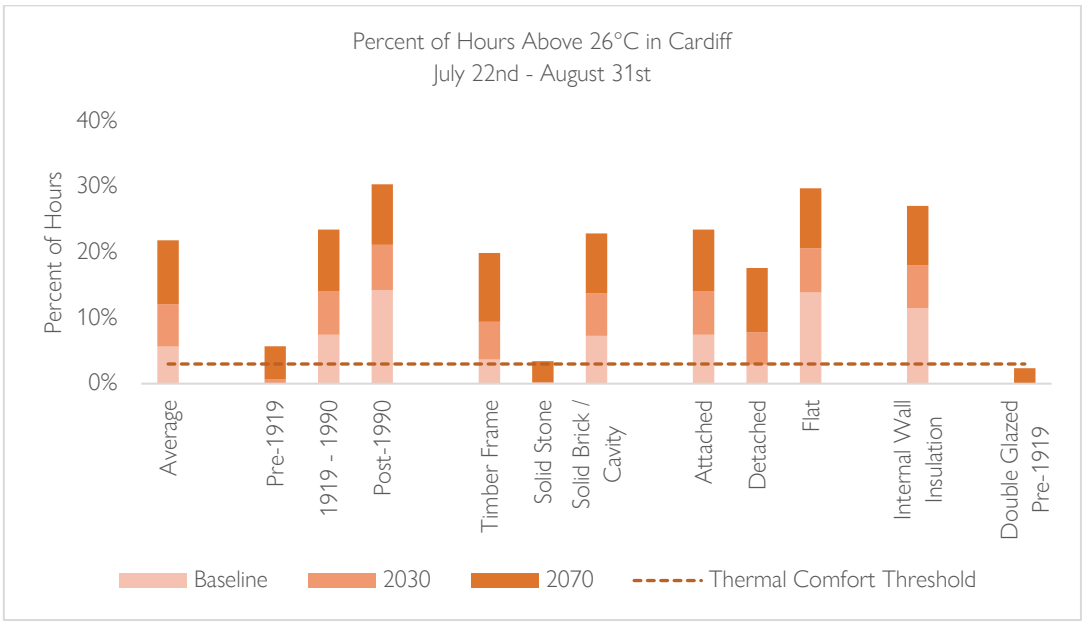
In 2021 Cardiff Metropolitan University, in collaboration with the University of Colorado and Resilient Analytics, conducted climate vulnerability modelling of domestic buildings in Wales for Cadw and Welsh Government (Hayles *et al.,* 2022). The modelling aimed to determine climate change risks to indoor environmental quality, specifically thermal comfort and moisture, as well as building fabric. UKCP18 local (2.2km) projections were used, under an emissions scenario of RCP 8.5, and three time periods were modelled, named 'baseline' (1981-2000), '2030' (2021 – 2040), and '2070' (2061-2080). 12 HadGEM3-GC3.05 models were used, and the results presented in the report covered six distinct geographical locations across Wales, namely Cardiff, Brynmawr, Narberth, Wrexham, Shotton, and Llangefni. The relationship between outdoor temperature and indoor temperature was based on a previous study that monitored 193 free-running dwellings, without heating or cooling (Beizaee *et al.,* 2013). Eleven separate building classes were identified, which aimed to represent the 40+ dwelling categories found across Wales according to age, construction and dwelling type. To understand the impact of climate change on the indoor environmental quality of dwellings in Wales, a six-week period from 22nd July – 31st August was modelled. Meanwhile, building fabric risks were calculated using service life data. Adjusted service lives, and associated costs were determined as a measurable and quantifiable output, by applying discrete climate variables to individual building materials and components.

The result of the study highlighted the following:

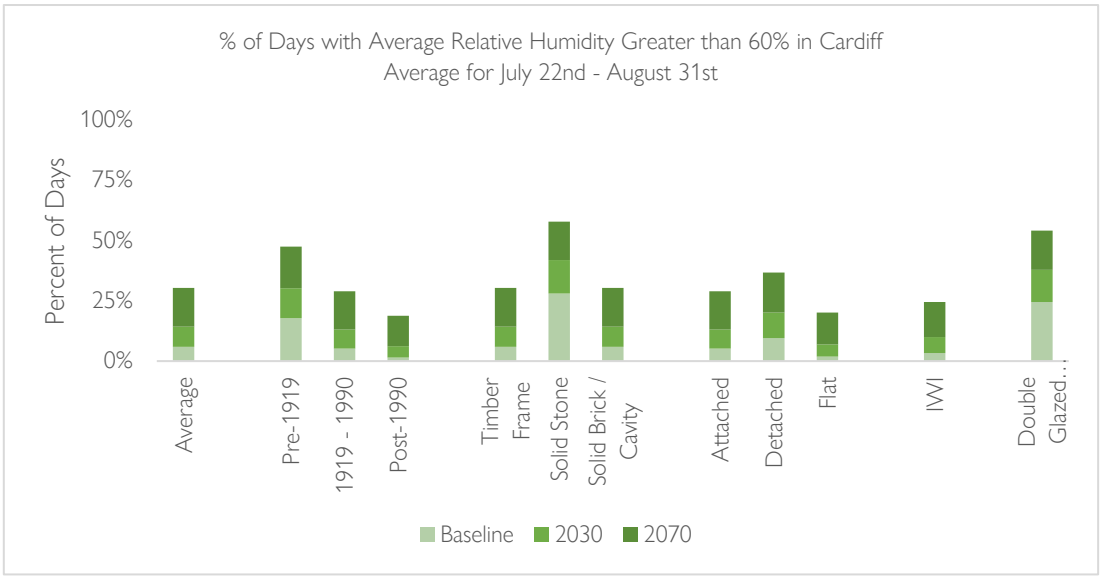
- There will be increased incidences of summertime overheating in a majority of dwellings across Wales, however, the best performing dwellings were pre 1919 dwellings and dwellings with solid stone walls. The results show that cooling strategies to reduce indoor air temperature will increasingly be required.
- There is the potential for poorer indoor environmental quality due to projected increases in indoor relative humidity. All locations will experience increases in relative humidity regardless of dwelling typology. However, relative humidity will be highest in pre-1919 dwellings and dwellings with solid stone walls. The results show that ventilation strategies to improve the extraction of moisture-laden air, whilst diluting the concentration of pollutants that are present indoors, are required if these dwellings are to avoid increased incidences of condensation, damp, and mould growth, and adverse impacts from other allergens, particles and pollutants.
- The climate vulnerability modelling indicates that there will be a modest reduction in the service life of building materials of between 1-7%, and an associated increase in repair and maintenance costs, due to increases in and changing patterns of precipitation and subsequent moisture ingress.
- Risks to building fabric from moisture, wind and driving rain under future climate driven changes in weather patterns are particularly associated with solid masonry walls, characterised by higher surface water absorption coefficients.
- It is anticipated that changes in climate factors will accelerate the erosion of detailing and construction, with the potential to undermine the integrity of e.g., binders and coatings.
- Dwellings retrofitted with inappropriate wall insulation systems are predicted to experience further issues with increased mould and damp where moisture-wicking pathways have been modified.

Adaptation

- Proposed behavioural adjustments, internal fit-out alterations and building fabric modifications can all provide historic building occupants with practical solutions to better manage climate change impacts.
- Improved indoor environmental quality can be achieved through the adoption of building appropriate cooling and drying strategies.
- Mitigating overheating by minimising both internal and external heat gains, and managing ventilation, with an emphasis on passive ventilation strategies and a particular focus on increasing nighttime ventilation, can be very effective.
- The building fabric vulnerability service life adjustment data can be used alongside knowledge and understanding of building fabric performance and deterioration mechanisms, to better inform frequency of repair and maintenance to mitigate further damage to historic buildings.



Percent of hours in the study period over 26°C threshold for thermal comfort. Values shown for the average building and eleven building classes. 3% of occupied hours threshold shown for reference.
© C Hayles



Percent of days in the study period with indoor daily average relative humidity above the 60% relative humidity threshold in Cardiff
© C Hayles

6. Conclusions

This interim review demonstrates that a wide range of climate change adaptation activities were undertaken during 2021, resulting from continued activity evidenced in 2020, but also new activity. Activities span most types of historic asset, and all contribute towards meeting the headline actions identified in the SAP and the related historic environment sub-actions in *Prosperity for All: A Climate Conscious Wales* (see Section 2).

Good progress has been made during the year on increasing our knowledge and understanding of the threats and opportunities for the historic environment. Much of this effort has focussed on identifying and recording good quality baseline data, resulting in an enhancement of the Historic Environment Record. The Cadw-funded thematic project on the survey of historic features associated with rivers and other fresh-water sources being undertaken by the Welsh Archaeological Trusts is an important example of this.

Partnership and collaborative projects such as CHERISH and Carneddau funded through Europe and the National Lottery Heritage Fund continued to deliver against a number of the headline actions in 2021. It is crucial that new partnership projects are developed, and funding is sourced to continue such proactive work. Projects such as these, alongside work undertaken by Cadw's embedded researcher and their continuing partnership work with Historic Environment Scotland, Historic England, English Heritage, National Trust and Communities Northern Ireland on hazard mapping, risk profiling and an adaption manual are crucial in developing the methodologies, tools and guidance that will build capacity and increase the resilience of the sector. Positive evidence that this is starting to happen can be seen in this activity report , but it is important that this output continues to grow in future years.

The publication of the SAP *Monitoring and Evaluation Framework* in 2021 and the subsequent publication in 2022 of the first two interim reports of activities for 2020 and 2021 was a great step forward by the HEG Climate Change Subgroup. Deeper analysis of the evidence gathered is now essential to identify areas where further action should be focussed and prioritised over future years. Improved promotion and engagement will be essential to deliver this.

Analysis of individuals and organisations that submitted evidence for this report indicates more work is required to increase the sphere of influence of the SAP, for example, with the University sector. The finalisation of a communication plan by the HEG Climate Change Subgroup will undoubtedly help with this, however, the limited financial and staff resources available to subgroup members continues to be a serious concern. The creation of a dedicated Climate Change Manager post (SAP action 4.2) and the appointment of a historic environment and climate change 'champion,' supported by appropriate budgets, remain key priorities. These actions would do much to increase the sphere of influence of the SAP and increase engagement with other sectors.

7. Abbreviations

AC-NMW: Amgueddfa Cymru – National Museum Wales

BBNPA: Brecon Beacons National Park Authority

CITiZAN: Coastal and Intertidal Zone Archaeological Network.

CPAT: Clwyd-Powys Archaeological Trust

CRDV AONB: Clwydian Range and Dee Valley Area of Outstanding Natural Beauty

DAT: Dyfed Archaeological Trust

DfC (NI): Department for Communities (Northern Ireland)

EH: English Heritage

FPAN: Florida Public Archaeology Network.

GAT: Gwynedd Archaeological Trust

GGAT: Glamorgan-Gwent Archaeological Trust

GNSS: Global Navigation Satellite System

HE: Historic England

HEAWG: Historic Environment Adaptation Working Group

HEG: Historic Environment Group

HEGS: Historic Environment Group Climate Change Subgroup

HES: Historic Environment Scotland

NRW: Natural Resources Wales

NT: National Trust

NP: National Park(s)

PCNPA: Pembrokeshire Coast National Park Authority

RCAHMW: Royal Commission on the Ancient and Historical Monuments of Wales

SAP: Sector Adaptation Plan

SCAPE: Scotland's Coastal Heritage at Risk Project

SNPA: Snowdonia National Park Authority

SU: Sheffield University

UAV: Unmanned Aerial Vehicle

UWTSD: University of Wales Trinity St Davids

WATs: Welsh Archaeological Trusts

WCMC: Wales Coast Monitoring Centre

WHQS: Welsh Housing Quality Standard

WG: Welsh Government

YU: York University

8. Links to Resources

Ancient Connections Project:
https://ancientconnections.org/

Barker, L., Bullen, J., Davidson, A., Fairweather J., & Laws, K. (2021). Climate Change and the Historic Environment in Wales. Developing and Delivering a Sector Adaptation Plan, *The Historic Environment: Policy & Practice* 12:3-4, 356-374.
https://www.tandfonline.com/doi/abs/10.1080/17567505.2021.1944574

Beizaee, A., Lomas, K., and Firth, S.K., (2013) National survey of summertime temperatures and overheating risk in English homes *Building and Environment* 65, 1–17.
https://doi.org/10.1016/j.buildenv.2013.03.011

Cadw guidance Flooding and Historic Buildings in Wales:
https://cadw.gov.wales/sites/default/files/2019-07/Flooding%20and%20Historic%20Buildings%20in%20Wales%20Eng.pdf

Carneddau Landscape Partnership Scheme:
https://www.snowdonia.gov.wales/looking-after/carneddau-partnership

CHERISH Climate Change and Coastal Heritage project:
http://www.cherishproject.eu/en/

CHERISH project eConference 2021:
https://www.youtube.com/playlist?list=PL3awNDJNynsPs6yXqfGt34EXpM6hT7hXn

CHERISH #ClimateHeritage stories for COP26, Heritage, Communities and Coastal resilience.:
https://www.youtube.com/playlist?list=PL3awNDJNynsOYevmfVywKV2dx5suXQoH6

CHERISH project covered in Channel 4 News special:
https://www.youtube.com/watch?v=x1HgNtVKEss

CHERISH project Caerfai Promontory Fort excavation covered in ITC Wales Coast and Country:
https://www.itv.com/walesprogrammes/articles/coast-and-country-series-9-episode-18

CHERISH project Caerfai Promontory Fort excavation DigVentures project and dig diary:
https://projects.digventures.com/caerfai-promontory-fort/background/

CHERISH project Bronze Bell Wreck Dive, MSDS marine dive diaries:
https://www.youtube.com/playlist?list=PL3awNDJNynsOzgJRrKqVW-kZ0YJDkSKOp

Clwydian Range & Dee Valley AONB - Landscape and Nature Recovery in a Changing Climate Climate:
https://www.clwydianrangeanddeevalleyaonb.org.uk/wp-content/uploads/2016/06/Landscape-Nature-Recovery-ENG-Interactive.pdf

Cook, I., Johnston, R., & Selby, K., (2021) Climate Change and Cultural Heritage: A Landscape Vulnerability Framework, *The Journal of Island and Coastal Archaeology*, 16:2-4, 553-571.
https://www.tandfonline.com/doi/abs/10.1080/15564894.2019.1605430

Fit for the Future Network:
https://www.fftf.org.uk/home

Hayles, C. S., Huddleston, M., Chinowsky, P., & Helman, J., (2022) Summertime impacts of climate change on dwellings in Wales, UK. *Building and Environment*, 219, 109185.
https://doi.org/10.1016/j.buildenv.2022.109185

Hayles, C.; Huddleston, M.; Chinowsky, P.; Helman, J., (2022) Quantifying the Effects of Projected Climate Change on the Durability and Service Life of Housing in Wales, UK *Buildings*, *12*, 184.
https://doi.org/10.3390/buildings12020184

Historic Environment and Climate Change in Wales Sector Adaptation Plan:
https://cadw.gov.wales/sites/default/files/2020-02/Adaptation%20Plan%20-%20FINAL%20WEB%20-%20English%20%281%29.pdf

Historic Environment and Climate Change in Wales Sector Adaptation Plan Monitoring and Evaluation Framework:
https://cadw.gov.wales/sites/default/files/2021-10/Historic%20Environment%20and%20Climate%20Change%20in%20Wales-Sector%20Adaptation%20Plan%20Monitoring%20and%20Evaluation%20Framework-June-2021.pdf

National Lottery Heritage Fund - Environmental sustainability guidance:
https://www.heritagefund.org.uk/good-practice-guidance/environmental-sustainability-guidance#heading-16

National Lottery Heritage Fund - Local Places for Nature and Community Woodlands grant programmes:
https://www.heritagefund.org.uk/funding/local-places-nature-guidance

National Trust Visitor and Climate Change Report - How climate change will affect the future of UK tourism:
https://www.nationaltrust.org.uk/features/how-climate-change-will-affect-the-future-of-uk-tourism

Natural Resources Wales - Good Practice Guides on forest resilience covering species, structural and genetic diversity:
https://naturalresources.wales/guidance-and-advice/environmental-topics/woodland-management/planning-for-the-future/making-woodlands-more-resilient/?lang=en

Natural Resources Wales - Communicating landscape change from adaptation and mitigation in a changing climate
https://www.whiteconsultants.co.uk/wp-content/uploads/2020/04/Communicating-landscape-change-final-report-310320r.pdf

Natural Resources Wales -South West Area Statement:
https://naturalresources.wales/about-us/area-statements/south-west-wales-area-statement/?lang=en

Pembrokeshire Coast National Park Changing Coasts project:
https://www.pembrokeshirecoast.wales/get-involved/changing-coasts/

RCAHMW Environmental Policy Statement:
https://rcahmw.gov.uk/about-us/corporate-information/future-generations/environmental-policy-statement/

RCAHMW Digital Past 2021:
https://www.youtube.com/playlist?list=PLbKw_Ere5rvT-2UpRIk0xX_LIHRdi8Evi

RCAHMW Cwmbrân New Town: An Urban Characterisation Study:
https://shop.rcahmw.gov.uk/collections/downloads/products/cwmbran-new-town-an-urban-characterisation-study

Snowdonia National Park Authority – Life Celtic Rainforests Project:
https://snowdonia.gov.wales/protect/conservation-work/celtic-rainforests-wales/

Snowdonia National Park Authority – Cyfoeth Ein Corsydd project
https://www.snowdonia-npa.gov.uk/looking-after/projects/cyfoeth-ein-corsydd

Snowdonia National Park Authority – Cynllun Eryri:
https://authority.snowdonia.gov.wales/the-authority/partnerships/cynllun-eryri/

Welsh Government climate change adaptation plan - Prosperity for all: A climate conscious Wales
https://gov.wales/prosperity-all-climate-conscious-wales