Review of the impacts of short- and long-term hydrological drought, including intermittent flow recovery, on freshwater ecology in Scotland

Section 1: Project Overview

Introduction

The Centre of Expertise for Waters (CREW) intends to commission a **capacity building project** aligned with CREW's **Hydrological Extremes, Coasts and Risk Management theme** that aims to evaluate the impacts of hydrological drought and intermittent flow recovery on freshwater biota in Scottish river systems.

Background

Hydrological drought occurs when prolonged dry conditions result in sustained low river flows and drying. In 2025, much of Scotland experienced a period of unprecedented water scarcity, particularly in the east of the country. Low flows were exceptionally prolonged, began earlier in the year than ever recorded, and in many catchments were interspersed by only short and limited periods of recovery**.**

Current climate change predictions indicate that such conditions are likely to occur more frequently in the future, increasing pressure on both water users and the environment. Existing policies, as set out in the National Water Scarcity Plan and current regulatory approaches to managing abstraction during drought in Scotland, are based on an understanding of the ecological impacts of relatively shorter periods of drought and do not account for the cumulative impacts of prolonged drought with intermittent periods of flow recovery. Furthermore, these approaches are applied uniformly across Scotland and may not reflect potential spatial variation in ecological risk dependent on river typology.

This project aims to address these evidence gaps to support the update and refinement of the National Water Scarcity Plan, ensuring it is better aligned with future climate pressures and ecological risk, while continuing to enable sustainable water use.

Knowledge gap

A 2017 literature review[1] commissioned by SEPA, examined the ecological impact of short-term drought (APEM environmental consultancy, 2017). It concluded that invertebrates and vegetation were generally resistant to low flows lasting less than one month, provided the channel did not dry completely. However, relatively few studies on fish were included, limiting confidence in conclusions for this key ecological receptor. River typology was also found to influence ecological resistance to short-term drought, but evidence from river types typical of Scotland was very limited. The review recommended further work to understand the effects of drought duration and frequency.

Informed by the available evidence, Scottish regulatory policy was subsequently developed with 'Significant Scarcity' defined as 30 continuous days of averaged low flows, which can reset following short-term rainfall events. The drought events in 2025 have highlighted the urgent need to understand the ecological impacts of extended drought periods and the cumulative effects of intermittent flow recovery on key ecological receptors.

There is therefore a clear need to broaden the scope of the 2017 APEM review to cover longer term drought, including cumulative events, incorporating brief recovery periods or drought over extended

[1] This 2017 literature review can be found on CREW website page for this project.

timescales. This updated review should integrate new evidence and address knowledge gaps to determine whether existing approaches are providing suitable environmental protection. While the 2023 Environment Agency review (Stubbington 2023) encompasses some relevant evidence, it lacks a Scottish context, limiting its direct applicability to Scotland.

Current regulatory approaches also apply uniform standards across all river types, despite the 2017 review indicating that certain river types are more sensitive to low flows, while others may be quicker to recover. A wider review of the effect of river typology is therefore needed to underpin a more structured and proportionate approach to regulating abstraction whilst maintaining practical application and clear communication between regulators and abstractors.

Aim

The overall aim of this project is to evaluate the impacts of hydrological drought and intermittent flow recovery on freshwater biota in Scottish river systems, and to assess whether current water scarcity policy provides adequate and practical environmental protection across different river typologies[2].

Through a review of available evidence from key organisations and relevant scientific literature interpreted in the Scottish context, the project should address Questions 1-5:

1. What is the current scientific understanding of the effects of the intensity, duration and frequency of hydrological drought, including extended periods of hydrological drought[3]on relevant ecological receptors?
2. What are the effects of intermittent periods of flow recovery[3] on biological receptors?
3. How do location and river type influence the response of habitats to periods of low flow, particularly regarding loss of wetted width and drying, and to what extent are these responses/effects predictable?
4. Is there empirical evidence of interactions between existing pressures, such as habitat degradation, water quality, abstraction and climate change, and the severity of drought impacts on biota?
5. To what extent can river type and Water Framework Directive (WFD) status be used to identify and predict important refugia for biological recovery following a drought event?

Through analysis of relevant policy across the evidence collected to answer Questions 1-5, Question 6 should be addressed:

6. Does current water scarcity policy provide appropriate and effective environmental protection to different river systems in Scotland?

Building on the findings from Questions 1–6, your expert opinion will then be used to address Question 7:

7. Looking ahead, is further investigation needed to identify and prioritise any evidence gaps on ecological impacts of hydrological drought and intermittent flow recovery?

[2] For river typologies, please use Table 1.2 within the SI/SR Template
[3] Like those experienced in Scotland in 2025

Deliverables

- A final report of 25-30 pages, excluding annexes and the bibliography, and including:
  - An evidence review (encompassing Questions 1-5)
  - A policy analysis (encompassing Questions 6)
  - A concise set of recommendations (encompassing Questions 7)
  - Cover image(s) with associated photo credits
- Policy brief (3-4 pages)
- A plain English summary of aims and results (1-2 pages)
- Website summary (200 words)
- Communications and impact plan – supported by CREW at the start and throughout the project

Events/meetings

- 3 Online Project Steering Group meetings (throughout the project lifecycle[4])

Intended impacts

There are multiple pathways for a project to achieve impact, and multiple factors that can impact the project's ability to achieve what it intends to do; both along the project lifecycle (A.IMPACT) and beyond project completion (B.IMPACT) (Figure 1).

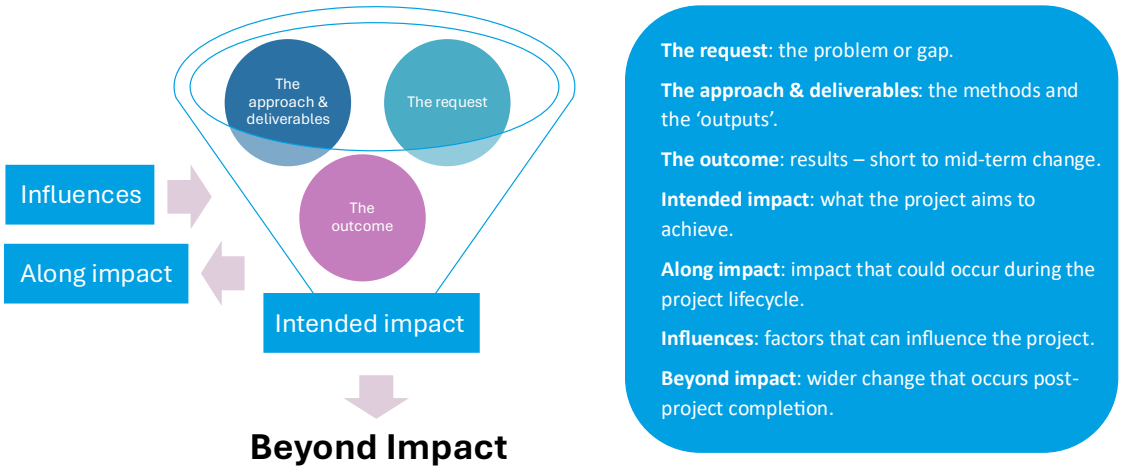

Figure 1:Pathways to impact

Along Impact *(A.Impact)*:

These stakeholders will be part of the project steering group: SEPA; Environment Agency; NatureScot, and Scottish Government.

Beyond Impact *(B.Impact)*:

The project will inform strategic objectives by providing evidence to shape Scotland's water resource policies. Its findings will support decision-makers in aligning drought management with long-term sustainability goals, ensuring that ecological protection and resilience are embedded in national policy frameworks. It is intended that the project findings will be incorporated into the review and update of the National Water Scarcity Plan, ensuring that drought management policies reflect the cumulative ecological impacts of prolonged low flows. The outputs are also intended to support adaptive

[4] Please note, CREW requests a brief written update c. two weeks prior to project steering group meetings. Please include Project Steering Group meetings as part of your milestone table.

management strategies and water resource planning policy for other organisations involved in drought management.

The project will influence on-the-ground actions by providing evidence-based guidance for managing water abstraction during drought in ways that minimise ecological harm as well as informing potential changes to morphology and habitats to increase resilience to drought. This could particularly improve environmental protection across distinct water scarcity events. The outputs may also inform guidance to support habitat and species protection.

The anticipated audience for the project deliverables includes: SEPA, NatureScot, Scottish Government, Scottish Water, Scotch Whisky Association, National Farmers Union of Scotland, Fisheries Management Scotland and the hydropower industry.

Section 2: Further information for applicants

Eligibility

CREW Capacity Building funding is open to applications from **all relevant Scottish HEIs and Research Institutes (approved subcontractors)**. One eligible organisation must lead the bid, however an eligible organisation can sub-contract work in accordance with the Grant Terms which would include putting in place an appropriate agreement with the relevant sub-contractor(s) (updated December 2022). Any UK based HEI, RI or SME can be sub-contracted. Where successful, CREW funding would be subject to agreement to the CREW Grant Offer Letter and T&Cs ("Grant Terms"). CREW encourages applications from experienced to early career researchers (ECRs) under the supervision and mentorship of experienced researchers.

Expectations and award criteria

A copy of expectations and the award criteria are provided on page 5 and 6 respectively.

Project management

Day-to-day communication will be between the research/review team (the contractor) and a CREW Project Manager and is likely to involve short catchups as agreed.

Communications and impact

CREW's impact officer will engage with the research team and project steering group on any agreed upon comms and impact activities throughout the project and for post project evaluation.

Project steering group

A CREW representative, and representatives of Scottish Government and its delivery partners, will form part of the project steering group. They will meet with the preferred bidder(s) for a pre-contract meeting. A pre-contract meeting will take place approximately **wb. 13th April 2026.**

Funding

The maximum amount of funding available **exclusive of VAT** (where applicable) is **£80,000.**

Anticipated timescale (c. 9.5 months)

- The project will commence on the **20th April 2026,** depending on contract processing and signage.
- The 1st PSG meeting should be held **in early/mid-June 2026.** Project progress should be presented, with an opportunity for the Project Steering Group to review any initial work in progress.
- The 2nd PSG meeting should be held **in mid-September 2026**, with an overview of project progress presented, ahead of submission of the first full draft.
- A first full draft of the report should be submitted by the **21st September 2026.** *Please allow 2 weeks for the project steering group to review the draft.*
- A second full draft of the report and a first draft of the policy brief and plain English summary should be submitted by the **20thNovember 2026.** *Please allow 2 weeks for the project steering group to review the drafts.*
- The 3rd PSG meeting should be held **at the start of December 2026**, following the project steering group review period.
- Final drafts of all outputs should be submitted by **the 8thJanuary 2027.** *Please allow 2 weeks for the project steering group to review the drafts.*
- All final outputs should be submitted for signed off by the CREW Director and for formatting by the **29thJanuary 2027.**

Submitting a proposal

Please complete a **CREW Capacity Building Application form** outlining your proposal.

Proposals need to be submitted to Procurement@crew.ac.uk for evaluation **by 15:00 on Thursday 12th March 2026.** We aim to notify the preferred bidder by **31st March 2026.**

Please contact Procurement@crew.ac.uk **by the 5thMarch 2026** if you would like any clarification on any of the above. You should highlight any potential conflicts of interest in your proposal. For queries about what may constitute a potential conflict of interest please contact the CREW Manager (Nikki.Dodd@hutton.ac.uk).

Expectations

No.	Criteria	Descriptor
1	Duration	The proposed duration will align closely to the details provided in the anticipated timescales section of the specification.
2	Staff time and effort	The proposed allocation of staff time and effort is appropriate and includes all deliverables. The proposal provides a commitment that named staff members will be available to work on the contract if the bid is successful. For any unnamed staff, appropriate risk identification and mitigation measures are provided.
3	Project costs	The estimated breakdown of project costs is realistic and inclusive of all deliverables.

Award criteria

No.	Criteria	Descriptor
1	Understanding the project ask and policy background	The proposal should include an introduction which demonstrates a clear understanding of the project requirements. This should include an understanding of the policy background and the supporting role of this project; the need for this research; the project aim; and how the proposal will address this aim.

2	Proposed methodology	The proposal should demonstrate a high quality and workable methodology, including: how the evidence will be identified, reviewed and assessed; consulting relevant stakeholders and/or experts where appropriate to address the key questions and produce the deliverables in the timescales required. It should explain the suitability, robustness and limitations of the proposed methodology.
3	Milestones	The project milestones are logical, practical and include all deliverables.
4	Project Management	The staff, resources and expertise are appropriate for conducting the proposed project. The proposal should name the project lead and outline their project management experience.
5	General and specific topic expertise and experience	The proposal should provide details of individual staff members who will work on this project and demonstrate how they will meet the project requirements, specifically: - general research experience and expertise; - **Specific experience and expertise in low-flow hydrology; the ecology of lotic macroinvertebrates, fish, and macrophytes (including algae and diatoms); and the assessment of low-flow impacts and hydro-ecological processes in Scottish catchments.**
6	General communication and deliverables	The proposal should describe the approach to producing the deliverables, which will be published on the CREW website. It should detail who will take lead responsibility for report-writing and overall report quality. It should provide examples of previously published reports and policy briefs in which they have been involved.
7	Quality assurance	The proposal should provide details of quality assurance procedures to demonstrate how the contract will be continuously delivered to a high standard. It should specifically address issues of quality control at different stages of the project, including evidence gathering, analysis and report writing. It should include a timetable for delivery of tasks, project milestones and allocation of staff and staff time against each task, covering the duration of the contract.
8	Risk	The proposal should provide a risk assessment matrix detailing any risks identified in relation to the delivery of this contract, and proposed mitigation measures to minimise their probability and impact, focused particularly on risk to completion on time.

Annex A. Relevant reports, studies and policies

- Review of the research and scientific understanding of drought - GOV.UK
- The effects of drought on biodiversity in UK river ecosystems: Drying rivers in a wet country
- National Water Scarcity Plan