

Enhancing the buffering capacity of wetlands across Scotland in the face of increased flooding and droughts: how existing and new policy can offer support

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Wetlands are important habitats that support biodiversity and can potentially help mitigate or 'buffer' extremes of water availability, from flooding and drought risks. Yet wetlands are often degraded, and benefits underappreciated, despite their relevance to climate change and biodiversity policy goals. This CREW Policy Note gives an overview of a broad range of wetlands in Scotland to inform policy direction for enhancing the water regulating services they provide for people and nature.

Background

Wetlands cover an estimated 2 million hectares (26%) of Scotland's land area^[1], with blanket bog being the most extensive wetland type. The UNESCO Convention on Wetlands, otherwise known as the Ramsar Convention^[2], defines wetlands as:

"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres"

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Overview

- Increased flooding and drought risks are predicted to become more frequent due to climate change impacts in Scotland.
- Wetlands can potentially buffer extremes of water availability but their capacity to do so is compromised by habitat loss and degradation, loss of connectivity with other wetlands and watercourses, changing climate and land use conversion.
- An evidence-based assessment¹ of the broad range of wetlands that occur in Scotland found that:
 - o Whilst most wetlands have a limited ability to mitigate extremes in water availability, certain wetland types (like floodplain fens, swamps, and reedbeds: **Box 1**) have the best potential to buffer both floods and droughts.
 - o There are more policy options available than restoring peatlands. Relative to area, the identified wetlands (**Box 1**) are more likely to enhance capacity to mitigate extremes in water availability across Scotland. These wetland types should be prioritised for restoration, expansion and creation.
 - o However, given the loss or poor health of many wetlands which affects their buffering capacity, a focus on restoring and expanding all existing wetlands alongside creating new wetlands, to increase their overall extent, is expected to improve overall buffering capacity in Scotland.
 - o Both wetland health, and the biodiversity of wetland vegetation communities, are at risk from climate change impacts if no policy action is taken.
- Existing policies (e.g., Third Land Use Strategy 2021-2026; Flood Risk Management (Scotland) Act 2009; Scottish Climate Change Action Programme (2019-2024) support the need to protect and restore all wetlands but with priority given to the key wetland types outlined (**Box 1**).
- The key recommendations are to:
 - o Strengthen existing policy links and prioritise restoration of a network of the key wetland types identified for enhanced buffering capacity across Scotland in the face of increased flooding and droughts.
 - o Establish a more favourable policy environment for creating, restoring and expanding networked wetlands of all other types to enhance the extent of healthy wetlands in Scotland.
 - o Target restoration funding on a broad range of wetlands, especially relevant prioritised wetland types, that are associated with areas vulnerable to flooding or droughts in Scotland.
 - o Review the current system of Site Condition Monitoring to focus on wetland health and reassess designated wetland sites in Scotland.
 - o Complete the Scottish Wetland Inventory by provision of site-specific assessment, long-term monitoring, earth observation data and representative reference wetlands across Scotland.

¹ The above key findings are based on information from the available literature, expert opinion, indicator data analysis, mapping visualisation methods, climate change scenario modelling, and engagement with workshop participants.

Wetlands serve important hydrological, carbon storage, and biodiversity functions. They occur across a wide variety of landscapes in Scotland from uplands to the coastline. Wetland character is strongly influenced by the storage of water as determined by the balance of inflows and outflows of water from a variety of sources. Wetlands have the potential to store and release water – depending on the balance of these fluxes of water, type, extent, and connectivity to stream networks and other wetlands.

When in good health, wetlands can potentially have capacity to buffer both high and low flows for moderating extremes in water availability (i.e., flood and drought risks respectively, both individually and in combination) which are predicted to become more frequent due to climate change. Yet the health of wetlands is under extensive pressure from land use conversion, its management, and climate change. Also, what has been missing up to now is consideration of a broad range of wetlands in Scotland with respect to their buffering capacities for both high and low flows. To improve wetland resilience, and the water regulating services they provide, there is a need to better understand the various impacts from changing climate, land use and management practice on such capacities, as well as on their biodiversity.

This CREW Policy Note summarises evidence from a comprehensive assessment of eighteen² wetland types occurring in Scotland to inform what policy options are available and where targeted restoration efforts may be needed for enhancing wetland buffering capacity in the face of climate-driven increased flooding and drought risks.

Understanding wetland buffering capacities and their potential for restoration in Scotland

Buffering capacity is wetland type-, health and location-specific. The main buffering capacity mechanisms are the storage of water and the delayed movement of water out of a wetland. This is controlled by complex interactions with a range of landscape factors (e.g., surface terrain; hydrological connectivity to ground and surface waters; soil type and condition; vegetation cover and surface roughness) and varies seasonally. Most wetland types have a limited ability to moderate extremes in water availability. However certain wetland types like floodplain fens, swamps, and reedbeds have the best potential to buffer both floods and droughts. The restoration of degraded blanket bogs and raised

² Knowledge on the buffering capacity of the eighteen specific wetland types considered was often limited, thus a cautious assessment was made.

bogs to mitigate water availability extremes is supported by policy (e.g., through the Peatland Action Programme) and some evidence. There are more policy options available than restoring peatlands. For example, relative to area, the identified wetlands (Box 1) are more likely to enhance capacity to mitigate extremes in water availability and should be prioritised for restoration, expansion and creation. However, given the loss or poor health of many wetlands, a focus on restoring and expanding all existing wetlands alongside creating new wetlands, to increase their overall extent, is expected to improve overall buffering capacity in catchments across Scotland.

Box 1: Key wetlands that have good potential to buffer high and/or low flows

Floods	Droughts
<ul style="list-style-type: none"> • Floodplain fens • Swamps • Reedbeds • Wet meadows • Alder and fen wet woodlands • Basin fens • Fen meadows • Transition grasslands 	<ul style="list-style-type: none"> • Floodplain fens • Swamps • Reedbeds

Changing climate, land use and management practice impacts on the capability of Scotland's wetlands to buffer extremes in water availability and their biodiversity

Wetland degradation from drainage, burning, peat extraction or excessive grazing impairs buffering capacity, as can a loss of the free connections of water flow between wetlands and, or adjacent watercourses. Water availability, particularly climate change driven combinations of droughts followed by flooding are key sources of impact risk to wetland buffering capacity. Impacts on wetland buffering capacity is site specific and can vary seasonally or over longer time periods due to changing climate, land use and management practice. Also shifts in vegetation communities (e.g., *Sphagnum* cover) in response to such changes, could in turn alter the ability of wetlands to mitigate extremes of water availability in Scotland.

The climate change projections indicate eastern and southern Scotland may get drier and the north-west wetter, but there is an increased probability of extreme droughts and floods. Wetland health is at risk of deterioration from climate change impacts for 10 out of the 18 wetland types if no policy action is taken. Ninety-eight out of 700 species on the Scottish Biodiversity List in the categories “conservation action needed” and “avoid negative impacts” are associated with wetlands. There is limited ability to predict the consequences of changes in water availability on biodiversity. However most wetland vegetation communities possess some, especially rare, species at risk due to projected future increases in dryness with others at risk due to increased wetness.

Future perspectives

There is growing interest in the use of land for carbon sequestration to enable climate change mitigation strategy. This is leading to acquisition of large areas of land, including wetlands, for tree planting, peatland restoration and ‘rewilding’ activities. This is associated with changes in motivation for land ownership and hence conversion in land use management practices. These changes are likely to conflict with active wetland management approaches, have consequences on the runoff of water in catchments and hence their capacity to buffer extremes in water availability in Scotland.

Existing policies (**Box 2**) support the need to protect and restore all wetlands for enhancing the water buffering capacity of wetlands in Scotland. The following are key recommendations with practical links to key policies available:

1. **Prioritise restoration of the key wetland types identified (Box 1).** Target additional funds, within and outwith designated sites, for restoration and maintenance of:
 - a. Wetlands currently less in the policy spotlight that nevertheless have the most potential to buffer low and high flows.
 - b. Especially where such wetlands coincide with catchments that include potentially vulnerable areas for drought and flooding [SCCAP-2, FRM Act].
2. **In parallel create, restore and expand healthy networked wetlands of all other types where opportunities arise.** A greater extent of healthy wetlands can potentially improve buffering of climatic extremes [FRM Act, LUS-3. SBS].
3. **Invest in local human resources to maintain and respectfully manage wetlands as part of the green recovery plan.** This can help to support community wellbeing as well as manage flood risk [FRM Act, SCCAP-2, NPF-4].

Box 2: Relevance of wetland restoration to the existing policy context

The main existing policy opportunities for encouraging enhancement of wetlands are:

- **The third Land Use Strategy 2021 – 2026 (LUS-3):** calling for large scale ecosystem approaches and the development of a “resilient water environment” that can “help Scotland adapt to our already-changing climate”, noting peatlands as a “sponge” to mitigate flood impacts.
 - **Scottish Biodiversity Strategy Post-2020 – A Statement of Intent (SBS):** highlighting the multiple benefits of wetland-based Nature Based Solutions as a means for increasing not only biodiversity but also to gaining the multiple benefits of tackling climate change, flooding and improving water quality.
 - **Flood Risk Management (Scotland) Act 2009 (FRM Act), Article 20:** requiring the 6-yearly assessment of natural features, including wetlands, whose alteration or restoration can contribute to flood risk management.
 - **The second Scottish Climate Change Action Programme 2019-2024 (SCCAP-2):** promoting large scale habitat restoration; promoting peatland restoration as a means of mitigating climate change, supporting biodiversity, and mitigating flood impacts.
 - **Fourth National Planning Framework (NPF-4) –** improving the natural environment for the wellbeing of communities and supporting the green recovery.
4. **Create catchment partnerships of land managers and businesses.** These have the potential to bring together multi-stakeholder interests to create a wider dynamic of shared understanding, communication, and management. They may also help to generate funds for wetland restoration projects [NPF-4].
 5. **Maintain ongoing wetland monitoring to meet dynamic policy needs.** This is needed to inform adaptive management strategy and innovative policy approaches to wetland management. The decline in available resourcing for Site Condition Monitoring is also an incentive to increase strategic monitoring efforts [FRM Act].

6. **Adapt restoration approaches.** Climate change impacts will make the implementation of projects more challenging through time. E.g., unless NFM measures on peatland are well established in the dynamic landscape they are vulnerable to extreme rainfall events washing out and damaging any measures [NFM Act].
7. **Develop and strengthen the human resource available for delivering wetland restoration.** People with relevant sufficient expertise and experience are needed to deliver wetland restoration projects both now and in future. This includes individuals and teams operating within private (e.g., contractors) and public sector (e.g., staff) organisations [NPF-4].
3. **Redesign agri-environmental schemes.** There is a need to tackle the twin climate and biodiversity crises whilst delivering on Brexit.
4. **Raise the policy profile of wetlands in Scotland.** Broaden knowledge of their capacity to buffer low flows as well as high flows. Consider adopting the EU Water Framework Directive approach to further engage wetland protection. E.g., all wetlands are valued especially in the face of climatic extremes.
5. **Review the current system of Site Condition Monitoring.** With consideration given to:
 - a. Focussing the new approach on wetland health and functional mechanisms.
 - b. Re-evaluating the current designated site series and its purpose.

Policy recommendations

The existing policy environment (**Box 2**) provides reasonable support for meeting the need to enhance wetland buffering capacity in Scotland. The following proposals are intended to establish a more favourable policy environment for enhancing the extent of healthy wetlands across Scotland:

1. **Identify and maintain reliable funding sources for enabling wetland restoration needs.** Help clarify and facilitate access to sufficient and sustainable financial resources. In this context, consider designing new incentive schemes for delivering well-managed targeted projects and large-scale wetland restoration objectives.
2. **Improve the national planning framework.** Provide a long-term planning vision integrated with a clear policy steer and adaptive framework on land use management. This may strengthen commitment to bringing about the desired wetland restoration outcomes in an uncertain policy, economic and climate arena. Incorporating wetlands into NFM and drought mitigation planning by local authorities could be effective.

6. **Complete the Scottish Wetland Inventory.** By:
 - a. Investing in site-specific wetland assessment, long-term monitoring and earth observation data.
 - b. Developing a network of representative reference wetlands across Scotland.

References

1. Lindsay, R., and Clough, J. (2017). United Kingdom. in: Joosten, Hans, Tanneberger, Franziska and Moen, Asbjorn (ed.) *Mires and peatlands of Europe: Status, distribution and conservation* Stuttgart Schweizerbart Science Publishers.
2. Ramsar Convention Secretariat (2016). *An Introduction to the Convention on Wetlands* [Online]. Gland, Switzerland. Available from: <https://www.ramsar.org/document/handbook-1-5th-edition-an-introduction-to-the-convention-on-wetlands>

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