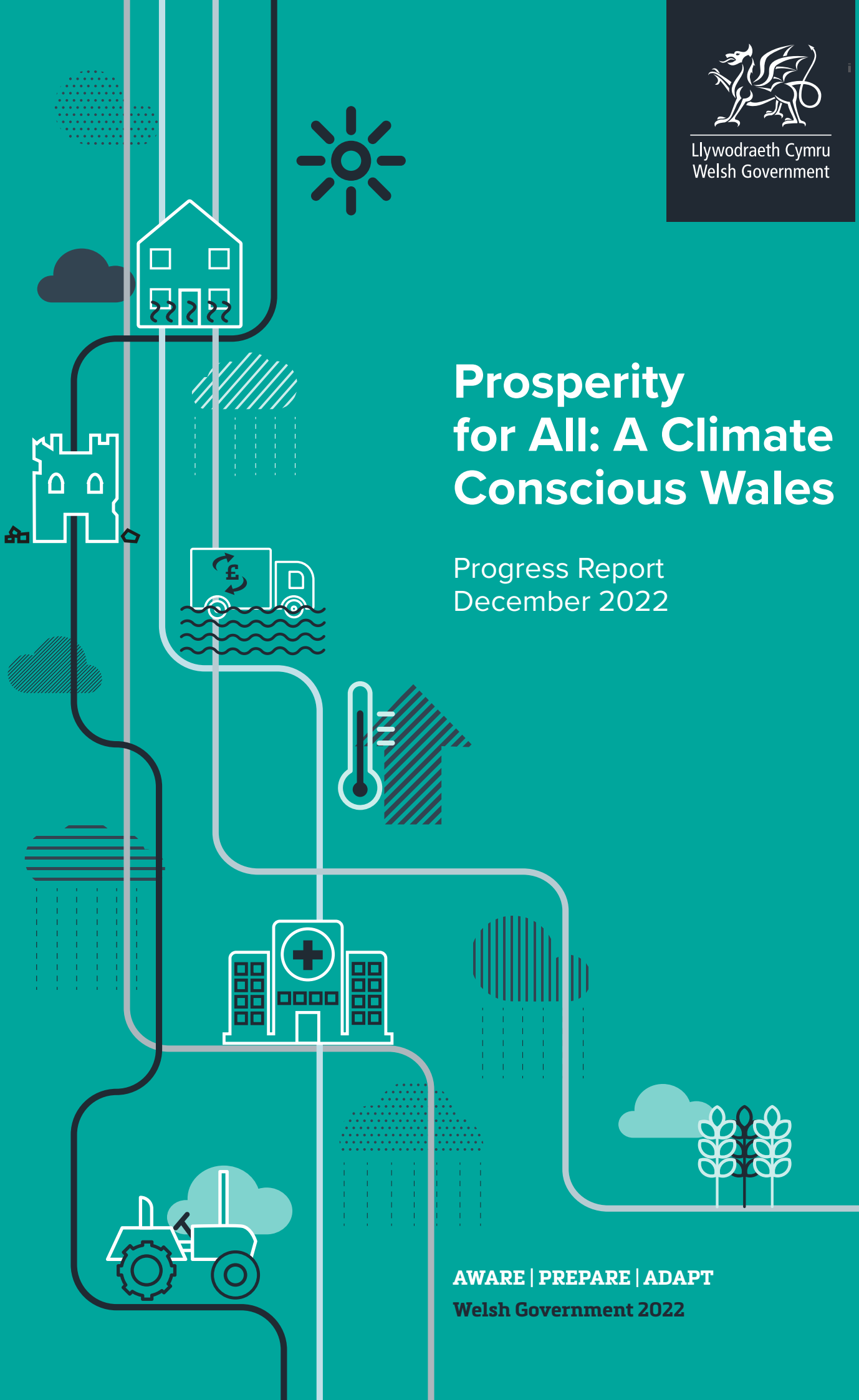


Llywodraeth Cymru
Welsh Government

Prosperity for All: A Climate Conscious Wales

Progress Report
December 2022

AWARE | PREPARE | ADAPT

Welsh Government 2022

Contents

Ministerial Foreword

We are striving for a more prosperous, equal and greener nation. We will use every day we have, and every lever we have, to make Wales a more equal, fair and just society. Climate change is a risk to us achieving this. We need to respond with greater pace to the consequences arising from climate change which are already impacting on the way we live our lives and how our planet can sustain all life on it.

This is why the Welsh Government declared a climate emergency in April 2019 and why we set out in the Programme for Government our commitment to embed our response to the climate and nature emergency in everything we do. We need to galvanise action across Wales and to accelerate plans to adapt to climate change. Adaptation requires us to understand the risks arising from climate change and how they might impact upon the ecosystems and people of Wales, our communities, our places of work, the length and breadth of the country.

In December 2019 we published our 5-year adaptation plan, Prosperity for All: A Climate Conscious Wales. It is based on the evidence from the Climate Change Committee's second Climate Risk Independent Assessment published in 2017. The Plan sets out a range of policy measures the Welsh Government is taking to address the most urgent areas of climate risk. Since its publication, the Climate Change Committee issued its third Climate Risk Independent Assessment, in June 2021, which has highlighted increased or additional risks in many areas and the need to do more.

It is clear from their evidence, the climate is changing and we need to keep pace to protect ourselves and future generations from the impact of this change.

This Prosperity for All: A Climate Conscious Wales - Progress Report 2022 summarises the progress we are making in delivering the current national adaptation plan and also provides an account of the additional steps we are taking in the light of the third climate risk advice from the Climate Change Committee.

The Progress Report recognises that many of the commitments within our Programme for Government will contribute towards climate adaptation in Wales or will be impacted by the changing climate. It reinforces the need to ensure that climate change adaptation is embedded within our policy development and decision-making. It also acknowledges the Welsh Government's full acceptance of the Climate Change Committee's latest advice. The report includes a number of commitments to develop additional adaptation measures and make improvements to our strategic policy approach, to ensure that we respond to the increasing risks arising from climate change.

The Progress Report demonstrates that we need to continue to take action to prepare and adapt to these changes before the full effects are felt, to ensure Wales continues to prosper. If we do not take appropriate action, the impact of climate change will be most acutely felt by the most vulnerable in our society. It is therefore imperative we take additional steps to protect our ecosystems and communities most at risk, to demonstrate our commitment to a more equal Wales.

When it comes to protecting our future generations, we have much to be proud of in Wales. We have put our commitments to protect our country into law, ensuring the Wales we leave behind is enjoyed by all, for many generations to come.

The Progress Report reinforces the need to continue delivering our plan and to introduce new measures to adapt. Success will mean Wales is a climate conscious nation, aware of the risks facing us, whilst being prepared and ready to adapt to the impacts before they occur.

Julie James MS
Minister for
Climate Change

1: Introduction

Our climate is changing. Over the coming years and decades, even in the best-case scenarios for global warming, we will continue to see increasing impacts arising from historic carbon emissions. We will see further sea level rise and we can expect to experience increasing frequency and severity of weather extremes such as storms, flooding, heatwaves and drought, as well as significant impacts from incremental average warming. These changes to our climate have implications for our health, businesses, infrastructure, public services, supply chains, natural environment and ecosystems. Mitigation and adaptation are both essential elements of a unified response to the climate emergency. In other words, it is vital that we meet all our domestic and international targets for decarbonisation if we are to avoid catastrophic levels of global warming, but we must also prepare and build resilience to the impacts of climate change.

There is a clear risk that the most disadvantaged within our society will be the most vulnerable to the impacts of climate change, and have the least resources at their disposal in order to adapt. The Welsh Government is committed to ensuring that fairness and social equity are at the heart of the policies we are developing to tackle climate change in Wales.

This report summarises the progress made in the delivery of our current 5-year national climate change adaptation plan for Wales, *Prosperity for All: A Climate Conscious Wales*[1], published in December 2019. The plan's Technical Annex[2] and Monitoring and Evaluation Framework[3] set out the range of actions we are taking to address climate-related risks in Wales, informed by the Met Office Hadley Centre's UKCP18 climate projections[4] and by the Climate Change Committee's (CCC) second Climate Change Risk Assessment Evidence Report 2017[5].

In June 2021, the CCC published its third Climate Risk Independent Assessment[6]. This comprises an updated assessment of the risks arising from the changing climate in the UK and represents the most up to date, comprehensive and authoritative evidence currently available to inform our ongoing national adaptation policy development. The CCC's updated assessment indicates the level of climate-related risk has increased significantly since the previous 2017 assessment, with 54 out of 61 areas of risk assessed as requiring further action or investigation. The CCC's advice also highlights there is a widening gap between the level of risk and the level of adaptation planning and action taking place across all four nations within the UK. The Welsh Government has accepted the CCC's findings in full and is committed to developing an improved strategic approach in order to build resilience to the impacts of climate change in Wales.

In response to the CCC's advice, we have taken immediate steps to identify and deliver additional relevant climate adaptation actions across policy areas, beyond those set out in *A Climate Conscious Wales*. These are included in this report to provide a complete picture of our current actions. We are also working at pace to develop and roll out an updated strategic approach towards climate adaptation across Wales.

The overall structure of this report mirrors the section headings and content within the Technical Annex of *A Climate Conscious Wales*, but with some additional sections included where appropriate in order to take into account the additional areas of risk highlighted by the CCC's 2021 climate risk advice.

2: Our Strategic Approach

Our current national adaptation plan, *A Climate Conscious Wales*, sets out the key policy measures we are implementing to address the impacts of climate change. This includes a number of overarching strategic actions focused on communications and awareness raising, engagement with ongoing research activities, and the integration of climate risk considerations into the processes and policies of the Welsh Government and other bodies.

Progress to date

The Welsh Government's Programme for Government[7], published in March 2021 and updated in December 2021, highlights our commitment to embedding our response to the climate and nature emergency into everything we do. This was recognised with the creation of a Climate Change Ministerial portfolio to oversee this commitment and embed climate change adaptation into our wider policies and governance arrangements.

In Wales we benefit from the unique provisions within the Wellbeing of Future Generations (WFG) Act 2015[8, 9]. The Act gives us a legally-binding common purpose through the seven well-being goals that apply to national government, local government, local health boards and other public bodies. It also details the ways in which public bodies must work, and work together, to improve the well-being of Wales, by thinking more about the long-term, working better with people, communities and each other, looking to prevent problems and taking a joined-up approach.

The COP26 conference held in Glasgow in November 2021 highlighted the importance of global collaboration and support in order to build resilience to the impacts of climate change. Our associated COP Cymru events also helped to raise awareness of the impacts and adaptation strategies we need to consider here in Wales.

In addition to the policy-specific activities set out in the later sections of this report, the Welsh Government continues to work with the UK Government and with the devolved governments in Scotland and Northern Ireland at a strategic level, on areas of shared interest in relation to climate adaptation. We also work with the Met Office Hadley Centre Climate Programme, the UK Climate Resilience Programme and the CCC, ensuring that we have a strong evidence base to inform our approach in Wales.

What next?

We are learning lessons from our experience of delivering *A Climate Conscious Wales*, and from the comprehensive updated climate risk advice published by the CCC in June 2021. We know that climate change adaptation in Wales and across the UK is not keeping pace with the risks arising from climate change. We are determined to ensure the approach we take in Wales translates into fair and meaningful resilience for our people, communities, wildlife and environment. This will require an updated strategic approach, which we are currently developing and which will inform the development of our next national adaptation plan.

The Welsh Government has commissioned an independent assessment by the CCC in relation to climate adaptation progress and future priorities in Wales, due to be published in summer 2023. The CCC's advice will be central to the further development of our national climate change adaptation policy. It will also include a review of the current status of adaptation planning across the wider public sector, designed to shape the support we provide to our public sector partners and wider stakeholders.

The Welsh Government is also developing a 'Strategy for Public Engagement & Action on Climate Change'. The purpose of this new 5-year Strategy will be to set out a framework and guiding principles around how we will involve society in climate policies that will affect them, and work with trusted messengers with a role in reaching different groups in society to enable and support public action at a local and regional level. The scope of the strategy will cover the sorts of actions which could be taken by groups and individuals in the areas of climate mitigation and adaptation and will emphasise the important relationship between the climate and nature emergencies and social justice.

Consulation on the strategy was an important focus for Wales Climate Week 2022, including deliberative workshops and events, with a particular focus on low income and marginalised groups.

We are working at pace to develop and roll out our updated strategic approach to climate adaptation in Wales, which includes consideration of:

- Further measures to address the areas of climate risk highlighted by the CCC's 2021 advice and the CCC's recommended 'principles for good adaptation'[10].
- Updated methodological approaches for mapping and monitoring of pathways towards good adaptation outcomes.
- Whole system perspectives for addressing different areas of climate risk, taking into account the implications of cascading impacts and interrelationships.
- A 'Team Wales' approach, with broader consideration and support for the actions needed across the Welsh public sector, stakeholders and society.

3: Progress across policy areas

The following sections provide a summary of progress in delivering the actions set out within *A Climate Conscious Wales*, along with an indication of additional actions we are already planning, taking into account the CCC's 2021 updated climate risk advice.

As the Welsh Government works to deliver against the commitments and priorities set out in our Programme for Government, we are working to take into account the risks and opportunities arising from climate change and to ensure climate change adaptation is embedded in our decision-making.

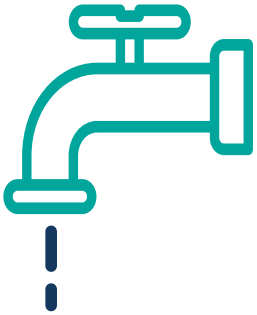
3.1: Adaptive Nature and the Rural Economy

3.1.1: Water resources

The Adaptive Nature and the Rural Economy section of *A Climate Conscious Wales* includes actions for the management of risks in relation to both water resources and flooding at river catchment scale, both of which are increasing areas of risk associated with climate change. Actions being taken in relation to flood risks are covered further within Section 3.2.1 of this report.

A Climate Conscious Wales highlights the role of River Basin Management Plans (RBMPs) for addressing pressures on the water environment, utilising the evidence base to deliver targeted interventions in catchments and improving water quality. The plans include a specific action to ensure water companies reduce water leakage.

The CCC's 2021 climate risk advice also highlights the increasing climate-related risks and cascading impacts of both flooding and reduced water availability upon our infrastructure networks (water, energy, transport, ICT), services, bridges and pipelines, businesses, buildings, people and communities. Some of these specific areas of risk are covered further in the other sections within this report.



Research undertaken

Natural Resources Wales (NRW) has a duty to promote the conservation of flora and fauna dependent on water as well as securing the proper use of water resources. NRW is working with academic and government partners to direct and enable research towards areas where it is most impactful, in addition to commissioning its own research on relevant issues for Wales. Recent examples of relevant research undertaken include the Natural Environment Research Council (NERC) droughts and water scarcity project and the joint water environment programme. The outcomes from this research are helping to inform ongoing flood and water resource management in Wales.

Actions taken

New Water Resource Management Plans (WRMPs) were published by the water companies in 2020. These take into account the impacts of climate change on the water available and how demand for water is likely to change with increasingly warmer weather and with lower overall rainfall in the summer.

In January 2018, the 'New Authorisations' process was introduced for water abstraction licences, to ensure water resources are managed in an environmentally responsible and fair way. Most previously exempt water abstractions (if over 20m^3/day) now require a licence to continue legally abstracting water.

These changes are enabling NRW to better manage water at catchment level as part of the wider policy measures in place in Wales to support the sustainable management and resilience of our natural resources and economic growth and development. NRW are currently screening New Authorisation applications and are due to issue determinations on these transitional applications by the end of December 2022.

Area Statements are also enabling collaborative nature-based solutions in catchments and at the coast[11], outlining the key challenges facing particular localities and the associated management requirements. The Wales Environmental Information Portal[84] is designed to communicate the evidence base behind the Area Statements, including spatial data on flood risk.

Ofwat has set water companies a minimum target to reduce water leakage by 15% by 2025. Dwr Cymru Welsh Water has set up Project Cartref to reduce water wastage through leakage or inefficient use. The project follows the company's recent successes in reducing leakage (by 40% since 2000). It has come about by predominantly tackling leakage in trunk mains and distribution networks and by smarter network management. Project Cartref is the next step to meet the expectations of customers and stakeholders to reduce consumption and leakage, while keeping bills down. It is a proactive and preventative approach aimed at saving water and money for current and future generations.

What next?

Updated RBMPs covering 2021-2027 have been consulted on and will be published towards the end of this year. The plans will set objectives for all rivers, lakes, wetlands, estuaries, coastal and ground waters in each river basin district and cover the period 2021-27. They are integrated at catchment scale, ensuring a connection across the wider environment for people and wildlife, from source to sea.

The next WRMPs are due in 2025. Guidance for water companies was published by NRW, Ofwat and the Environment Agency in 2021[12], which includes specific guidance for companies on accounting for climate change impacts using the Met Office UKCP18 climate projections modelling. Water companies are required to assess their water resource zones in terms of their vulnerability to climate change. Those in Wales assessed as either 'medium' or 'high' vulnerability are required to ensure they have adequately planned for higher climate change scenarios (including presenting actions where supply is forecast to be below demand). NRW are also promoting the uptake of nature-based solutions by water companies to improve their water resources (in addition to waste water) through embedding the 'Sustainable Management of Natural Resources'[13] approach within water company decision-making and within the National Environment Programme for the 2024 price review. The Welsh Government is monitoring this work to ensure water resources are sustainable in the context of the changing climate. We are also considering the need for new policy development in the light of the CCC's 2021 updated climate risk advice, to strengthen co-ordination across sectors, to deliver more ambitious reductions in water consumption and strategic planning of new water supply infrastructure.

Through the statutory water price determination process, targets for further reducing leakage and demand for water will be considered by the water industry regulators and water companies for 2025-2030 and beyond.

Our proposed Sustainable Farming Scheme (SFS), due to be introduced in Wales from 2025, is being designed to support farmers to deliver sustainable land management. One of the core objectives of the scheme, which is set out in more detail below, is to mitigate and adapt to climate change, including a focus on ensuring clean water and management of risks associated with flooding and drought.

3.1.2: Agriculture

A Climate Conscious Wales sets out the actions we are taking to develop a sustainable, evidence-based agriculture policy which will support climate change adaptation alongside other objectives. Associated actions include improving nutrient management and the resilience of soils and water, engaging in research on agricultural climate adaptation, and assessing future crop vulnerability and viability.

The CCC's 2021 updated climate risk advice highlights the impacts of climate change upon agricultural productivity, livestock and crops, due to temperature changes, water scarcity, wildfire, flooding, coastal erosion and wind. We can expect to see changes to pests, pathogens and invasive species. Sea level rise will increase the risk to coastal land due to coastal erosion and saltwater intrusion. There are significant risks in relation to natural carbon stores, carbon sequestration and greenhouse gas (GHG) emissions. Climate change is also expected to have a significant impact on landscape character. However, there are also potential opportunities arising from new or alternative species becoming suitable for cultivation in Wales.

Actions in relation to woodland creation on agricultural land are covered in Section 3.1.6.

Research Undertaken

The development of the new SFS is being informed by the Capability, Suitability and Climate Programme (CSC)[14] evidence published in May 2020 and final data published in March 2021. It sets out how agricultural land may change as a consequence of climate change and assesses the impacts on land classification, including how this may change both the type and output of crops grown in Wales. The Climate Smart Agriculture report is also being used to inform the development of the SFS.

The development of the SFS has also been underpinned by the Environment and Rural Affairs Monitoring and Modelling Programme (ERAMMP)[15] Sustainable Farm Scheme Evidence Pack[16]. This integrated analysis draws upon the findings from 849 peer-reviewed research papers and provides a robust logic for the design of the scheme. The scheme development is also being complemented with the use of the Integrated Modelling Platform (IMP)[17], which enables exploration of the potential effects of different on-farm management practices on agriculture, land use, biodiversity and a range of ecosystem services including greenhouse gas emissions and carbon sequestration.

The Food, Agriculture, Biodiversity, Land and Energy (FABLE)[18] consortium has established a model-aided decision-support mechanism for sustainable land use planning. The Welsh Government has worked collaboratively with FABLE to develop a sub-national version of the model to explore

policy questions for Wales. The work has examined the interactions between land use and food production, nature recovery, and decarbonisation pathways for reaching net zero emissions by 2050. The model accounts for changes to the climate, applying the Intergovernmental Panel on Climate Change's (IPCC) greenhouse gas concentration trajectory, Representative Concentration Pathway (RCP) 2.6, to adjust crop growth. Output from the model for different scenarios has demonstrated the interactions of different policy areas on land use and has highlighted the level of change, interrelationships and competition for the available land area. This work will carry forward to inform development of more detailed scenarios for a pathway to net zero, taking into account climate change impacts. We will also keep our future evidence needs under review in line with the most up to date climate change projections.

Further projects have been commissioned via the Soil Policy Evidence Programme[19] (e.g. Grassland Suitability under future climate scenarios), as well as supporting the application of Best and Most Versatile (BMV) land policy in the planning system via the updated Agricultural Land Classification (ALC) Map. Further products from this work include the Peatlands of Wales map, soil data digitisation, Soils of Wales Map development, predictive ALC and land quality maps linked to climate change, and mapping of habitat and crop suitability. This work will inform our understanding of how climate change will both constrain and enable different crops and pasture mixes to be cultivated in Wales.

Actions Taken

The Welsh Government has made the following relevant commitments within its Programme for Government:

- Supporting active farmers and landowners based in Wales to encourage woodland creation on less productive land and explore ways of drawing investment for woodland creation that secures local ownership and control, with associated climate adaptation benefits for communities and ecosystems.
- Examining potential pathways to achieving net zero carbon emissions by 2035, acknowledging that natural carbon stores in soils, woodland and other vegetation are a critical element.
- Working with the farming community to deploy the Water Resources Regulations 2021[21] to improve water quality and air quality, taking an approach targeted at those activities known to cause pollution.

The Welsh Government has recently introduced an Agriculture Bill which establishes Sustainable Land Management (SLM) as the framework for all future agriculture support. Future farm support is being designed to reward farmers who take action to meet the challenges of the climate and nature emergencies alongside the sustainable production of food. The content of the Agriculture Bill and the proposals for the SFS have been informed by three consultations: Brexit and Our Land; Sustainable Farming and our Land and the Agriculture (Wales) White paper.

The Welsh Government is also continuing to work on a range of policy initiatives aimed at the agricultural and amenity sectors in order to reduce the impacts of pesticides, fertilisers and slurry upon water quality, ecosystems and soils. These include the introduction of the Control of Agricultural Pollution Regulations and the provision of nearly £1m of funding to, and follow-on legacy work from, Dwr Cymru Welsh Water's PestSmart[22] project to drive behavioural change and encourage people to consider 'smarter' ways of storing, using and disposing of pesticides.

The Red Meat Development Programme (RMDP), the Dairy Improvement Programme (DIP) and some wider Rural Development Plan-funded projects are informing future

policies for agriculture, animal health and welfare, to support sustainable practices from both an environmental and business perspective.

Healthy livestock are associated with reduced levels of capital loses and reduced emissions, and with greater agricultural productivity and production levels. The new SFS will therefore focus on the inclusion of an Animal Health Improvement Cycle (AHIC) and enhanced biosecurity on farms to promote the principle that prevention is better than cure. Climate change has the potential to bring about changes to endemic pathogen patterns, as well as create opportunities for exotic pathogens to spread more extensively. The Welsh Government is committed to ensuring that the animal disease surveillance system for Wales and Great Britain has maintained capability and coverage and is able to detect significant changes in climate-related threats to animal health.

What next?

Agriculture policy is currently a very active area of development and is a key commitment within our Programme for Government, especially in relation to the forthcoming SFS. Our policy approach will help to address the very significant areas of risk to agriculture arising from extreme weather events and changing climatic conditions, as highlighted by the CCC's 2021 climate risk advice.

While climate change impacts on livestock systems are not addressed explicitly within *A Climate Conscious Wales*, we are considering further measures that may be necessary for climate change adaptation, both in terms of accommodating predicted changes to population diet for climate change mitigation, and in terms of pasture viability, animal health, welfare and diseases. This includes the need to consider diseases that may affect both animals and humans and the impact of climate change on the increased presence of vectors (e.g. mosquitoes, ticks and midges).

The Welsh Government published an outline of the SFS in July this year[20] and has launched the second phase of co-design in collaboration with stakeholders. Throughout the scheme design process the Welsh Government is seeking to ensure the SFS establishes and delivers support to the agricultural industry to ensure it is resilient and meets the challenges of the climate emergency. The intention is to start the transition to the new system of farm support from 2025.

Leading up to 2025, through our rural investment schemes, £275m of support will be provided across a range of low carbon farming measures, schemes supporting land use change alongside wider environmental goals, and sustainable food and farming supply chains aligned to the delivery of Net Zero Wales and the sustainable management of natural resources.

Through these schemes we will continue to support investments and activities that enhance the environmental, technical and financial performance of farm businesses while also targeting areas of Wales where the greatest environmental benefit can be achieved. Investment in infrastructure to enhance on-farm nutrient management will continue to be a priority, as well as supporting small capital works that provide environmental improvements such as new or renovated hedgerows.

This year the Welsh Government launched its first grants schemes dedicated specifically to horticulture. These grants for new equipment are designed to contribute towards environmental, social and economic benefits that can come from a successful horticultural sector, with consideration of the need for viable alternative species and varieties of plants and trees in the face of climate change. A new Organic Conversion Scheme has been opened this year to support farmers during the conversion period as they transition their land to a system which does not use artificial fertilisers or pesticides. A new Growing for the

Environment grant scheme[23] to encourage the growing of crops and pastures that provide an environmental benefit, such as protein crops, mixed leys and cover crops, will also be offered. The crops supported within the scheme have been selected to provide environmental, biodiversity and cost saving production benefits to farm businesses.

Further to our Capability, Suitability & Climate Programme that assessed a range of climate scenarios and Wales' potential for a range of cropping options, we are also undertaking further research to assess how grass growth may respond under future climate scenarios.

Work on understanding how the risk of how sea level rise and saltwater intrusion would impact aquifers and agricultural land in Wales is not currently being progressed, but we plan to commission a risk assessment to consider this in the future.

3.1.3: Terrestrial Ecosystems

The actions set out within *A Climate Conscious Wales* in relation to terrestrial ecosystems are focused on maintaining and enhancing our protected sites and building resilient ecological networks across our wider landscapes. This includes the development of a robust evidence base for Area Statements[24], as well as actions focussed on embedding ecosystems resilience within wider Welsh Government policies such as the Sustainable Farming Scheme (SFS), and taking forward a management programme to improve the condition of our protected sites.

The CCC's 2021 climate risk advice highlights that the risks to terrestrial and freshwater habitats are still increasing as a result of the changing climate. Species and habitats are being impacted by changing climatic conditions and extreme weather events, including temperature change (on land and water), water scarcity, wildfire, flooding, wind, and altered hydrology (including water scarcity, flooding and saline intrusion). Further impacts include phenological shifts and changes to pests, pathogens and invasive species. The CCC have also highlighted the importance of considering potential opportunities arising from new species colonisations and changes to their geographical range.

Further information on peatland and soils, forestry and woodland, pests, diseases and Invasive Non-Native Species (INNS), and the SFS can be found in other sections within this report.

Research undertaken

In 2020, NRW launched its Wales Environmental Information Portal[84], providing access to a wide range of NRW GIS datasets that can be used to help define Resilient Ecological Networks (RENs). These include the Habitats Network maps, which describe the current connectivity of a range of semi-natural habitats, and the CuRVe (Current Relative Value) maps, which describe the relative level of ecosystem resilience across Wales. This is based on the DECCA attributes of ecosystem resilience framework (diversity, extent, condition, connectivity and adaptability) developed by NRW and provides an essential evidence base for targeting and managing resilient ecological networks across Wales. Use of the CuRVe mapping to help inform REN mapping has recently been piloted in Swansea and the Brecon Beacons National Park as well as feeding into the development of Area Statements.

In May 2021, NRW published its evaluation of the condition of protected site features across Wales. The baseline evaluation results confirm that more information is needed for nearly 50% of the features of interest on our protected sites (contained within 1071 SSSIs). The evaluation found 30% of protected sites are in unfavourable condition, but could be up to 60% if extrapolated

for features where the condition status is unknown. This lack of information is being addressed through the development of innovative and more collaborative monitoring programmes and a more risk-based approach to gain a better picture of the condition of these sites. Evidence on the condition of the protected site network is presented in the latest State of Natural Resources Report (SoNaRR)[26] published in December 2020. The updated surveys informed the final report published in March 2021.

As outlined in the CCC's 2021 climate risk advice, the ongoing decline in the state of nature in Wales leaves habitats and species more vulnerable to climate change impacts. The Welsh Government is currently working on modelling to explore how climate change and air pollution are affecting ancient woodlands, peatlands and protected sites. Whilst our overall strategic approach in Wales is aimed at maintaining and enhancing resilient ecological networks to accommodate species movement, further research is needed on individual habitats and species, particularly those listed as being of 'principle importance for the purpose of maintaining and enhancing biodiversity in relation to Wales' under Section 7 of the Environment (Wales) Act 2016[27].

Actions Taken

The Minister for Climate Change declared a nature emergency in an Oral Statement on Biodiversity in June 2021. "We see it as another part of the climate emergency. The nature emergency is being driven by changes in the climate, the reduction of habitat, and all the rest of it that goes alongside the climate emergency."

Wales is responding to the nature and climate emergencies which threaten our well-being. Nature recovery is key to rebuilding ecosystem resilience and sustaining the benefits that it provides for us. This needs to be done at a faster pace and at a larger scale if we are to reduce the potential impacts of these two interrelated emergencies.

Habitats and species are more resilient to damaging changes if they are diverse, are in good condition and have sufficient area with multiple connections across the landscape. Thinking at a landscape scale about managing integrated habitat networks to improve resilience and maintain or enhance nature (biodiversity) is a relatively new approach. It is an approach that seeks to shape not only the way landscape features are managed but also how different stakeholders could co-operate to achieve multiple environmental and socio-economic benefits. In Wales, we have coined the term 'Resilient Ecological Networks' (RENs) to describe this approach. It is a new way of working for many sectors, so NRW has published a practitioners' guide[28] which offers practical advice on using this approach. This guide has been used to develop ecosystem profiles for NRW's South Central Area Statement[29] and will continue to be used to help co-design and deliver the vision for RENs in this area going forward. An Ecosystem Resilience Field Guide[30] was also published in July 2021 to highlight the importance of ecosystem resilience and encourage practical action that can be taken to build this across Wales by a wide range of stakeholders.

Our Natural Resources Policy (NRP)[31] highlights the need to align all our policies to the delivery of the national priorities identified within it, such as the use of nature-based solutions, green infrastructure and the development of RENs. This cross-sector process is ongoing but has already been applied to our world-leading requirements to implement sustainable drainage systems (SuDS), our priority for nature-based flood management schemes, Planning Policy Wales, Future Wales the National Plan 2040[32] and also the development of our SFS.

For example, Future Wales contains indicative maps and strong policies to build Resilient Ecological Connectivity, a key element of RENs, into our development planning processes as well as identifying National Natural Resource Management Areas. In Policy 9, Resilient Ecological Networks and Green Infrastructure, the Welsh Government is working with key partners to identify areas which should be safeguarded and created as ecological networks. This is in recognition of their importance for adaptation to climate change, habitat protection, restoration or creation, to protect species, or which provide key ecosystems services, to ensure they are not unduly compromised by future development. In June 2022 the Welsh Government started pilot work with three Local Planning Authorities to develop an evidence base and ecosystem-led planning guidance for the Gwent Levels.

In April 2020 NRW published its Area Statements, which support the national priorities within the NRP and are linked to the NRW Environmental Information Portal. Area Statements are a key evidence source for all our nature recovery actions and activities across Wales, but also for Development Plans, and could inform opportunities for action under the new SFS.

Our core environment grant funding programmes, such as the Sustainable Management Scheme[33] and the Enabling Natural Resources and Well-being in Wales scheme[34], which include requirements for addressing ecosystem resilience, have generated a number of exemplar landscape scale initiatives and projects across Wales. Our National Peatland Action Programme (NPAP)[35] is working within the Tywi Forest to restore peatland within and around protected sites, and other site restoration work is being carried out through the Sands of LIFE, Dee, Marches and Mosses and Welsh Raised Bog LIFE funded projects.

At the core of our RENs and essential for climate change adaptation are our protected sites (SSSIs, SACs, SPAs, NNRs and Ramsar sites) which contain some of our richest biodiversity. However, as described above, many of their features are in unfavourable condition. It is essential that these are improved. The Welsh Government is working with NRW and others on the development of a multi-year Nature Networks management programme to address this. The type of projects funded so far include connecting fragmented woodlands to enable species to establish habitat over larger areas, reducing phosphate pollution in rivers to protect nature downstream, and improving the condition of habitats to enable some of our most iconic species to have greater freedom to conduct their lifecycles, such as the curlew and marsh fritillary butterflies.

The Nature Networks Programme (NNP) has now moved on to develop large-scale planning for the management of our protected sites in Wales, aiming to tackle the key issues to improve the condition of site features, whilst strategically targeting action to consolidate and build networks between them to improve ecosystems resilience. Priority Ecological Networks (PENs) have been identified which encompass many Protected Sites and the areas in between which connect them and are a basis now for planning action for Nature Networks. Existing network modelling provides a foundation for this. Maps have been produced of networks that provide potentially good connectivity between SSSIs for marine, woodland, grassland, heathland, fens, bogs, and coastal habitats.

While the approach to our NNP builds in climate change adaptation into the strategic restoration and management of our protected sites by considering these in the context of mapped Priority Ecological Networks, there is still a need, as highlighted by the CCC's 2021 climate risk advice, to fully embed adaptation into individual protected site management plans.

At a smaller scale our Local Places for Nature (LPN) scheme, launched at the start of 2020 with the aim of supporting communities to create nature on their doorstep, works with local authorities and community groups both large and small. Whilst the NNP delivers at landscape scale, the LPN scheme supports modest measures that can make a big difference at a community level, improving access to nature by creating and enhancing green spaces closest to where people live and work, from community food growing to nature-friendly mowing practices. Such measures can help biodiversity thrive within our urban areas and green infrastructure and make them more resilient in the face of a changing climate.

The Welsh Government updated the NRAP in 2020 to cover the period 2020-21, in order to take into account the growing evidence around the scale of the loss of biodiversity and the changing policy context in Wales. This includes consideration of the current legislative framework and the NRP, the expected impacts of our exit from the EU, the escalating ecological crisis and the need to respond to the climate and nature emergency.

What next?

The Welsh Government is working to build ecosystem resilience in Wales in the context of the additional impacts arising from climate change, as set out within the CCC's 2021 climate risk advice.

In accordance with the commitments within our Programme for Government, we are working towards the establishment of an Environmental Governance Body, a statutory duty and targets to protect and restore biodiversity, delivering nature-based flood management in all major river catchments to expand wetland and woodland habitats. We also intend to legislate to strengthen the requirements for the use of sustainable drainage systems that provide wildlife habitat.

Wales is committed to the Convention on Biological Diversity (CBD)[36] and the upcoming Conference of the Parties 15 (COP15), during which the post-2020 Global Biodiversity Framework (GBF) will be finalised. Wales has been working with the other UK administrations to help shape the UK contribution to the Framework and to plan for how Wales will deliver the individual goals and targets. The framework is likely to contain commitments to enhance the integrity of all ecosystems, with an increase of at least 15 per cent in the area, connectivity and integrity of natural ecosystems, supporting healthy and resilient populations of all species. It will also contain targets for integrated biodiversity-inclusive spatial planning: to have at least 20% of degraded ecosystem under restoration and at least 30% globally of land and sea areas, especially areas of particular importance for biodiversity and contributions to people, conserved through effective management by 2030 (commonly referred to as the '30 by 30' target).

The Minister for Climate Change has publicly announced her support for the '30 by 30' target. In May this year we started a Ministerial 'Deep Dive' process to focus on identifying and mobilising practical actions to meet this target which, linked to other targets such as the restoration target, will sharpen our approach to halt and reverse biodiversity decline and in turn help nature better adapt to a changing climate. The results of the Deep Dive, published in October 2022, include a set of additional actions to help Wales meet its Global targets[37].

The Welsh Government has committed to set its own statutory duty and targets for biodiversity within this Senedd term which will link to the Global targets and our statutory natural resource management framework, including our Natural Resources Policy, Nature Recovery Action Plan (NRAP)[25], SoNaRR and Area Statements. The Welsh Government will work with NRW and other stakeholders to consolidate the appropriate evidence base linked to each of the relevant targets to enable the robust baselining, objective setting, monitoring and reporting of progress.

Looking to the immediate future with around 80% of Wales being farmland, the Welsh Government is seeking to ensure that the SFS delivers strongly for biodiversity and climate change adaptation by improving the diversity and resilience of the whole farm ecosystem (both agricultural and semi-natural), in order to contribute to the wider resilience of terrestrial ecosystems. This includes incentivising specific farming practices over others to improve ecosystem resilience.

3.1.4: Pests, Diseases and Invasive Non-Native Species (INNS)

The actions set out within *A Climate Conscious Wales* for this policy area include implementation of the Great Britain (GB) INNS strategy[38], development of biosecurity measures, raising awareness and setting priorities and contingency planning for newly arrived INNS.

The CCC's 2021 updated climate risk advice recognises the level of risk arising from pests, pathogens and invasive species is still increasing in the face of the changing climate. This has the potential to impact upon agriculture, forestry, and terrestrial, freshwater and marine species and ecosystems.

Research undertaken

A GB horizon scanning exercise was conducted late in 2019[39] to identify the top thirty non-native species likely to become invasive in GB in the next 10 years. Horizon scanning is a key element in work to help prevent these new species from arriving and establishing in GB and helps guide our efforts on risk analysis, pathway management and contingency planning.

NRW undertook a Welsh marine invasive non-native species pathways assessment in 2020 and an assessment in 2021 of the impact of key marine invasive non-native species on Welsh Marine Protected Area (MPA) habitat features, fisheries and aquaculture. NRW have also completed periodic monitoring of the sea squirt species *Didemnum vexillum* at Holyhead Marina since the eradication attempt in 2009-13. The Welsh Government funded a trial of further eradication options in 2020-21, which will continue as part of the Nature Networks programme.

In 2021 and 2022 the Welsh Government provided funding to CABI Biosciences to undertake trials in Wales using biological control agents to help tackle the priority invasive plant species Himalayan balsam and New Zealand pygmyweed.

CABI biosciences were also contracted in late 2021 to update a review of the economic impacts of INNS. The last such review was undertaken in 2010[40] and evaluated the cost to the GB economy to be £1.7 billion pa or £1.25m for Wales. It is anticipated the latest review will be published later this year.

Actions Taken

The requirements of the EU Invasive Alien Species Regulation (No. 1143/2014) (IAS Reg)[41] have been retained in domestic legislation under the EU Withdrawal Act. Operability amendments were made,

principally through the Invasive Non-native Species (Amendment etc.) (EU Exit) Regulations 2019. Enforcement and permitting requirements of the IAS Reg are implemented through the Invasive Alien Species (Enforcement and Permitting) Order 2019[42], which came into force in December 2019. This includes new licensing and permitting mechanisms which are managed in Wales by NRW and the Animal and Plant Health Agency (APHA) respectively. The licensing regime forms part of the management measures for widespread invasive species. The Welsh Government leads on the rapid response to incursions of non-widely-spread species listed under the IAS Reg, working with NRW and other bodies. An assessment has been undertaken of the current list of species listed under the IAS Reg based on future climate predictions, which will help to focus resources on species that are of greater threat.

The Welsh Government and other stakeholders in Wales continue to collaborate on the actions within the 2015 GB INNS Strategy and associated public awareness campaigns. The Strategy is currently under review and a refreshed version is due to be published later this year. Work includes:

- Improving biosecurity and the prevention of new INNS, pests and diseases in Wales, for example the development of GB Pathway Action Plans (PAPs)[44] to prevent or manage the spread of INNS within high priority sectors.
- National campaigns targeting INNS and biosecurity, for example the 2020 relaunch of the Be Plant Wise campaign[45] to help reduce the risk of invasive non-native garden plants spreading into the wild.

The Welsh Government also works with a wide range of other groups and projects, including:

- The Wales Biodiversity Partnership INNS Group[46], which brings together expert stakeholders to support the Nature Recovery Action Plan in Wales and acts as the country-level INNS group for Wales under the GB INNS Strategy.
- Working with NRW and Dwr Cymru to provide funding to the Wales Resilient Ecological Network project[47], which is establishing a framework for tackling invasive species across Wales in a collaborative, strategic and sustainable way.
- Funding a project being undertaken by the North Wales Wildlife Trust to pilot the use of new eDNA techniques to undertake early INNS detection and monitoring in river catchments.
- Participating in the UK Plant Health Risk Group which maintains the UK Plant Health Risk register.
- Working with NRW to produce and implement draft contingency plans for terrestrial vertebrates, freshwater animals, plants and marine INNS in Wales, including the provision of funding. These draft plans are used to guide responses to incursions of newly arrived species in Wales. From 2021 onwards we are providing funding to NRW to monitor and start to eradicate the invasive fish Topmouth gudgeon from waterbodies in south-west Wales.
- Contributing to the running of a pilot GB INNS Inspectorate[48], based within the APHA, which aims to complement the existing inspectorates for the other biosecurity regimes in GB (Plant Health, Animal Health, Fish Health and Bee Health).
- Working with NRW to engage with the British Irish Council Biosecurity in Aquaculture Working Group, which is working towards a voluntary biosecurity protocol in the shellfish and integrated aquaculture industry.

- Establishing a European Maritime and Fisheries Fund (EMFF) Biosecurity Project, to develop and roll out effective biosecurity planning for Pen Llŷn a'r Sarnau (PLAS) European Marine Protected Site (EMS). A Wales specific marine INNS identification guide was published earlier this year.
- Working in partnership with APHA on the establishment of the Wales Sentinel Site network[49], which provides an early warning system for potential tree and plant pests and diseases.

Other areas of work being undertaken by NRW include:

- Working with the Forestry Commission and the Animal and Plant Health Agency to carry out extensive monitoring on behalf of the Welsh Government for plant pests both at the borders and in the wider environment and supporting appropriate responses.
- Managing the Welsh Government Woodland Estate (WGWE), taking into account the increased risks from pests and diseases arising from the changing climate.
- Participating in the Marine Climate Change Impacts Partnership (MCCIP) which has carried out work investigating the impacts of climate change on the future establishment and spread of marine INNS[50].
- Including appropriate biosecurity conditions within marine licences, for example in the consideration of the use of Pacific Oysters by shellfish producers.

What next?

Action will continue in order to improve our processes and develop tools to ensure the effective fulfilment of obligations under the IAS Reg in Wales. The draft refreshed GB INNS Strategy highlights the links between taking action to tackle INNS and climate change issues, and while a considerable amount of work is being undertaken on the ground to tackle INNS in Wales, there is scope to improve the coordination of these activities in line with the GB INNS strategy. The Welsh Government will continue to support the Wales Resilient Ecological Network project[47] to help overcome these barriers.

The Welsh Government will continue to contribute to the pilot INNS Inspectorate, which will have a particular focus on work at the border and will improve measures to intercept new introductions. We will also continue to fund biocontrol trials to improve control of plant INNS and reduce the use of chemical pesticides.

NRW will work to develop a Marine INNS and Biosecurity workstream as part of the Nature Networks programme aimed at improving the condition of protected sites across Wales. This will be supported by two additional workstreams, one reviewing options for monitoring INNS to support biosecurity planning, and another which will investigate the use of novel technology for the removal of marine INNS.

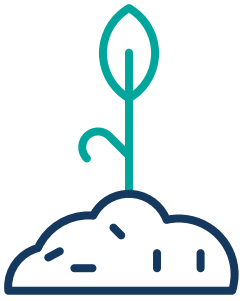
Our proposals for the Sustainable Farming Scheme (SFS) will also support farmers to take a holistic approach to pest management on farms through integrated pest management. The SFS is covered further in section 3.1.2.

3.1.5: Peatland and soils

The actions set out within *A Climate Conscious Wales* focus on the development of a National Peatland Action Programme (NPAP) and costed proposals for the provision of a five-year peatland restoration programme in Wales.

The CCC's 2021 climate risk advice highlights the increasing risks to soils arising from the changing climate, including temperature changes, seasonal aridity and wetness.

Healthy soils are essential for agricultural productivity and for healthy ecosystems. They are a key focus for addressing the nature emergency. They also represent our most significant natural carbon store so are critical for carbon-sequestration and for achieving our pathway to net zero emissions. Peatland restoration is essential in order to halt greenhouse gas emissions arising from damaged peatlands.



Research undertaken

A significant amount of research has been undertaken to inform the NPAP[35], which was launched in November 2020, as described in more detail in the next section.

The Welsh Government has worked with NRW to complete the following research activities:

2019/20 – Peatland condition assessments were undertaken to provide objective information concerning the ecological condition of a range of Welsh peatland sites.

2019/20 – Peatland depth and carbon surveys were undertaken to inform mapping and carbon stock estimates.

2019/2022 – NRW initiated surveys of the Welsh Government Woodland Estate (WGWE) in order to select relevant sites for inclusion within the five-year NPAP.

Survey work has continued in the second year of the NPAP programme to assess afforested peat within the WGWE. This will inform the upcoming forest resource planning process that NRW undertakes every ten years, which will be compiled within a new Forest Resource Plan (FRP).

In the first year of the NPAP programme, surveys were commissioned for the Dyfi, Coed Y Brenin and part of the Cambrian Mountains. The surveys have expanded in Year 2 to cover all or part of the Cambrian Mountains, Alwen, Cilcennin and Lampeter, Rhydymain, and Gwydyr areas.

The peat survey assessment uses a modified version of NRW's 2017 Afforested Peat Toolkit to ensure a:

- more ecologically relevant threshold for slope as a negative attribute
- specific element to assess current vegetation quality as an integrated measure of restorability
- reduced emphasis on the use of peat cracking and soil aeration depth as negative attributes.

The NPAP has invested in developing work plans for delivery in future years. This includes identifying NRW-owned land requiring restoration within current forest design plans, undertaking extensive drone surveys of inaccessible areas, obtaining environmental screenings for proposed sites, and addressing screening suggestions.

The Peatlands of Wales Map (PWM)[52] and the Welsh Peatland Data Portal[53] were launched in April this year. These provide an updated distribution map of Welsh peatlands as well as estimates of peat thickness (depth), carbon stock estimates, greenhouse gas emissions, and habitat and restoration data. The portal will also capture restoration activity from NRW and partner organisations for national reporting.

The NPAP has identified 105 different types of restoration activities and defined each of these in a coded checklist for completion by external grant recipients. Collated national activity maps are in preparation for publication, pending finalisation of data delivery from partners and data sharing agreements. These maps will be hosted on the Welsh Peatland Data Portal and made available to download from Data Map Wales[54].

We are working with academics to develop a robust programme of research and evidence on the implications of climate change on disused coal tips. Focus areas include rainfall events and inclement weather, biodiversity and habitats, and the resilience of existing infrastructure. This work is aimed at ensuring that future strategies in the management and reclamation of disused tips are robust to the challenges climate change brings. Progress is being made in supporting research across this area, both directly and indirectly, through funding and sponsorship, making data accessible and supporting the establishment of forums and communities.

Actions Taken

The National Peatland Action Programme (NPAP)[35] was launched in November 2020, informed and supported by a range of research and development activities described above. The NPAP is a 5-year programme funded by the Welsh Government and delivered by NRW. Restoration actions aim to ensure peatland bodies are able to function with a changing climate and continue to provide resilient ecological networks for water, carbon and biodiversity.

The NPAP is delivering peatland restoration through:

- Targeted actions to restore degraded carbon stores in peatlands, which continue to be delivered by the NPAP with coordinated proposals being developed for the SFS.
- Preventing the loss of soil resources – functioning wet bogs where erosion and fire risk have been reduced.
- Repairing and maintaining the hydrological integrity of peat bodies.
- Restoring peatland bodies to provide resilient ecological networks for water carbon and habitats.
- Peatland monitoring and data recording through the NPAP and Peatland Data Portal.

The NPAP has delivered:

- 2020/21: >650ha of restored peatland with restoration activity occurring over ~1,500ha, ~50ha of which was on the WGWE.
- 2021/22: >1,000ha of restored peatland with restoration activity occurring over ~2,700ha, ~63ha of which was on the WGWE.

The Historic Environment Group Climate Change Subgroup has also established a Peatland Working Group to connect the historic environment with the NPAP.

What next?

The NPAP has invested in developing work plans for delivery in future years. This will include identifying NRW-owned land requiring restoration within current forest design plans, undertaking extensive drone surveys of inaccessible areas, obtaining environmental screenings for proposed sites, and addressing screening suggestions (e.g. obtaining water course consents, water vole licences, peat surveys, data collation, undertaking line-checks etc). The NPAP has also worked to develop further land management agreements (under Section 16 of the Environment (Wales) Act 2016)[27], so that they can be finalised and delivered in subsequent financial years. The Welsh government is developing plans to raise the ambition set out in the NPAP, so that by 2030 the programme will be delivering at a scale capable of reaching the net zero 2050 target of 45,000 ha of peatland restored.

The proposed Sustainable Farming Scheme (SFS) seeks to incentivise farming practices that increase and protect the carbon content of agricultural soils where possible and includes provisions for the protection and enhancement of peatland habitats. The Welsh Government is currently working with farmers and other stakeholders in a process of codesign for the scheme. Further information about the SFS is covered in section 3.1.2.

Our Programme for Government includes a specific commitment that we will introduce legislation to deal with the legacy of centuries of mining and ensure coal tip safety, strengthening local authority powers to protect the public and the environment.

The White Paper consultation[55] on our proposals for a new regulatory regime on Coal Tip Safety in Wales closed on 04 August this year and work is on-going to develop a Bill for introduction in the Senedd legislative programme for 2022/23. A robust inspection regime has been introduced to identify any maintenance or urgent work requirements on coal tips and will run until a new regime is introduced under the new legislation.

The trialling of technology ensures appropriate technical solutions can support the longer-term monitoring of coal tips. Sensor equipment and earth observation techniques have been employed at over 70 higher-risk coal tip sites.

Given the increasing impacts of climate change that are now adding to the vulnerability of Wales' coal tips, the Welsh Government will explore options for necessary reclamation, repurposing and remediation work to help ensure our communities are safeguarded.

Case study

Peatland restoration at Carn Fflur, Ceredigion

Carn Fflur is an eroded peatland that has never been planted with trees but has suffered from possible historic drainage and landscaping works, and seeding-in from adjoining forestry. It is thought the areas of bare peat are historic, probably being caused by a combination of a drought and a wildfire. These areas have then struggled to re-vegetate naturally, resulting in areas of bare peat across the site. At Carn Fflur the eroded peat is to one metre deep. Restoration and rewetting will help the peat body to withstand periods of drought and will reduce fire risk.

Two separate contracts were undertaken on this site. Contract 1 focused on the felling of conifers using a chainsaw team, and chipping of a stunted, windblown crop of pine trees, using an excavator (with tree shears) and woodchipper. Broadleaved species on the main bog areas were chemically treated. Contract 2 focused on the construction of contour bunds, peat dams in channels and general groundworks restorations across the site.

Carn Fflur following tree removal and construction of contour bunds and peat dams.

3.1.6: Woodland and Forestry

A Climate Conscious Wales includes actions for increasing tree cover and well-located woodland to deliver ecosystem services and assist climate change adaptation. The plan also includes actions for restoring and improving woodland site condition and for addressing tree pests and diseases.

The CCC's 2021 climate risk advice highlights the increasing risks to forestry productivity due to extreme weather events and changing climatic conditions (including temperature change, water scarcity, wildfire, flooding, coastal erosion, wind) as well as from the impacts of pests, pathogens and invasive species. There are associated risks to the ability of forests to sequester carbon from the atmosphere as a key component of our decarbonisation pathway. The CCC have also highlighted the opportunities to adapt to climate change through the introduction of new and alternative tree species suitable for the future climate.

Research undertaken

The revised and updated Woodland Opportunity Map (WOM)[56] was launched in September 2021. This is an interactive on-line viewer which aims to identify areas of Wales most suited to tree planting based on the delivery of a range of ecosystem services. It also highlights areas that are potentially sensitive to woodland planting and provides further guidance on consultation with the appropriate authority.

The ERAMMP National Forest Evidence Pack[57] includes consideration of futureproofing our woodlands, including some modelling of species suitability for future climate scenarios.

The Welsh Government receives regular detailed reports from the Tree Health and Diagnostic Service within Forest Research in relation to tree pests and diseases in Wales, which are used to inform our actions and those of our partners.

Actions Taken

The Welsh Government and NRW are taking forward a range of policy measures to help address the climate-related risks to woodland and forestry, and our Programme for Government includes the following commitments:

- Creating a National Forest to extend from the North of Wales to the South, and harnessing the economic, cultural and recreational potential of the woodland as part of progress towards a sustainable timber industry.
- Supporting communities to create 30 new woodland and connect habitat areas, and strengthening the protections for ancient woodlands.
- Delivering nature-based flood management in all major river catchments to expand wetland and woodland habitats.
- Supporting active farmers and landowners based in Wales to encourage woodland creation on less productive land and exploring ways of drawing investment for woodland creation that secures local ownership and control.

The Woodlands for Wales Strategy (WWS)[58] sets the strategic policy direction for Welsh woodlands, including ambitions around woodland creation and woodland management, as part of a holistic approach to natural resources management, including consideration of climate change. The Welsh Government is committed to planting 43,000 hectares of woodland by 2030 and a total of 180,000 by 2050. 580 ha of new woodland was planted in Wales in 2021/22, and a further 1,480 ha of woodland restocking was funded.

All remaining woodland creation funded by the Glastir Woodland Creation (GWC) scheme is due to be completed by 31 March 2023. 5,284.92 ha of GWC planting was selected for support in the 2022/23 year. Contracts for over 1,800ha of new planting remain active and are due to be planted in the 22/23 planting season.

The Welsh Government has launched a Woodland Creation Planning Scheme to ensure that plans are compliant with UK Forestry Standard (UKFS)[59] before grant funding is allocated.

The Welsh Government continues to encourage and support tree planting in line with the principles of Sustainable Management of Natural Resources (SMNR)[13], through the UKFS and UK Woodland Assurance Scheme[60]. These schemes include consideration of climate change adaptation. For example, the UKFS includes a specific section on climate change, with measures to be considered when planning management of forest and woodlands. These range from climate adaptation planning for forests, to operational activities such as reducing disturbance to soils and the choice of appropriate species.

NRW continues to manage and improve the condition of the 11,221 ha of Plantation on Ancient Woodland Sites (PAWS) that exist within the Welsh Government Woodland Estate (WGWE), the requirements for which are set out in the UKFS.

The Welsh Government has promoted the i-Tree Eco tool[61], which is designed to quantify the benefits of urban trees so local authorities are able to make more informed decisions around resource management and policies. It has been adopted by Swansea Valley, Bridgend, Cardiff, Wrexham and more recently, Newport Local Authorities.

What next?

The Woodland Creation Grant Scheme for funding woodland creation was launched this year, replacing the Glastir Woodland Creation scheme.

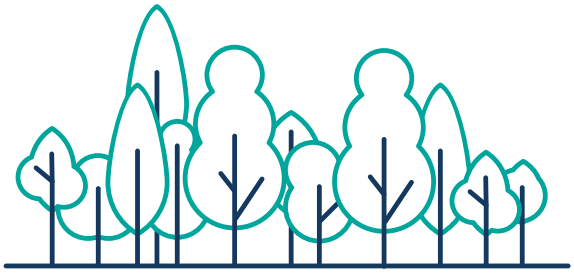
A Small Grants – Woodland Creation scheme was also launched this year for schemes planting up to 2 ha of predominantly broadleaved woodland in low-risk sensitivity areas below the upper limit of enclosure. These schemes will have a UKFS compliant plan, but will not need a registered woodland planner to write the scheme.

The Welsh Government is aiming to maximise the adaptation benefits in the design of the National Forest for Wales[62], the details of which are currently in development. The National Forest aims to improve ecosystem resilience through the creation of a connected woodland network running throughout Wales, incorporating existing ancient woodland sites.

Further work will be needed to ensure the delivery of timely, appropriately located tree cover at the scale required to deliver the necessary ecosystem service value, climate change adaptation and mitigation.

This work will be supported by the Sustainable Farming Scheme (SFS) incentivising the management and creation of on-farm woodland, alongside tree planting for the purposes of supporting agricultural production through agroforestry systems.

Work is ongoing to understand resilient trees species and varieties for the future climate and to monitor risks in relation to tree pests and diseases.



3.2: Protecting our Coasts and Seas

3.2.1: Coastal Erosion and Flooding

The focus within *A Climate Conscious Wales* for this policy area is on the delivery of the updated Flood and Coastal Erosion Risk Management (FCERM) Strategy and associated measures. The increasing risks to our society, infrastructure and natural resources arising from sea level rise, storms, coastal erosion and flooding are also highlighted further within the CCC's 2021 updated climate risk advice.

Research undertaken

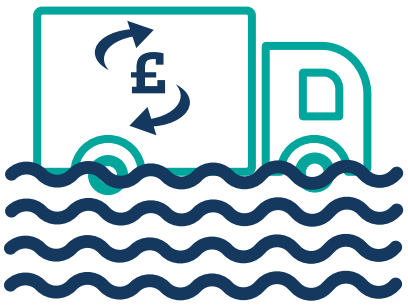
The FCERM strategy[63], published in October 2020, includes provisions to address research gaps and sets out the approach to monitoring, funding and prioritisation of actions.

A National Asset Database has been initiated which provides, for the first time, a complete overview of asset ownership and condition across Wales. Further mapping improvements were introduced in 2020 with the new Flood Risk Assessment Wales (FRAW)[64]. This is helping to improve our understanding of risk and, together with the improved asset data, gives a much more realistic estimation of true present day flood risk from all sources. Future scenarios arising from climate change are also being considered and the Welsh Government will continue to work with NRW to consider the appropriate timing and scope of publication to inform climate adaptation.

The Welsh Government continues to support the Wales Coastal Monitoring Centre (WCMC). Conwy, Gwynedd, the Vale of Glamorgan Councils and Welsh Local Government Association (WLGA) take a collective lead, assisting all coastal Risk Management Authorities (RMAs) by managing and sharing relevant data on coastal processes.

Other monitoring programmes are also underway, including the Pembrokeshire Coast National Park Authority's Changing Coasts project, involving the public in monitoring of the coastal path through fixed point photography.

We are taking into account the latest published research findings to inform policy in relation to landfill waste management options and Shoreline Management Planning in the context of predicted sea level rises. This includes consideration of building or upgrading shoreline flood defences or managed realignment in cases where continued defence into the future may no longer be sustainable and thus create more space for water/sea and potential habitat creation.



Actions Taken

The FCERM strategy sets out our long-term policies for managing flooding, as well as the measures which will be taken over the next decade by organisations like NRW, Local Authorities and water companies to improve how we plan, prepare and adapt to climate change over the coming century. The strategy reflects the new methodologies and data available from all sources of flooding to enable prioritisation of funding for communities at greatest risk. An advisory board has been set up to aid decision making and share best practice, as well as a National Programme of Investment for FCERM.

In addition, Coastal Groups, who have a regional strategic overview of coastal management, are made up of Local Authorities, NRW, the Welsh Government and other bodies with coastal responsibilities, such as Network Rail. They are responsible for producing, implementing and monitoring the progress of Shoreline Management Plans (SMPs), as part of the overall governance of flood and coastal management. They report to Welsh Ministers via the Flood & Coastal Erosion Committee. An unpublished update of the SMP approach was undertaken this year which improved guidance and undertook a 'health check' of the associated policy documents. These have been passed to the relevant local Coastal Groups for action.

The use of SMPs to inform decision making by Local Planning Authorities has been limited to date. The revised Technical Advice Note (TAN) 15 planning guidance seeks to address this by bringing consideration of SMP policy into the main planning policy document on flood risk (see Section 3.4.3).

The FCERM programme supports Local Authorities to deliver schemes to reduce the risks associated with flooding and coastal erosion, in line with the national strategy. This programme, which commenced in 2019, aims to reduce risk to over 15,000 properties over a 4-year period. In 2022/23 we are investing £34m capital and £37.1m revenue across Wales.

A key priority of the FCERM Strategy and reinforced through the Programme for Government, is to deliver more natural interventions and catchment approaches to help improve environmental, social and economic resilience. This includes working with natural processes and green infrastructure, collectively defined as Natural Flood Management (NFM). Research into NFM indicates that while it may not always be effective in isolation, or during extreme flood events, it can be effective in larger catchment scale projects or when used in conjunction with more traditional interventions, acting to reduce and delay peak flows, thereby reducing the risk of other defences failing or being overtopped. Examples of NFM include interventions such as tree planting, offline water storage areas, in-stream obstructions, soil and land management, dune and beach management and creation of new wetlands.

Mitigating flood risk through NFM also aligns with our Natural Resources Policy[31] and our move towards a low carbon economy. The Welsh Government is seeking to improve the pace of delivery of NFM and catchment schemes throughout Wales, using approaches that replicate natural processes to help protect the coastline and reduce the rate of run-off from upper catchment areas into our rivers and streams.

Our new Natural Flood Management Programme which provided 100% grants and £2.46m for its first two years has had excellent take-up, with 15 schemes approved as of March 2021. A key element of this additional support is monitoring outcomes and sharing experiences between RMAs so that lessons can be learned on all stages of NFM delivery.

Cadw is working to raise awareness and use of its technical guidance on Flooding and Historic Buildings in Wales[66], which was published in July 2019.

What Next?

In accordance with our Programme for Government commitments, we are funding additional flood protection for more than 45,000 homes. The schemes will be designed to plan for and implement measures so they can adapt to a changing climate through a managed, adaptive approach. We will continue to develop nature-based flood management in river catchments and coastal areas. We will commission an independent

review of the NRW and Local Government reports (under Section 19 of the Flood and Water Management Act 2010)[67] and into the extreme flooding in winter 2020-21. We are also establishing a targeted scheme to support restoration of seagrass and saltmarsh habitats along our coastline[68].

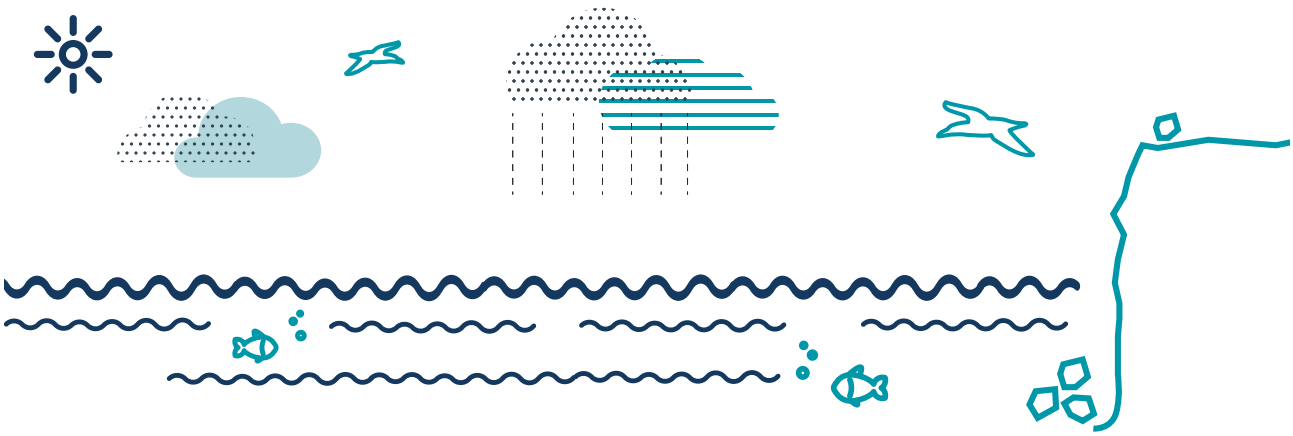
We will continue to work with agricultural partners to encourage appropriate land management practices and NFM schemes, utilising NRW's published maps to identify potential locations for such measures within river catchments.

The four Welsh SMPs will be complemented by coastal adaptation guidance, which will also support RMAs in implementing 'managed realignment' and 'no active intervention' policies in cases where this represents a change in approach. The challenge is to consider coastal erosion as part of a wider process of coastal change in combination with rising sea levels and increasingly frequent storm events.

We will work to ensure that contingency plans, including building or upgrading of artificial defences and Shore Management Planning, are developed to manage the risks, recognising that climate change will exacerbate the risk of erosion and flooding, and could also result in the release of solid waste and leachate from landfill sites, industrial and household premises.

The role of the TAN15 planning policy guidance[69] on flood risk management, is covered further in Section 3.4.3. The associated Flood Map for Planning published in September 2021, maps predicted flood extents from rivers, the sea and from surface water and small watercourses taking account of climate change over a 100-year development lifetime period. It also reflects the SMP approach and will soon map erosion bands over different time periods. This is providing an informative first step that can be used to help tackle the impact of climate change through the avoidance of risk and awareness raising.

Wastewater and drainage aspects are considered further in section 3.4.1.



Case study

Salt marsh creation, St Ivy

Cwm Ivy Marsh, on the North Gower coast, is a site of lowland fen meadow and freshwater ditches behind a sea wall defence, owned by the National Trust. The SMP policy for this section of the coast is No Active Intervention, with no planned investment in new defences as it is not cost-effective and the natural environment is considered capable of responding effectively. The marsh was protected by a sea wall since the 17th century which over the years was increased in size and strength. In 2014, the wall breached and the sea is now reclaiming the land, transforming Cwm Ivy from freshwater marsh to saltmarsh. The area of new saltmarsh created is around 20 hectares, growing to a potential of 38 hectares.

3.2.2 Marine Ecosystems and Fisheries

A Climate Conscious Wales sets out actions for this policy area focused on understanding and mitigating risks to marine habitats and fisheries and safeguarding the features and resilience of designated sites.

The CCC's 2021 climate risk evidence update highlights the increasing risks to marine species, habitats and fisheries as a result of changing climate conditions, ocean acidification and higher water temperatures, and from pests, pathogens and invasive species. The CCC's assessment also highlights the risk of reduced natural carbon storage capacity in the oceans.

Research undertaken

The Welsh Government is developing its climate change marine evidence base, working closely with NRW and other stakeholders. For example, we contribute funding to the Marine Climate Change Impacts Partnership (MCCIP), which produces report cards[70] on the impacts of climate change on a range of issues, including habitats, fisheries and aquaculture.

The Marine Online Assessment Tool (MOAT)[71] provides the evidence used to inform assessments of Good Environmental Status (GES) in UK waters and of Marine Protected Areas (MPAs), including consideration of climate impacts on marine processes.

The second edition of the State of Natural Resources Report (SoNaRR 2020)[26], published in March 2021, includes a register of marine pressures and opportunities. The Marine Area Statement[72] also brings together evidence of the impacts of climate change on marine ecosystems and their resilience, and proposes key themes for place-based action.

Improving our understanding of the potential impacts of climate change on marine ecosystems, in particular in relation to fish stocks (including disease and aquaculture), MPA features, and 'Section 7' listed habitats and species (under the Environment (Wales) Act 2016), is also a priority of the Welsh Marine Evidence Strategy[73], published in 2019. The strategy will report on research outputs annually (internally only in 2021), including results on a study of the vulnerability of habitats within MPAs to climate change pressures. A study of the vulnerability of our fishing fleet is also underway as part of assessing the resilience of Welsh fisheries to climate change.

NRW also contributes funding to the MarClim project[74], which is undertaking a fifteen-year programme of annual surveys across 100 long-term rocky intertidal sites.

A Nature Networks funded project is also aiming to assess the wider extent of coastal habitat that will be lost through changes to the coastline within the context of climate change. This evidence work will be critical in understanding the full scale of potential 'coastal squeeze' losses compared with the likely compensatory measures provided through the NRW-managed National Habitat Creation Programme (NHCP).

Actions taken

The Welsh Government is co-ordinating the management and delivery of actions for the MPA network via the MPA Management Steering Group, to ensure the resilience and coherence of the network.

We are collaborating on the UK Marine Strategy Part 3, which will set out the measures taken to achieve GES in our waters.

We are also progressing a programme of work to improve marine control and enforcement monitoring systems, which will further protect marine ecosystems. Key deliverables include

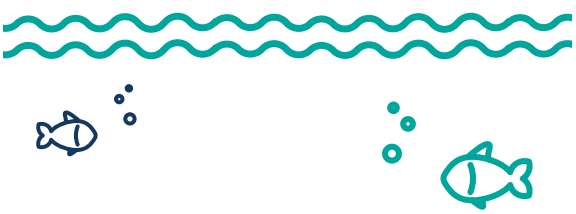
the introduction of Catch recording for under 10m vessels and the Inshore Vessel Monitoring System for under 12m vessels. These new systems are providing new data on fishing activity in Welsh waters, for decision making about the management of the marine environment.

The Welsh National Marine Plan (WNMP)[75], published in November 2019, includes policies directly related to climate change resilience, with supporting implementation guidance published in June 2020[76].

The FCERM strategy also helps to address the loss of coastal habitat as a result of 'coastal squeeze' resulting from sea level rise, in relation to some types of sea defence interventions by RMAs. NRW also manages the NHCP, which aims to deliver timely and appropriate compensatory measures, based on a collaborative approach between RMAs[77].

What Next?

In line with the CCC's 2021 climate risk advice, the Welsh Government is continuing to develop policy measures to address the increasing risks to fisheries, marine species and ecosystems arising from the changing climate. Our Programme for Government also includes a specific commitment to establish a targeted scheme to support restoration of seagrass and saltmarsh habitats along our coastline. A partnership project managed by the World Wildlife Fund (WWF) has begun off the Llŷn Peninsula in Gwynedd and Anglesey, with the aim of creating 10 hectares (25 acres) of seagrass meadow by the end of 2026.



The Welsh Government will continue to develop its marine climate change evidence base to meet priorities highlighted within the Welsh Marine Evidence Strategy[73] and policies in the Joint Fisheries Statement[79] and Net Zero Wales[80]. This includes identifying and developing research to address the evidence needs around the management of blue carbon habitats, through working with the Welsh research community and the UK Blue Carbon Evidence Partnership.

Maps of the distribution of habitats and species underpin much of our evidence work and we will continue to work with NRW to improve maps for marine mammal, bird and non-native species distributions.

Climate change has and will continue to alter the marine environment around the UK, changing the species composition of marine ecosystems. As the biogeographic range of economically important fish and shellfish stocks change there will be consequential changes in fishing activity. In accordance with the climate change objective of the UK Fisheries Act[81], the Welsh Government, as a fisheries policy authority, will support fisheries to adapt to these changes and challenges. We will also pursue appropriate policies to control fishing activity on vulnerable stocks and to protect, recover and enhance valuable blue carbon habitats.

We will continue to work towards a well-managed and resilient MPA network, building on the actions within the MPA Action Plan to improve our understanding of the increasing pressures of climate change. The MPA Network completion project will also help to increase the resilience of the network

Further research is being considered for those areas where GES is not currently being achieved and which are linked to climate change (for example food availability, habitats, water quality and wider biodiversity). We will also consider the findings of the Joint Nature Conservation Committee's (JNCC) work due to be published in 2023, which will provide an update of the MOAT and the assessment of GES.

Case study

Understanding climate change impacts on MPA features

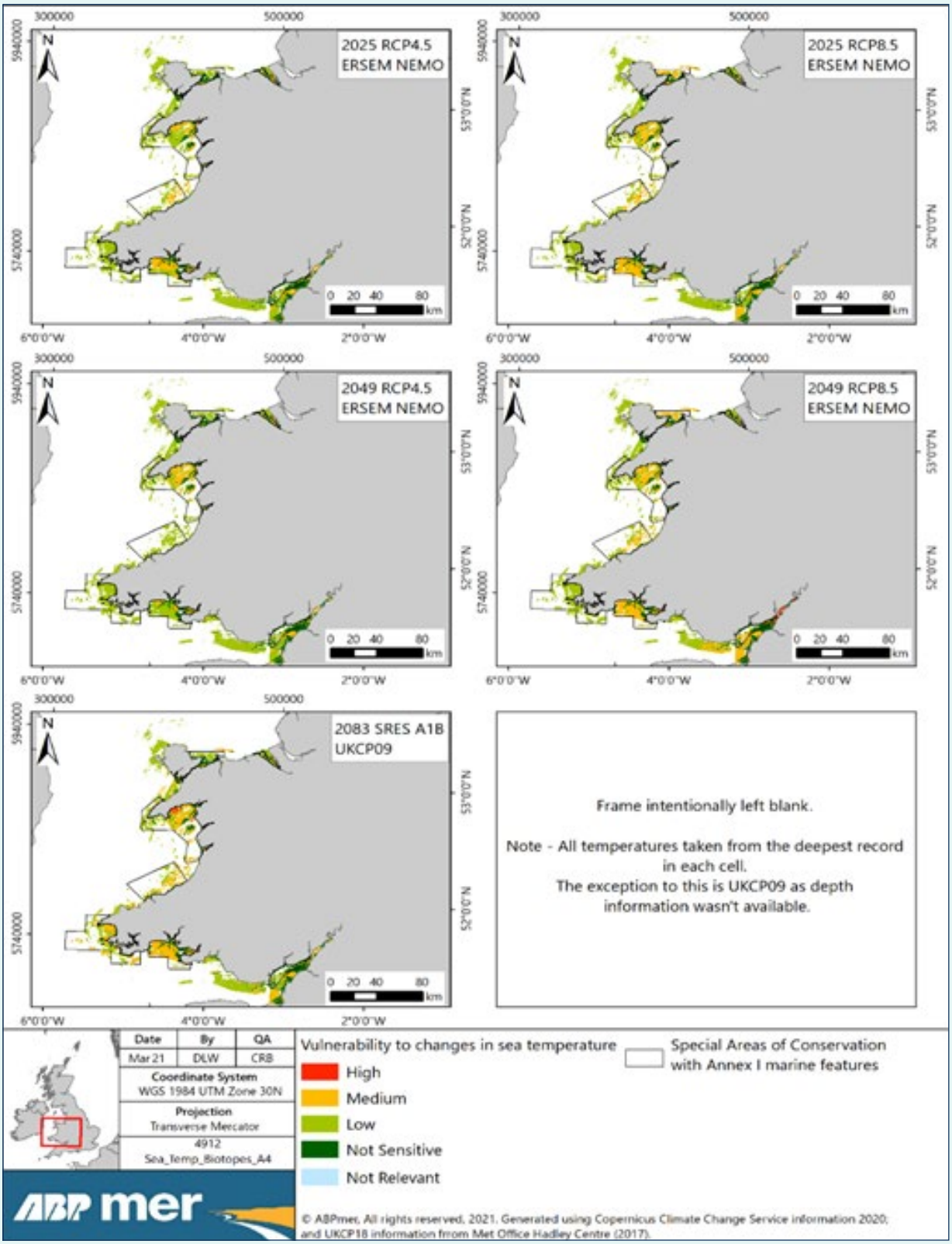
Like the rest of the marine environment, our Marine Protected Areas (MPAs) will be impacted by climate change. If we can understand more about these likely impacts, we may be able to introduce measures to increase resilience of MPAs to climate change.

ABPmer was commissioned by NRW to further the understanding of climate change pressures on Habitats Directive Annex I marine habitat features, and their levels of vulnerability under various emission scenarios and management timeframes (up to 2100). This involved developing a Geographic Information Systems (GIS) based model using the latest climate projections and spatial data on marine habitats in Wales. A literature review on the sensitivities of features to climate driven physical and chemical pressures was also undertaken to inform the assessment and set thresholds in the model.

The outputs of the modelling work (Oaten et al., 2021)[82] indicate that intertidal features such as saltmarsh, intertidal reef and mudflats and sandflats not covered by seawater at low tide are most likely to be vulnerable to climate change. The vulnerability of these features is mainly driven by projected rises in sea level, which result in nearly all intertidal component biotopes being assessed as having high vulnerability by the end of the century. Intertidal features are also considered vulnerable to other climate change pressures such as air temperature, wave exposure, and sea temperature change.

The outputs from this project can be used to help identify any likely future changes in feature vulnerability resulting from climate change pressures, which in turn will feed into the development of climate-related management and/or adaptation options at feature, site and network levels.

Vulnerability of component biotopes of Annex I marine habitats to projected sea temperature change in Wales.



3.3: Staying Healthy

3.3.1: Heat and Weather Impacts

We know the environment around us, the places where we live, work and play, can have a profound impact on our health and wellbeing. Climate change is a prime example of this relationship and is regarded by the World Health Organization (WHO) as the single biggest health threat facing humanity[86]. The health impacts of climate change incidents are already being reported in the UK and here in Wales. For example, Storm Christoph hit the UK in January 2021 and Storm Arwen in November 2021, causing major flooding and damage to homes in Scotland, Northern Ireland, North Wales and North-West England. There were significant floods in South Wales in October 2021 and July 18 2022 saw the hottest day on record in Wales, with 37.2 Celsius recorded at Hawarden (Flintshire) easily surpassing the previous record high of 35.2 C.

A Climate Conscious Wales includes actions to improve our understanding of the risks that increased temperatures and extreme weather bring to public health and well-being, and to the delivery of health and social services. The actions also focus on improving contingency planning across the health system. These areas have also been highlighted within the CCC's 2021 updated climate risk advice.

Heat and weather impacts are not felt equally across society and can exacerbate existing health and wider inequalities. Socially vulnerable neighbourhoods are over-represented in areas prone to flooding and certain parts of society are less able to cope with the effects of flooding. The most vulnerable are the very young, the elderly and disabled, or those already in poor health, who may require additional support during a flood event for example.

Research undertaken

Social vulnerability to flooding is now being considered through the Communities at Risk Register (CARR)[83]. The Social Flood Vulnerability Index (SFVI) is one of the datasets used in the calculation. The SFVI is a composite index based upon three social indicators (long-term sick, single parents and elderly) and four financial deprivation outcomes indicators (home and car ownership, unemployment and overcrowding). The score is then categorised into 5 bands (score 1 = low vulnerability to 5 = highly vulnerable). This aims to ensure that investment in mitigation and adaptation reaches those most in need.

The second edition of the State of Natural Resources Report (SoNaRR 2020)[26], published in March 2021, includes an assessment of the issues relating to healthy places and health protection from environmental hazards as well as opportunities for action.

Environmental inequalities intersect socio-economic and spatial inequalities, and this burden is borne primarily by socially and/or spatially disadvantaged and/or vulnerable populations. These same communities are the most vulnerable to the effects of the climate and nature emergency, have less access to quality green space and are more likely to be exposed to environmental hazards.

Area Statements are advocating for, and enabling, collaboration to deliver nature-based solutions to tackle urban heat and health inequalities, for example through green infrastructure assessments and local tree planting and green wall initiatives. Nature-based solutions are critical for increasing green infrastructure in urban heat island areas to provide cooling for people, buildings and businesses.

The Wales Environmental Information Portal[84] has been launched to communicate the evidence base informing Area Statements, seeking to support place-making and nature-based solutions, including the demand for greenspace and nature-based intervention to tackle flooding, air pollution and noise in areas with high levels of deprivation.

Actions taken

Whilst COVID-19 priorities have impacted upon progress, adapting to the health and health service delivery risks from heat and extreme weather remains a key focus for public health activity, with Wales' Chief Medical Officer making clear recommendations on the need for both mitigation and adaptation activity across the health and social care system in his 2021-2022 Annual Report[43].

In line with the commitments set out in *A Climate Conscious Wales*, Public Health Wales (PHW) has reviewed the CCC's 2021 updated climate risk advice and updated public health guidance, advice, and messaging for episodes of extreme heat, cold, and flooding accordingly. In November 2021, PHW published a series of infographics[85] which highlight the importance of climate change impacts on the health and wellbeing of the population in Wales, and which aim to support public bodies and businesses to take action to address any impacts. In July 2022, to further support health system partners, 'Heat Health Advice' was published by the Welsh Government, which aims to be the first in a series of health-related adaptation planning tools.

What next?

We will work to build on the actions above, to improve our health and climate change related surveillance systems and to build climate change risks into wider health protection systems. We will continue to work with health and social care system partners to strengthen our evidence base and ensure this is factored into the right level of adaptation planning and action across the health and social care sector in Wales.

Case study

Wildfires

Current climate change predictions suggest we will see hotter and drier summers that will create the ideal conditions for fire. Projections from the Met Office show that a 2°C increase in global average temperatures will double the days in the UK with very high fire danger and extend the wildfire season into late summer and autumn.

Wildfires can present very real risks to local people. The smoke can contain a range of hazards, such as fine particulate matter and irritant gases, which can cause breathing difficulties and exacerbate lung and heart conditions. Many wildfires occur in our most disadvantaged community areas too, where population health is poorer and people are more susceptible if exposed to air pollutants. In the future, wildfire events are also likely to coincide with periods of extreme hot weather and drought, which will also challenge people's health. Wildfires can also cause soil erosion, which can increase the risk of landslides and flooding, contaminate water courses and supplies and, of course, damage the natural environment, which is very influential on health and wellbeing.

Organisations across the health protection system (including emergency services, Natural Resources Wales, local authorities, Public Health Wales, and the Welsh Government) have been working collaboratively to raise awareness of the risk of wildfires, educate communities around fire safety and develop better ways to prevent wildfires. Operation Dawns Glaw, an all-Wales task force focused on reducing the number of wildfires, runs annual campaigns to raise awareness of their impacts, and the Welsh Government has recently funded the Healthy Hillside Project. This latter project is focused on reducing the impacts of wildfires across seven high risk sites in the South Wales valleys and creating a sustainable integrated approach to wildfire prevention by linking conservation management with proactive wildfire prevention techniques, such as controlled burns, vegetation management and the creation of fire breaks.

3.3.2: Vector-Borne Pathogens

A Climate Conscious Wales includes actions covering continued monitoring at sea and airports, raising awareness about Lyme disease amongst health care professionals and the general public, and understanding the increased risk of vector-borne pathogens in relation to climate change. The increasing risks of vector-borne diseases (VBD) is recognised in the CCC's 2021 climate risk evidence.

Changes to the climate have the potential to affect the distribution, prevalence and transmission of diseases spread by arthropod vectors such as ticks and mosquitoes and include a wide range of vectors and diseases. VBDs have increased dramatically in their incidence and distribution in Europe in the last decade and the threat to Wales and the UK is becoming more imminent.

The threat of an incursion and subsequent establishment of a non-native mosquito species is the most pressing threat. Several species of invasive *Aedes* mosquitoes have established in Europe in the last 20 years, moved globally through international trade in used tyres and wet-rooted plants. Movement along highway systems throughout Europe by vehicles has facilitated their rapid spread. *Aedes* species are considered potential disease vectors to humans of a range of tropical viruses.

Research undertaken

COVID19 priorities have impacted progress on climate change adaptation research priorities for the health sector. A veterinary focus on vectors capable of carrying and spreading diseases with significant impacts on animal health will provide useful data on the role of those vectors impact on zoonotic diseases under the "One Health" approach. The Public Health Wales Communicable Disease Surveillance Centre (CDSC) is, in conjunction with veterinary and entomology colleagues, monitoring the incidence of VBD.

Actions taken

Monitoring is ongoing at sea and airports for mosquitoes in collaboration with the association of Port Health Authorities, as well as surveillance at imported tyre companies, passive surveillance with Environmental Health and more recently at motorway service stations and truck stops.

What next?

We will continue to develop our response to the increasing risks of vector-borne pathogens, as highlighted in the CCC's 2021 climate risk advice.

We will continue working to improve understanding of the risks of climate change in relation to vector-borne pathogens, and to raise awareness of Lyme and other vector-borne diseases, including those associated with travel to areas where vectors and pathogens are established. CDSC is, due to the change in mosquito distributions throughout the UK, developing updated vector and VBD control plans, including the identification of scenarios that would require urgent action by public, veterinary and environmental health, overseen by the Welsh Government.

We will also consider the need to establish more intensive surveillance activities, e.g. serological surveys of horses, bird surveys and expanding viral detection in mosquitoes together with appropriate veterinary and medical laboratory capability.

3.3.3: Air Quality

There is an increasing awareness, backed by numerous scientific studies, of the interrelationship between climate change and air quality, and how climate change can greatly exacerbate the impacts of air quality on human health and the natural environment. This interrelationship was clearly demonstrated during the extremes of weather we experienced in the summer of 2022. The prolonged hot, dry, and sunny

weather (which is predicted to be become far more common in the future climate) greatly exacerbated the impacts of air quality on human health and biodiversity. For example, there was a significant increase in photochemical smog production. Defra's Air Quality Bulletin of 19/07/2022[87], highlights the widespread exceedance of ground level ozone thresholds across many parts of the UK. This issue will be amplified further by climate change in the future so adaptation to the impacts of air quality events need to be considered hand in hand with decarbonisation.

Carbon sequestration into natural ecosystems is a crucial element of our decarbonisation pathway. Sequestration rates can be significantly compromised by air quality in the form of nitrogen deposition or local ammonia concentrations. At low levels of nitrogen deposition, many researchers have reported enhanced carbon sequestration across ecosystems (particularly forests). However, at the level of nitrogen deposition currently experienced in the UK, the opposite has been observed i.e., the inhibition of carbon sequestration. Weather patterns can also affect the formation and dispersion of air pollutants harmful to the health of humans, animals, plants and ecosystems.

A Climate Conscious Wales includes actions focused on ensuring climate impacts are considered in all future policy developments for improving air quality in Wales.

The CCC's 2021 updated evidence advice also highlights the potential impacts of climate change upon some pollutants or precursors of health-relevant pollutants, though there are uncertainties as to the predicted outcomes for different elements of air quality, which may be dependent on a range of factors.

Research undertaken

The Welsh Government is working with researchers and experts from our Clean Air Advisory Panel to establish evidence-based guidance and recommendations to understand how climate and other factors affect indoor air quality. The work will inform future communication interventions, including ways to reduce exposure risks in the existing and future housing stock.

Work is underway to produce air quality models and impact assessments for various policy proposals, based on the recently published WHO air quality guidelines. Following completion of the modelling and report, the next stage will be to conduct concentration mapping and analysis to provide recommended air quality targets for Wales.

Actions Taken

The Clean Air Plan for Wales: Healthy Air, Healthy Wales[88], published in August 2020, sets out a range of cross-sector actions to deliver improvements in air quality for the benefit of public health, biodiversity and the natural environment. The Clean Air (Wales) Bill White Paper[89], published for consultation in January 2021, contained a proposal to review and publish a Plan at least every 5 years to ensure sustained progress in tackling air pollution. Comprehensive air quality information and forecasts are also provided on the Welsh Government's Air Quality in Wales webpage[90].

The Clean Air (Wales) Bill, which we will introduce in 2023, is only one of a number of actions set out in our Clean Air Plan. Action already taken includes consideration of air quality within the Wales Transport Strategy 'Llwybr Newydd'[91], work to establish a Wales Air Quality target-setting framework taking into account the latest WHO air quality guidelines,

and an enhanced monitoring service which will provide greater information on air quality across Wales.

The Control of Agricultural Pollution Regulations 2021[21] are an example of effective linking between different policies. The Regulations tackle water pollution but also contribute towards the Clean Air Plan by reducing emissions of ammonia and greenhouse gases.

What next?

Health and the environment are at the heart of the Welsh Government's decision making and we are committed to tackling the sources of air pollution and supporting people's need to breathe clean air in Wales. Delivery of the Clean Air Plan for Wales is ongoing and we are drafting a Clean Air Act for Wales to be introduced during the second year of the current Senedd, in order to reduce air pollution and its impacts.

The proposals for the Sustainable Farming Scheme (SFS) also contain specific actions for farmers to improve air quality. We have outlined clean air as one of the outcomes of the SFS in our recent publication 'Sustainable Farming Scheme – Outline Proposals for 2025'[20]. Actions that support cleaner air are distributed throughout the proposed SFS, including actions to prevent nutrient loss to the air, ammonia emissions from slurry tanks or spreading and emissions from degraded habitat (e.g. peatland). Woodland planting actions also seek to plant trees to manage air pollution.

3.3.4: Fuel Poverty

The focus of action for this policy area within *A Climate Conscious Wales* is to continue tackling fuel poverty through the Welsh Government Warm Homes Programme. The CCC's advice highlights that even in a warming climate there will be an ongoing need to tackle cold-related health impacts.

Research undertaken

Earlier research published in October 2019[94] assessed health outcomes for recipients of the Welsh Government's support under its 2011-17 Warm Homes schemes. The research showed reduced respiratory and circulatory health conditions for beneficiaries of the Warm Homes Programme and reduced frequency of General Practice (GP) events for those with respiratory health conditions.

The Welsh Government has commissioned Public Health Wales to provide advice on satisfactory home heating regimes. The advice will include an assessment of the minimum temperature to be maintained to safeguard health and well-being in colder weather, but will also consider the impacts of high temperatures and overheating. Public Health Wales are expected to report their findings to the Welsh Government by March 2023.

Actions Taken

Based on the available evidence, the Welsh Government has expanded the Warm Homes Programme Nest Scheme. The expanded Health Conditions Pilot Scheme introduced a low-income threshold and included homes rated EPC-D and below. In the period from July 2019 to March 2022, more than 3,700 lower income households otherwise ineligible for the scheme have benefitted from home energy efficiency improvements.

Since its launch in 2010, more than 67,100 households have benefitted from home energy efficiency improvements through the Warm Homes Programme, saving on average an estimated £300 on their annual energy bills at 2021 prices.

What next?

In 2022/23, Welsh Government investment in the Warm Homes Programme has increased by £3m to £30m. This will maintain the rate of homes to be retrofitted in year, but with an increased focus on renewable energy, such as solar PV systems and battery storage systems to be more widely available.

3.3.5: Food safety and security

A Climate Conscious Wales does not include specific actions to address climate-related risks to food security as it was not an area of risk highlighted in the CCC's 2017 climate risk advice that informed the plan when it was published in 2019.

The CCC's 2021 advice highlights risks to food safety and availability due to high temperatures, extreme weather, water scarcity and ocean changes globally. It also highlights opportunities to take advantage of potential increases in productivity and areas suitable for agriculture, in the UK and abroad, and for potential new export opportunities.

Actions taken

The Welsh Government published its food vision[95] in 2021, with the aim of creating a strong and vibrant Welsh food and drink industry with a global reputation for excellence, having one of the most environmentally and socially responsible supply chains in the world.

Wales' food security continues to be highly integrated with UK supply chains which are further integrated across the European Union (EU) and further afield.

The Covid-19 pandemic, EU Exit and the war in Ukraine have all tested our food security acutely in the last few years. Grocery retailers have managed to keep the nation fed in the face of these events, albeit with less choice of products in store and sometimes for extended periods. Governments have also responded quickly to ensure the food security of vulnerable people in the wider population. However, the recent food price inflation has been very significant, with the greatest financial and dietary impacts being experienced by the economically disadvantaged.

While Wales alone may not be able to address all potential food security risks arising from climate change, we have many supporting policies in place, including:

- Continuing support for innovation in product and process technologies leading to healthier products and efficiency and productivity improvements. Factory of the Future developments enable increased automation to counter workforce shortages and ensure factories remain open and food supplies consistent.
- Continued capital grants to food manufacturers will grow food processing capacity and deliver efficiencies in production, including reducing waste and allowing for the repurposing of by-products to produce other ingredients or products.
- New grant schemes to support an increase in horticultural cropping in Wales and to support both existing producers and those new to horticulture, while the Sustainable Farming Scheme (SFS) will provide farmers with support for both the delivery of environmental outcomes alongside the sustainable production of food.
- Support for Controlled Environment Agriculture production systems for the production of salad crops and other foods. The publication of our Vision for the Food and Drink Industry in November 2021 is an open invitation to commercial interests to establish in Wales.
- Support for approximately 100 food manufacturing businesses through the Sustainability Cluster, to improve the sustainability of their production systems,

including advice and financial support to members to secure industry accreditation.

- Requiring manufacturing businesses receiving support to commit to the Economic Contract to deliver climate change mitigation, resilience and fair work.
- The Welsh Government's Programme for Government commitment to deliver a Community Food Strategy, which will build on 900 community growing initiatives across Wales enhancing local food chains. This will also deliver wider social and health benefits.
- Our commitment to overseeing and monitoring delivery of the dietary shift objectives set out within Net Zero Wales Carbon Budget 2021-2025, which will provide a detailed map of the food system that influence dietary choices in Wales.

What next?

Food supplies in Wales will be increasingly at risk from climate change impacts in other countries that we import from. There may be scope for import substitution in areas such as red meat and dairy, which can be produced in many parts of Wales yet we currently import some of our consumption. Other products including cereals, fruit and vegetables cannot always be grown in Wales to any significant extent and we are likely to continue to rely on imports. Our encouragement for Controlled Environment Agriculture may in time enable more of these imported foods to be produced in Wales.

The SFS has committed to pursuing the development of resilient and productive farms, and working with farmers to help them adapt to changes in the environment or market. Our commitment to farmers is to give them the tools they need, through the SFS and Farming Connect, to support them to be world leaders in delivering Sustainable Land Management and sustainable food production.

3.4: Safe Homes and Places

3.4.1: Wastewater and Drainage

A Climate Conscious Wales sets out actions for this policy area focused on Sustainable Drainage Systems (SuDS) for new developments, evidence based long-term planning for waste water and sewerage management, and a planning framework for implementation in Wales. The CCC's 2021 advice has further highlighted the increasing risks arising from climate change to waste water infrastructure, services and pipelines, due to river and surface water flooding, coastal flooding and erosion.

Actions Taken

In 2019 the Welsh Government commenced Schedule 3 of the Flood and Water Management Act (2010)[67] to make SuDS mandatory on all new developments in Wales where the construction area is 100 square metres or more, thereby minimising the impact of new developments on flooding risk and helping to manage on site surface water risk to the development itself, as well as to the wider environment. Developments must be designed and built to comply with statutory standards and approved by SuDS Approving Bodies (SABs) in each local authority before construction begins.

While the Welsh Government took steps to assist stakeholders with early implementation, the number of proposed developments was initially affected by the COVID-19 pandemic. However, there has since been a reported sharp increase in the number of applications.

A review of the effectiveness of the SuDS legislation and the overall approach to SuDS is currently underway, with a view to reporting recommendations for further changes in spring 2023.

What next?

In September 2018, Water UK developed a Drainage and Wastewater Management Plan (DWMP) framework[96], which was endorsed by the Welsh and UK Governments. This could help to improve the long-term planning of drainage and wastewater services subject to the active participation of regulators, local authorities and other stakeholders. Water companies are now working with stakeholders and NRW to prepare DWMP's, which are due to be published ahead of the 2023 target set by the Welsh Government. This will inform the next price review in 2024. DWMP's are not currently a statutory requirement, but the Welsh Government intends to put the next round of DWMPs (due in 2027) onto a statutory basis. We have also established an independent steering group to facilitate effective cooperation between key stakeholders.

The Welsh Government is considering whether further measures may be needed to protect homes and communities from the risks of flooding, in addition to the new SuDS requirements. We may need to undertake further work to understand whether widespread retrofitting of SuDS schemes and green infrastructure will be required in the built environment in order to relieve pressure on the public sewer system. We are also considering measures to encourage property owners to better understand their risk in the future and support them to take action to plan and prepare for climate change impacts

In response to the CCC's 2021 advice, we will also consider whether further work is needed to ensure long term planning (drainage strategies) are embedded into the management of sewer networks, to help overcome barriers to water company action to reduce surface water in sewer networks.

3.4.2: Buildings

The actions set out within *A Climate Conscious Wales* for this policy area are focused on influencing the design of homes and buildings to protect them from the impacts of climate change. This includes reviewing part L (energy efficiency) of the Building Regulations to mitigate the risk of overheating in new dwellings and ensuring opportunities for climate change adaptation are considered as part of Welsh Government research on decarbonising our housing stock, as well as in future reviews of the building regulations.

A further area of risk highlighted in the CCC's second (2017) climate risk assessment that informed *A Climate Conscious Wales*, was the need to understand the future risks to building fabric from moisture, wind and driving rain. The CCC's 2021 climate risk advice has further highlighted these increasing areas of risk for buildings.

Research undertaken

A recently concluded 12-month Embedded Research Fellowship post has led to the publication of a report[97] that provides a broad understanding of the impacts of climate change upon the building fabric and indoor air quality of the Welsh housing stock. Further information can be found in the Case Study on page 43. Using environmental evidence pertaining to climate stressors, the research has developed Welsh-specific climate vulnerability modelling and a risk-based prioritisation index for use when considering adaptations for different housing types. This research has also identified knowledge gaps that currently exist around climate change impacts on buildings and will also inform future policy development in relevant sectors. The Welsh Government proposes to evaluate the report and discuss with the other UK administrations in relation to common areas of interest.

A second phase of the Research Fellowship is currently underway and will focus on the following:

- Stakeholder Engagement Events – to disseminate the published research findings to relevant policymakers and the bodies responsible for developing UK building standards and guidance, including retrofit.
- Creation of factsheets for asset managers and retrofit coordinators – combining the published research findings with known adaptation pathways, advice and guidance to produce a series of downloadable PDF factsheets aimed at helping social housing building professionals to better understand the impacts of climate stressors on the building stock, highlighting known vulnerabilities, the relationship between mitigation and adaptation, and potential interventions.
- Pilot Mapping Project – developing dashboard information via an interactive map of Wales to highlight climate vulnerabilities to housing types across all geographical regions of Wales, allowing pertinent data to be shared with social housing building professionals (particularly asset managers and retrofit coordinators) to interrogate climate vulnerabilities relating to the building stock within their care.

Actions Taken

The Welsh Government has been carrying out a review of Part L (Conservation of fuel and power) and Part F (Ventilation) of the Building Regulations. The consultations were split into 3 stages, stage 1 covered the technical proposals for new dwellings, stage 2A covered building work to existing dwellings and proposals to mitigate overheating and improve air quality in new dwellings, and stage 2B covered non-domestic buildings. Consultation stage 1 and 2A closed in 2020, the Welsh Government response was published in 2021 and amended regulations were laid in May 2022. They came into force on 23 November 2022.

The amended regulations implement our decision to introduce a 37% reduction in carbon emissions for new dwellings (compared with current standards), and introduce measures to mitigate the risk of overheating. The 37% reduction is a stepping stone towards the next changes to energy efficiency in Building Regulations in 2025, where new homes will need to produce a minimum of 75% less CO2 emissions than ones built to current requirements.

Responses to the 2021 Stage 2B consultation for non-domestic building have been published, taking forward an average 28% reduction in carbon emissions for new non-domestic buildings (compared with current standards). The changes are planned to come into force in March 2023.

The Part F (Ventilation) review of the building regulations introduced simplified guidance for ventilation requirements in new dwellings. In relation to existing dwellings, the changes principally focus on a wider range of common scenarios of domestic energy efficiency retrofit. The associated guidance document (Approved Document F1) identifies where additional ventilation is likely to be needed and provides reasonable provisions that in ordinary circumstances may be accepted as demonstrating compliance for Part F.

What next?

The policy measures outlined above will be helpful in addressing the increasing risks to buildings and their inhabitants from climate change, as highlighted within the CCC's 2021 advice. We will continue to consider options for addressing these risks across the building stock in Wales and to build upon the findings of the research set out above.

Our Programme for Government also includes a number of wider commitments in relation to buildings, which will provide opportunities for climate change adaptation. In delivering against these commitments we will work to embed climate change resilience considerations into all relevant decision-making processes, including:

- Seeking a 30% target for working remotely.
- Building 20,000 new low carbon social homes for rent.
- Establishing Unnos, a national construction company, to support councils and social landlords to improve the supply of social and affordable housing.
- Supporting cooperative housing, community-led initiatives, and community land trusts.
- Decarbonising more homes through retrofit, delivering quality jobs, training and innovation using local supply chains.
- Investing more than £1.5 billion in the next phase of the 21st Century Schools and Colleges Programme.
- Transforming learning environments, including net-zero carbon schools and opening up school facilities for local communities.
- Developing more than 50 local community hubs to co-locate front-line health and social care and other services.

Case study

Research into the climate resilience of buildings[97]

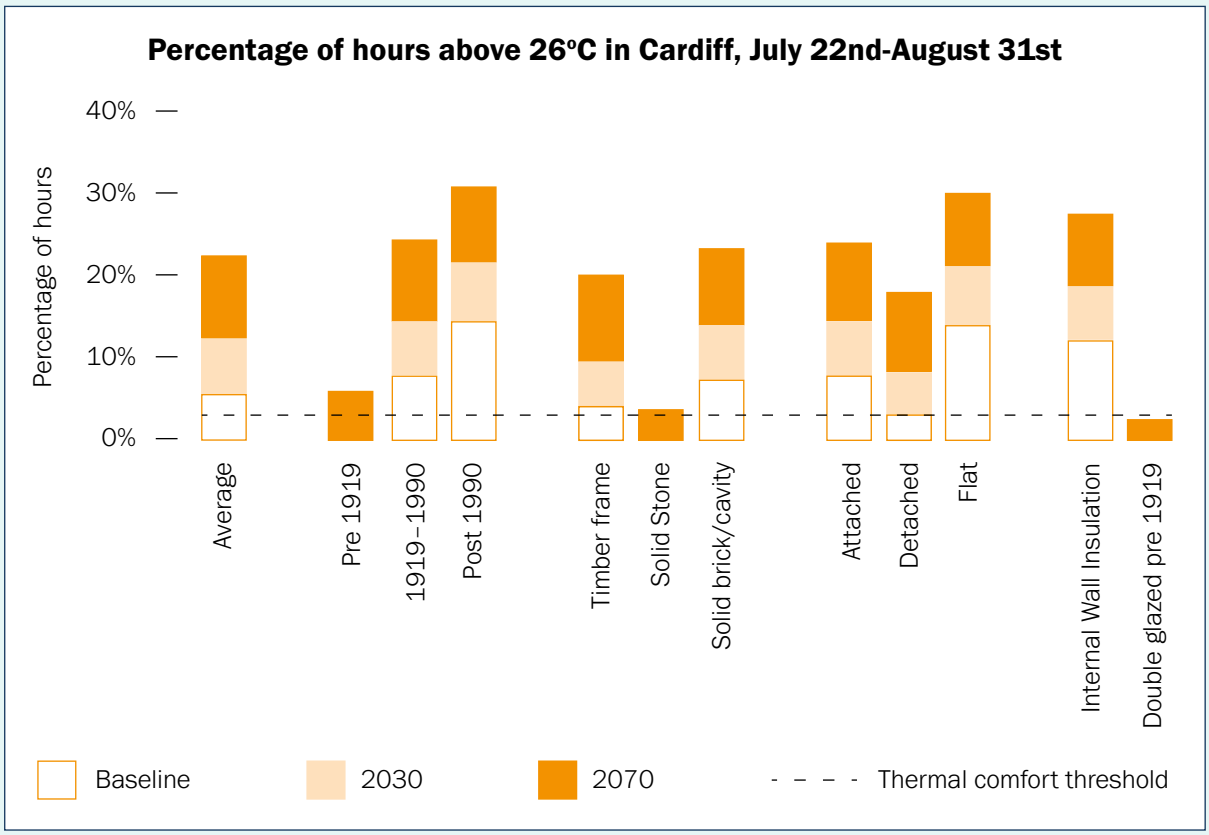
In 2021 Cardiff Metropolitan University, in collaboration with the University of Colorado and Resilient Analytics, conducted climate vulnerability modelling of domestic buildings in Wales for Cadw and the Welsh Government (Hayles et al., 2022). The modelling aimed to determine climate change risks to indoor environmental quality, specifically thermal comfort and moisture, as well as building fabric, across six distinct geographical locations in Wales.

The results 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 poorest performing dwellings were post-1990 dwellings, flats and properties with internal wall insulation. 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 options:

- 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 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.

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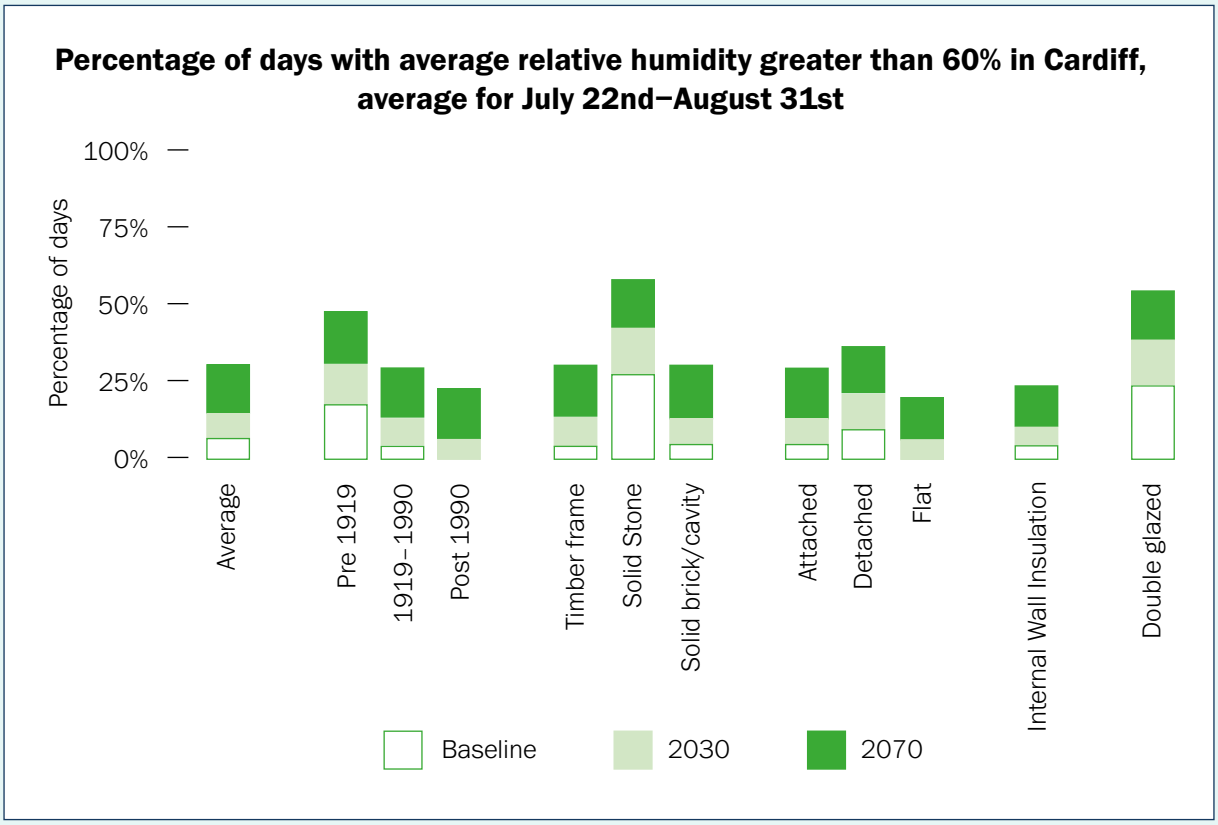

Percent of days in the study period with indoor daily average relative humidity above the 60% relative humidity threshold in Cardiff

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3.4.3: Planning

The actions set out within *A Climate Conscious Wales* for this policy area are focused on ensuring the planning system in Wales plays a key role in facilitating sustainable growth and helps build resilience to the impacts of climate change. This includes the new National Development Framework (NDF) for Wales; the review of planning policy and guidance on managing flood risk in Technical Advice Note (TAN) 15; and increasing the use of green infrastructure and nature-based solutions. The CCC's updated climate risk advice also highlights the risks to landscape character arising from climate change as well as the risks to communities from flooding and sea level rise.

Research undertaken

Planning Policy Wales[99] requires local planning authorities to undertake green infrastructure assessments to support the preparation of development plans. NRW has developed guidance for planning authorities setting out the types of data it holds which can be usefully used in the assessments. A survey of local authorities was commissioned in May 2021 to assess what progress has been made on these assessments, including information on how well climate risks are being considered. While it did not prove possible from the responses received to draw statistically significant conclusions, the Welsh Government will be able to use the feedback for development plan preparation.

Actions Taken

The new NDF for Wales, 'Future Wales – the National Plan 2040'[32], was published in February 2021. It represents the highest tier of our statutory development planning and will help to shape planning and investment decisions at every level of the planning system. Climate resilience is factored into the overall strategy and ambitions of the plan, with a spatial strategy that focuses developments towards the most sustainable locations. Future strategic development plans (at the regional scale) and local development plans (at local authority scale) must conform to the NDF.

The framework provided by Planning Policy Wales and Future Wales places emphasis on the role of nature-based solutions for ensuring adaptation to climate risks as part of the planning process, with particular emphasis on ensuring the resilience of ecological networks and the provision of multi-functional green infrastructure.

The Clwydian Range and Dee Valley Area of Outstanding Natural Beauty (AONB) and NRW have jointly prepared and published Landscape and Nature Recovery in a Changing Climate[100] identifying the key climate change risks, challenges, and potential mitigation and adaptation actions by landscape character type and through future visualisations. Development of a further plan for designated landscapes in Wales is being considered in 2022 to 2023. The effects and rate of climate change and its impacts on local landscape character, pattern and distinctiveness is also assessed in the Historic Environment and Climate Change Sector Adaptation Plan[101], including risks, opportunities and adaptation actions.

A review of the planning policy and guidance on managing flood risk in TAN 15[69] was finalised in September 2021, with a view to the new TAN 15 taking effect in the planning system from December 2021. Its release has now been rescheduled to June 2023 to allow a transition period for stakeholders to accomodate the relevant policy changes. The updated guidance document and the new Flood Map for Planning[102] complement the FCERM Strategy and enable identification of areas projected to be at risk of flooding in the future as a result of climate change. This will ensure planning authorities can consider the future resilience of development proposals in their decision-making processes.

The Welsh Government has required all local authorities to review their Strategic Flood Consequences Assessments (SFCAs) in line with the new policy and Flood Mitigation Improvement Plan, which takes climate change into account (SFCAs support Local Development Plans). The new TAN 15 also notes the need for flood resistance and resilience measures to help mitigate the impacts of climate change. It also recognises the benefits of open green space in mitigating flood risk and seeks to protect this in floodplains.

What next?

As mentioned in section 3.4.2, our Programme for Government includes a number of commitments for improving the built environment. We will consider the implications of our changing climate and weather extremes when delivering against those commitments in terms of the overall approach to planning and design of the built environment.

We will also further review the clarity provided in existing planning policy and guidance on the role of the planning system in protecting the carbon storage function of certain habitats, and how this should be delivered.

We are reviewing our planning policy to deliver a net benefit for biodiversity, which will be essential for ecosystems resilience to climate change. We are preparing further guidance in Planning Policy Wales on how local planning authorities can secure and deliver a net benefit. The amended guidance will be subject to a consultation exercise, before being incorporated into an updated version of Planning Policy Wales.

The Welsh Government is working with the Chartered Institute of Ecology and Environmental Management (CIEEM) to prepare a good practice guide on examples of biodiversity enhancement measures that can be considered for differing scales and types of development. This guide is intended to be used by local planning authority development management officers when engaging with developers to secure biodiversity enhancement as part of planning applications.

Planning Officials are also working with the Building with Nature Board to explore ways in which the use of their accreditation system can be promoted as part of planning projects. The Building with Nature Standards[103] consider factors relevant to climate change adaptation such as wellbeing, biodiversity and water management.

Updated guidance on flood risk and the coast is due to be published in June 2023 and the National Development Framework, Future Wales, will be continuously monitored.

3.5: Caring for the Historic Environment

A Climate Conscious Wales sets out actions focused on the publication and monitoring of the Historic Environment and Climate Change Sector Adaptation Plan, including measures to improve our understanding of climate change threats and opportunities, and the development of tools, guidance and measures for adaptation. The CCC's 2021 updated climate risk advice also highlights the increasing risks to cultural heritage and landscape character, arising from changes in temperature, precipitation, groundwater, land, ocean and coastal change.

Research undertaken

The Historic Environment Group Climate Change Subgroup has developed a Monitoring and Evaluation Framework to support its Sector Adaptation Plan (SAP)[101] and to monitor progress against the priorities identified in the action plan. The interim reports of activity for 2020 and 2021 are available on the Cadw website. They demonstrate that a wide range of climate change adaptation activities have been undertaken by the sector, spanning most types of historic asset. Moreover, they are all contributing towards meeting the headline actions identified in the SAP and the related actions set out in *A Climate Conscious Wales*. An initial review of the evidence has indicated that further work is required to increase the sphere of influence of the SAP with the university sector, for example, in order to influence future research.

2021 saw the continuation and initiation of several projects focused on improving baseline data. Spatial mapping has been developed, including a pan-UK hazard mapping project. Other projects include those focused on the heritage assets associated with rivers and floodplains, the Carneddau Landscape Partnership Scheme[105], and a Cadw-hosted Welsh Government Environmental Evidence Programme-funded fellowship to investigate the resilience and adaptation of the Welsh housing stock (see Section 3.4.2).

Knowledge exchange is facilitated through links with a number of groups, including Fit for the Future, the UK Heritage Adaptation Partnership and the Climate Heritage Network. NRW is also considering the historic environment in major projects assessing coastal adaptation options for managed realignment or retreat for Flood Risk Management assets facing change.

The EU-funded Climate, Heritage and Environments of Reefs, Islands and Headlands project (CHERISH)[107] targets the coastal zone of Wales to improve baseline data using a range of survey technologies for mapping and monitoring maritime, intertidal, coast edge and Island sites and landscapes. In the maritime zone both CHERISH and Bangor University Centre for Applied Marine Sciences are researching the effects of marine processes on wreck sites and the integrity of marine structures.

An update to the Wales Marine Evidence Report, in support of the Welsh National Marine Plan[75], was also published in January 2020, identifying the key climate change impacts on the historic environment to inform marine planning.

Actions Taken

The SAP, *Historic Environment and Climate Change in Wales*[101], which is hosted on the Cadw website, was launched in February 2020. Associated engagement and communications activities were undertaken by the Historic Environment Group Climate Change subgroup.

The use of existing networks, partnerships, working groups and committees has proved to be effective, with COP26 providing an important focus for collaborative activity. Several conferences, workshops and training events on the theme of climate change adaptation have been delivered. These include the Climate Resilience Heritage Summit, Pembrokeshire Coast National Park Archaeology Day, the Royal Commission's Digital Past conference, and the CHERISH Coastal Cultural Heritage and Climate Change conference, amongst others.

A wide range of activity has also been undertaken relating to historic assets at risk that include monitoring, excavation, mapping and research, assessment, repair and project work. This is an area of activity that delivers well against the overarching themes in the SAP of increasing our knowledge and building resilience.

The subgroup and its partners are developing new case studies for Wales, which will be published on the Cadw website.

Cadw is also working to raise awareness and use of its technical guidance on Flooding and Historic Buildings in Wales[66], which was published in July 2019, and to influence the development of training standards, qualifications and guidance relating to energy efficiency and retrofit to include awareness of climate change adaptation.

The National Trust is leading on scoping a climate change heritage adaptation manual for the UK heritage sector in partnership with Cadw, Historic England, Historic Environment Scotland, English Heritage, National Trust Scotland and the Department for Communities in Northern Ireland. The manual will identify options and adaptation pathways, and will be aimed at site managers and decision-makers.

The National Trust is also reviewing its coastal adaptation and management plans across all aspects of the coastal estate, including the historic environment. A new risk assessment is being undertaken for all coastal sites.

What next?

The actions reported here are a small cross-section of activities currently being undertaken by Cadw and other members of the Historic Environment Group Climate Change subgroup and its partners.

The subgroup will continue to have strategic oversight of the Sector Adaptation Plan and its implementation, and will monitor progress against the priorities identified in the action plan. The interim reports of activity for 2020 and 2021 are available on the Cadw website. A deeper analysis of the evidence will be undertaken to identify gaps and areas requiring further attention.

Key priorities for the subgroup in the next 12 months include engagement and awareness raising, and developing new and existing partnerships to encourage further cross-sector working. To assist this, the subgroup is commissioning the development of a communications strategy, which will be published in 2022/23. The subgroup also plans to establish a knowledge exchange group for historic environment practitioners and academics to develop specific research questions and build project partnerships and funding bids.

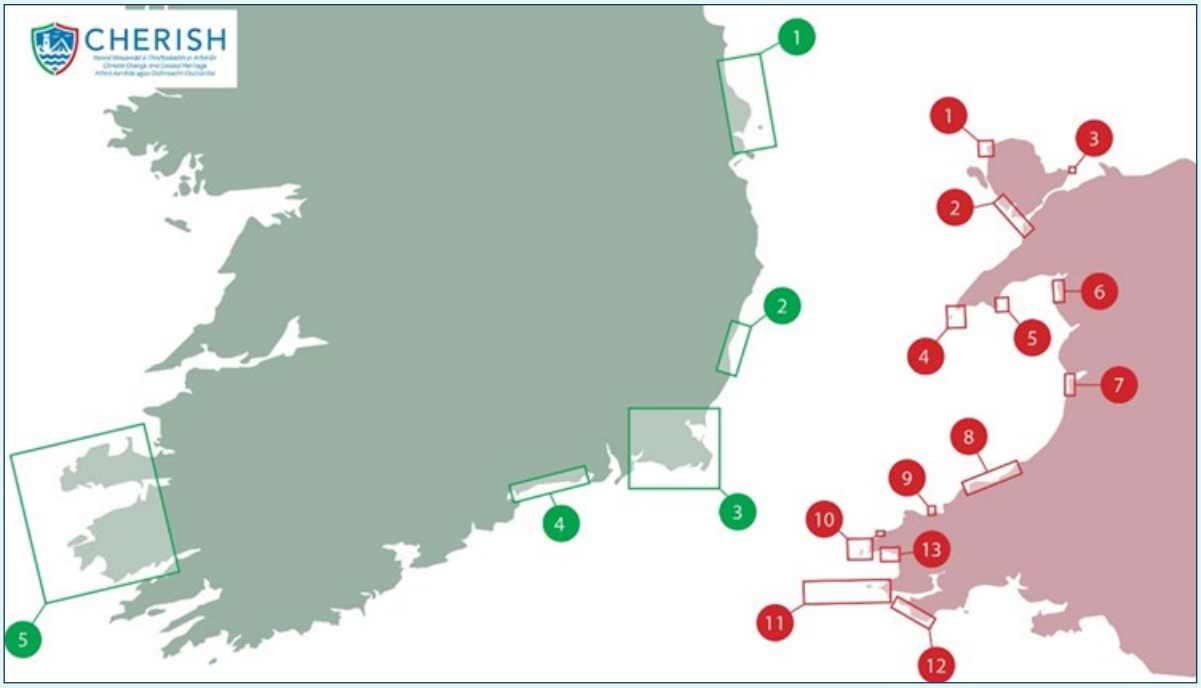
The Welsh Government will also build on the successes of Glastir by integrating historic environment considerations and climate change adaptation into the new Sustainable Farming Scheme (SFS).

Case study

CHERISH[107]

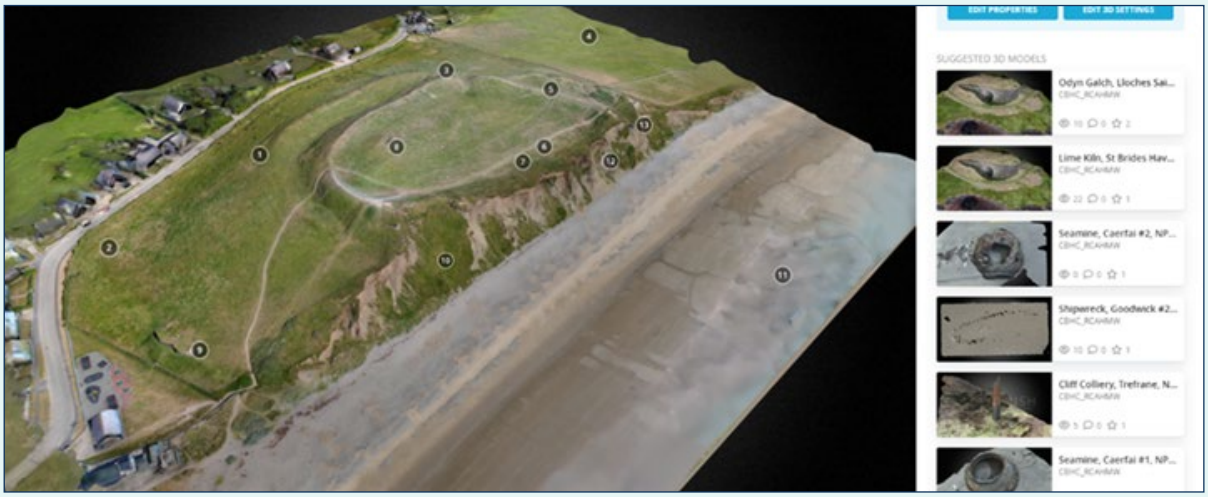
CHERISH is an EU-funded project discovering how climate change is affecting the coastal and maritime heritage of Wales and Ireland. CHERISH stands for 'Climate, Heritage and Environments of Reefs, Islands and Headlands'. It is a six-year Ireland-Wales project, bringing together four partners across two nations: the Royal Commission on the Ancient and Historical Monuments of Wales; the Discovery Programme, Ireland; Aberystwyth University: Department of Geography and Earth Sciences; and Geological Survey Ireland. The project began in January 2017 and will run until June 2023. It will benefit from €4.9 million of EU funds through the Ireland Wales Co-operation Programme 2014-2020.

The project team of archaeologists, geographers, geologists and marine surveyors is mapping important historic features such as coastal forts, shipwrecks and sand dunes to create a permanent record of these sites, monitoring change to reveal the impacts of weather and climate change and to study and record the sites before they are lost.



There are 12 project areas along the Welsh coast and 5 around the Irish coast.

Welsh sites include Dinas Dinlle hillfort, Caernafon. A quarter of the hillfort has already been lost to the sea and we are in danger of losing the entire prehistoric fort over the next few centuries. CHERISH has investigated the site using the full range of technology and equipment used across its study sites. Dinas Dinlle has been recorded through drone, GNSS and photogrammetric survey, as well as cliff-face and targeted excavation, coring for paleoenvironmental material, aerial photography, and laser scanning, to understand the prehistoric hillfort and wider landscape before more is lost.



The 3D model created from the laser scan data has been viewed online nearly 700 times.

Going forward, CHERISH is trying to anticipate and highlight more ‘at risk’ heritage sites on the coast, creating baseline data that can be used for future monitoring. This will facilitate adaptation of site management as the climate continues to change. The aim is also to inform policymakers, Governments and other bodies to build on current climate change strategies.

3.6: Successful Business

A Climate Conscious Wales includes commitments to undertake research to identify industry sectors at risk and potential climate change mitigating options for businesses, and to provide support and advice to businesses to help them adapt to climate change.

The CCC's 2017 second Climate Risk Assessment, which informed *A Climate Conscious Wales*, also particularly highlighted the need to understand the impacts of higher temperatures on employee safety and productivity, the uptake of, and spending plans for, flood protection measures by businesses, and the risk of wider aspects of disruption to ICT, power and transport infrastructure that could prevent workers accessing premises or working remotely. These areas of increasing risk are also highlighted in the CCC's 2021 updated climate risk advice.

Research undertaken

Research has been undertaken to review the level of awareness and preparedness of Welsh businesses in relation to the impacts of higher temperatures on the work environment, and the impacts related to physical infrastructure such as road, rail and bus transport. The evidence report was published in September 2020[109].

What next?

The Welsh Government will continue to review and develop our policies to support businesses in Wales, to help them build resilience to the impacts of climate change, as highlighted within the CCC's 2021 climate risk advice.

We are planning new policy measures to address the recommendations from our September 2020 research report (as described in the previous section), to support businesses to understand specific risks and identify adaptation measures. Action will focus on framing climate change adaptation within the context of general risk preparedness and business continuity. Information will be provided on the precise risks for specific sectors and regions, and examples adaptation plans will be shared. We will work with 'early adopters' to identify how businesses have put strategies in place to assess and mitigate climate change risks.

Our Programme for Government includes a commitment to strengthen our Economic Contract[110]. Through the Economic Contract we are ensuring that our direct business support is targeted at businesses and organisations which contribute to our strategic objectives, including becoming more resilient to the impacts of climate change. Following a review last year, the contract will be strengthened to ask more of the businesses we work with and to ensure that we are driving real and measurable behavioural changes. In addition to reducing carbon footprints, we will support businesses to consider, for example, how they might plan to invest in flood protection measures, address the risk of disruption to power or ICT and consider how flexible working or active travel can be incorporated into policies to reduce staff travel.

We will also work to embed climate change adaptation into the delivery of our wider Programme for Government commitments related to businesses, including:

- Supporting Wales TUC proposals for union members to become Green Representatives in the workplace, with consideration of risks in relation to overheating, weather impacts and power failures.

- Considering the potential climate-related impacts on supply chains, as we work to enable our businesses and town centres to support local supply chains and delivery services, and promoting made-in-Wales products and services
- Implementing our new export plan, with consideration of impacts and opportunities arising from climate change internationally
- Incorporating the requirement to consider climate change resilience within our Social Partnership and Public Procurement (Wales) Bill, which aims to improve public services through social partnership working, promoting fair work and socially responsible public procurement, including through the establishment of a Social Partnership Council.

3.7: Resilient Infrastructure and Transport

A Climate Conscious Wales sets out actions for this policy area focused on the need to better understand the risks to existing assets arising from extreme weather events and flooding, the need for climate resilient design of new assets, and the need to improve coordination across inter-dependent elements of infrastructure, contingency measures and emergency response. The impacts, and the potential cascading impacts, of extreme weather events upon different elements of infrastructure and services, is an area of risk also highlighted within the CCC's 2021 climate risk advice.

Cross-cutting actions for infrastructure resilience

In addition to the sector-specific actions set out in the following sections, a number of cross-cutting arrangements are being taken forward that will help to address the impacts of climate change upon our infrastructure in Wales:

- In accordance with our Programme for Government commitment, we are asking the National Infrastructure Commission for Wales to assess how the nationwide likelihood of flooding of homes, businesses and infrastructure can be minimised by 2050.
- The Welsh Government's updated Wales Infrastructure Investment Strategy (WIIS), published in December 2021, recognises the need to consider the long-term nature of development, by undertaking sustainability assessments in light of future trends, including the implications of climate change impacts such as flooding risk.
- The Welsh Government participates in a UK-wide Infrastructure Resilience Forum to mitigate multi-service disruption.
- All Shoreline Management Plans (SMP's) within Wales include consideration of risks to coastal infrastructure.
- Local Resilience Fora (LRFs) monitor and mitigate risks and emergencies at a local level, putting resources in place to manage issues such as flood.
- Public Service Boards (PSBs) in Wales are required to have regard to the most up to date UK Climate Change Risk Assessment when undertaking their local wellbeing assessments.

3.7.1: Transport

Research undertaken

The Welsh Government has undertaken an internal evidence review in relation to climate change and transport networks, and is planning a further review of the potential impacts from climate change on the motorway and trunk road network.

We have participated in a focus group assisting the British Geological Survey (BGS) with the development of a project to classify the susceptibility of infrastructure assets to river scour. We have also applied the associated 'GeoScour' modelling to the trunk road network in Wales, to identify and assess sites with a high susceptibility to scour on the trunk road and motorway network which were then subject to further assessment by river geomorphologists. The Welsh Government has also supported an Engineering and Physical Sciences Research Council (EPSRC) bid on 'Risk-informed bridge scour monitoring', led by Cambridge University.

Transport for Wales (TfW) and Network Rail have carried out climate change risk assessments in relation to the rail asset in Wales. Network Rail's Third Adaptation Report[111] was published in December 2021. It summarises the progress made in understanding and managing the impact of climate change and sets out how Network Rail are implementing actions to increase network resilience.

An extensive mapping exercise has also been carried out on the Core Valley Lines (CVL) assets and their interface with known flooding sites using NRW flooding data.

Actions Taken

In March 2021, the Welsh Government published Llwybr Newydd: the Wales transport strategy (WTS)[91]. Climate Change is an intrinsic element of the strategy, and climate change adaptation was one of the key objectives of the Integrated Sustainable Appraisal (ISA)[112] carried out at the draft stage of the WTS. In June 2021, we instigated a review of new road schemes funded by the Welsh Government, to ensure that road investment is fully aligned to the delivery of the Wales Transport Strategy ambitions and priorities, Welsh Government Programme for Government commitments and Net Zero Wales. The Roads Review panel has developed a set of criteria which identify appropriate circumstances for expenditure of Welsh Government funds on roads. These include road maintenance and the adaptation of existing road infrastructure to cope with climate change. The final recommendations of the Roads Review Panel are due to be published in late 2022.

The Welsh Government works with Highways England on all reviews and updates of the Design Manual for Roads and Bridges (DMRB), which applies to all new highways and to the maintenance of existing highways infrastructure. New and recently updated DMRB guidance includes The Design of Structures for Hydraulic Action[113], updated in March 2020, which provides direction on scour assessment and scour protection design. A new Climate standard for the DMRB was also published in October 2019[114], providing specific requirements for assessing and reporting the effects of climate on highway resilience. The A40 Penblewin to Redstone Cross Improvements scheme is a recent example where this standard has been applied (as detailed in Chapter 18 of the scheme Environmental Statement)[115].

Inventory records for drainage assets on the trunk road network are currently being updated. This work includes maintaining a list of areas across the network at high risk of flooding and bringing forward solutions on a site-by-site basis.

In May 2020, Network Rail published the Route Weather Resilience and Climate Change Adaptation Plan for Wales 2019-2024[116], informed by an evaluation of the resilience of rail infrastructure to historical weather events as well as assessment of the potential impacts from regional climate change projections.

TfW took over ownership of the CVL in March 2020, with Amey Infrastructure Wales (AIW) as delivery partner. Their role includes the development of extreme weather plans for the management of assets during extreme weather. TfW has created a Strategic Asset Management Plan (SAMP)[117] including drainage, structures and earthworks. In addition, AIW produce accredited Asset Management Plans, which highlight key activities including adverse weather events and the establishment of trial sites.

A Sustainable Development Advisory Group for TfW has also been created that includes an expert member to represent climate change adaptation.

Recent rail track replacement on the line north from Troedyrhiw used an updated track form with reduced risk of rail breaks in the winter and of track movement in the summer. SuDs principles have also been applied to the design of a number of improvement schemes to reduce flooding risk, including the new Bow Street station.

In response to the August 2020 rail accident near Stonehaven, Network Rail have also published a report on the resilience of rail infrastructure.[118]

What next?

TfW is currently developing its process for assessing climate risk, which will include guidance and a framework aligned to the latest climate change projections relevant to the CVL. They will then start to assess the climate risk for the CVL assets, as well as the fleet and additional services such as Traws Cymru, which fall within the Transport for Wales remit.

TfW are developing a Climate Adaptation and Resilience Plan, which is expected to be published towards the end of this year. The Plan will set out what TfW will be doing to ensure climate resilience is embedded in its work to safeguard Wales' transport network. The Plan will include an assessment of current vulnerability to adverse weather and future vulnerability, informed by the latest climate change science and evidence.

The Plan will seek to address the key risks affecting the transport sector in Wales, as highlighted in the CCC's 2021 climate risk advice. Climate Change Risk Assessments will also be undertaken across the public transport network, services and operations. A series of first actions have already been shown to have enhanced future resilience. Bespoke delivery plans will be developed following completion of risk assessments on the network.

The Welsh Government will be reviewing all its scour assessments on the trunk road network once the new Design Manual standard is published. The assessments are expected to begin in April 2023 subject to funding.

We will continue to work with the BGS and framework partners to further develop our approach for assessing risks to the trunk road network using the Geoscour modelling and will continue to work with framework partners to proactively assess potential scour sites on the trunk road and motorway network. If successful with the research bid, we will work with Cambridge University on 'risk-informed bridge scour monitoring'.

The Welsh Government Trunk Road Maintenance Manual is currently being reviewed and will include improvements to the way climate change impacts are reviewed, monitored and mitigated.

The TfW actions reported above will also be continued in relation to Welsh rail assets. In addition, discussions are underway to formalise collaboration between TfW and other stakeholders to enhance our understanding of transport assets.

Our Programme for Government includes a number of wider commitments for improving our transport infrastructure and services. We will work to embed climate change adaptation into their delivery as appropriate, for example to ensure resilience to extreme weather events such as flooding, storms and heatwaves.

3.7.2: Energy

A Climate Conscious Wales recognises the potential for climate change to affect our energy infrastructure and specifically mentions urgent risks due to flooding, high winds and lightning. Energy infrastructure can also be involved in cascading failures from interdependent infrastructure networks.

Responsibility for generation, transmission, distribution and supply of electricity is a reserved matter falling under the responsibility of the UK Government. However, given the severe and widespread impact on society that damage to the network would cause, the Welsh Government cooperates closely with the UK Government to understand and build resilience to climate impacts.

Actions Taken

In addition to our cross-cutting actions in relation to infrastructure set out above, the Welsh Government also works with the UK Government and key infrastructure operators in Wales to ensure that actions are in place to improve resilience to climate impacts on the energy sector. Each of the energy network operators in Wales have climate resilience plans to support their business plans.

3.7.3: Digital

A Climate Conscious Wales recognises the interrelated risks to energy, transport and digital infrastructure arising from extreme weather events such as extreme heat, flooding and high winds. The Plan also recognises that impacts on digital infrastructure can create significant knock-on impacts for businesses and essential public services and utilities. This is also highlighted as an increasing area of risk in the CCC's 2021 updated climate risk advice.

Actions taken

Digital Connectivity policy is not devolved to Wales and is therefore led by the UK Government. The Welsh Government engages with the UK Department for Digital, Culture, Media and Sport on a range of issues including resilience matters. The UK-wide Electronic Communications Resilience and Response Group produced a Climate Change National Adaptation Report in December 2021 that addressed the risks to the telecommunications sector and action being undertaken.

3.7.4: Materials collection, recycling and disposal

While not a specific area of focus within *A Climate Conscious Wales,* nor within the CCC's 2021 climate risk advice, the Welsh Government is considering the potential impacts of climate change upon infrastructure and services associated with materials collection, recycling and disposal.

Research undertaken

In 2018, NRW conducted an assessment of flood risk to landfill sites in Wales. They concluded that no landfill sites in Wales were at risk of exposure to surface water flooding (1:30 or greater) or exposure to river flooding (1:75 or greater).

However, some sites were considered to be at risk from coastal erosion.

A project is therefore being funded under the Welsh Government MPA Steering Group to look at Welsh coastal landfill sites and their impacts on marine protected areas. The objectives of the project are to conduct research focusing on coastal Marine Protected Areas (MPAs) and improve understanding of impacts of landfill sites, to identify management measures to prevent or mitigate adverse impacts and to identify priority sites where intervention is required.

Actions Taken

1,785 legacy landfill sites in Wales have been identified and mapped and action is already being taken by some local authorities to address the risks, for example in areas around the Bristol Channel where landfill infrastructure is at risk from erosion.

NRW are also undertaking an exercise to identify landfill sites of particular impact on MPAs and to identify measures to prevent or mitigate adverse impacts. The Welsh Government is undertaking a review of strategic waste and recycling infrastructure in partnership with Local Authorities, which will include consideration of climate resilience.

What next?

The Welsh Government is working with local authorities consider risks to current recycling and waste infrastructure (including energy from waste plants). Contingency plans will also be considered in order to mitigate risks and avoid impacts upon recycling, municipal and clinical waste streams, and downstream supply chains.

The Welsh Government will also review the arrangements for the management of risks to Energy from Waste plants and collection and recycling infrastructure, particularly those classed as critical infrastructure, including the potential cascading impacts to other key services. This work will be taken forward in collaboration with local authorities.

In reviewing the risks to these services, the potential implications for planning permissions, permits and contracts in relation to climate related impacts will be considered, together with the effectiveness of protection and contingency measures, for example in relation to flooding, to ensure adequate provision and capacity.

With the legacy landfill sites having been mapped across Wales, the next stage will be to identify those most at risk from erosion and ensure effective Site Management Plans are in place where needed.

The Welsh Government is also working with local authorities on their adaptation plans for materials and waste management infrastructure to ensure they are incorporating the CCC's recommendation to 'adapt to 2°C and assess the risks up to 4°C', in relation to sea level rise and weather extremes.

3.8: International Dimensions

The CCC's 2021 climate risk advice highlights the increasing risks to the UK of climate change impacts overseas, including factors such as human migration, changes to international law and governance arrangements, violent conflict, financial risks and changes to global supply chains and distribution.

Actions taken

Wales is committed to acting as a responsible nation on the global stage, to take action to respond to the global climate emergency and to respect and protect human rights. Risks in relation to international violent conflict and international law and governance are matters which are reserved to the UK Government and Wales does not hold the powers to directly respond. Any escalation in these areas would be raised through the UK Government, who will undertake conversations with partners at an international level. However, we regularly use bilateral engagement as a means to raise awareness of the work to address climate change. Welsh Government offices overseas play a key role in ensuring this work is included in their activities.

The Welsh Government's approach to trade policy is developed through the lens of the Well-being of Future Generations Act. We consider trade deals to be about more than economic gains and believe trade deals should contain provisions on key issues such as climate change and the environment. Wherever possible, we will make representations to the UK Government at both official and ministerial levels to ensure our concerns are heard. We also work with the other devolved administrations to ensure Wales is properly represented in discussions and negotiations about trade.

The Welsh Government supports the progression of climate change action within any trade policy agreement, including dedicated chapters and provisions where appropriate. We will continue to engage with a wide range of stakeholders to understand the impacts of trade deals on sectors in Wales and to identify potential opportunities for Welsh producers in any trade deal negotiations.

The risks to food security are considered in section 3.3.5.

Abbreviations

AHIC	Animal Health Improvement Cycle
AIW	Amey Infrastructure Wales
ALC	Agricultural Land Classification
APHA	Animal and Plant Health Agency
BGS	British Geological Survey
BMV	Best and Most Versatile
CARR	Communities at Risk Register
CBD	Convention on Biological Diversity
CCC	Climate Change Committee
CDSC	Communicable Disease Surveillance Centre
CHERISH	Climate, Heritage and Environments of Reefs, Islands and Headlands project
CIEEM	Chartered Institute of Ecology and Environmental Management
COP	Conference of the Parties
CSC	Capability, Suitability and Climate programme
CuRVe	Current Relative Value
CVL	Core Valley Lines
DECCA	Diversity, Extent, Condition, Connectivity and Adaptability
DIP	Dairy Improvement Programme
DMRB	Design Manual for Roads and Bridges
DWMP	Drainage and Wastewater Management Plan
EMFF	European Maritime and Fisheries Fund
EMS	European Marine Protected Site
EPSRC	Engineering and Physical Sciences Research Council
ERAMMP	Environment and Rural Affairs Monitoring and Modelling Programme
EU	European Union
FABLE	Food, Agriculture, Biodiversity, Land and Energy consortium
FCERM	Flood and Coastal Erosion Risk Management
FRAW	Flood Risk Assessment Wales
FRP	Forest Resource Plan
GB	Great Britain
GBF	Global Biodiversity Framework
GES	Good Environmental Status
GIS	Geographc Information System

GP	General Practice
GWC	Glastir Woodland Creation
IAS Reg	EU Invasive Alien Species Regulation
IMP	Integrated Modelling Platform
INNS	Invasive Non-Native Species
IPCC	Intergovernmental Panel on Climate Change
ISA	Integrated Sustainable Appraisal
LPN	Local Places for Nature
LRF	Local Resilience Forum
MCCIP	Marine Climate Change Impacts Partnership
MOAT	Marine Online Assessment Tool
MPA	Marine Protected Area
NDF	National Development Framework
NERC	Natural Environment Research Council
NFM	Natural Flood Management
NHCP	National Habitat Creation Programme
NNP	Nature Networks Programme
NNR	National Nature Reserve
NPAP	National Peatland Action Programme
NRAP	Nature Recovery Action Plan
NRP	Natural Resources Policy
NRW	Natural Resources Wales
PAP	Pathway Action Plans
PAWS	Plantation on Ancient Woodland Sites
PEN	Priority Ecological Network
PHW	Public Health Wales
PLAS	Pen Llŷn a'r Sarnau
PSB	Public Service Board
PWM	Peatlands of Wales Map
RBMP	River Basin Management Plan
RCP	Representative Concentration Pathway
REN	Resilient Ecological Networks
RMA	Risk Management Authority
RMDP	Red Meat Development Programme
SAB	SuDS Approving Bodies
SAC	Special Area of Conservation

SAMP	Strategic Asset Management Plan
SAP	Sector Adaptation Plan
SFCA	Strategic Flood Consequences Assessment
SFS	Sustainable Farming Scheme
SFVI	Social Flood Vulnerability Index
SLM	Sustainable Land Management
SMNR	Sustainable Management of Natural Resources
SMP	Shoreline Management Plans
SoNaRR	State of Natural Resources Report
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
TAN	Technical Advice Note
TfW	Transport for Wales
UKFS	United Kingdom Forestry Standard
VBD	Vector-borne diseases
WCMC	Wales Coastal Monitoring Centre
WFG	Wellbeing of Future Generations
WGWE	Welsh Government Woodland Estate
WHO	World Health Organisation
WIIP	Wales Infrastructure Investment Plan
WLGA	Welsh Local Government Association
WNMP	Welsh National Marine Plan
WOM	Woodland Opportunity MAp
WRMP	Water Resource Management Pan
WTS	Wales transport strategy
WWS	Woodlands for Wales Strategy

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