Regional Scalability Plan - Case study 17

2050 Scalability Plan for River and Peatland Restoration in the Forth Catchment

Forth basin restoration UK

Imprint

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Content

1 For the reader

2050 Scalability plan for River and Peatland restoration in the Forth Catchment.

1. A plan to enable landscape-scale change in terms of works to improve biodiversity, natural flood management and climate resilience across the rivers and peatland in the Forth region, while allowing stakeholders the means to live, work and thrive on the land. This paves the way for the scaling-up of Biodiversity and Natural Flood Management projects deemed to be most effective in contributing to reaching nationally set targets, ultimately seeing the protection and re-establishing of vulnerable species and habitats while successfully mitigating against the effects of climate change. To achieve this, the main pressures to overcome across the catchment include poor water quality, barriers to fish passage, poor natural river / peatland function due to anthropogenic influence and Invasive non-native species.

2. The plan was written as part of The EU Horizon project MERLIN, so that it can be used as a resource for restoration practitioners both in the Forth Region, nationally and across Europe. It was written by a cohesive partnership between stakeholders such as Local Authorities Land Managers and Local Communities, Government Bodies and Non-Government Organisations in the Forth Region.

3. The case study partners were Forth Rivers Trust, NatureScot, UK Centre for Ecology & Hydrology, James Hutton Institute and Stirling Council. Other stakeholders from the Region that have contributed to the plan are covered in chapter 3 (Figure 6). Stakeholder consultation was done in three ways. One to one discussion, small sectorial meetings –(e.g. a farmer cluster meeting) and a larger cross sector stakeholders round table meeting.

4. This plan aims to identify a clear vision and strategy for upscaling river and peatland restoration by 2050. Upscaling restoration is identifying and overcoming barriers on all the sub catchments in the Forth region. It aims to build a realistic economic and socially inclusive route map taking all the major stakeholders into account to achieve increased biodiversity whilst building resilience to climate change in these interrelated habitats. By allowing practitioners to finance restoration on a catchment scale throughout the region. It should help government actors fulfil their tasks and responsibilities and prepare local communities for climate change impacts and empower restoration practitioners to do the work on the ground.

2 Focus of the RSP

2.1 Regional characteristics

The Forth region spans an area covering over 3000km².

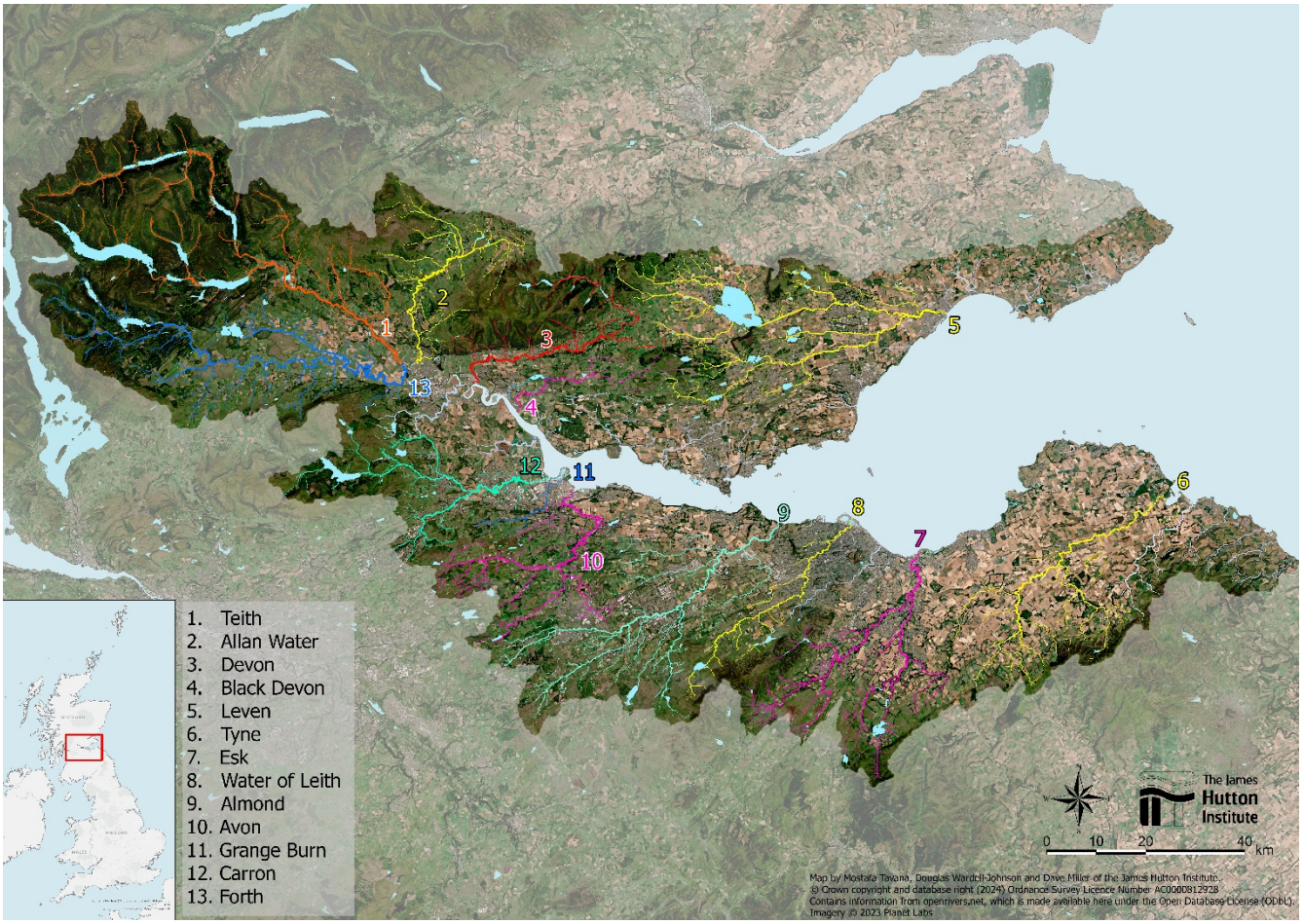


Figure 1 The Forth Region and its 13 river sub catchments. Map created by James Hutton Institute

Defined to the north and south by parallel geological faults, the Forth catchment shapes the geography of the Eastern half of Central Scotland. From the broad fertile floodplain of the Forth itself to the upland habitats of the headwaters. The catchment is a diverse landscape, encompassing many different types of sub-catchments with a wide variety of pressures facing each one. It is an iconic part of Scotland. The landscape is heavily modified by centuries of cultivation and industry. There are sites of early extractive industry such as coal and iron and later sites modified by the industrial revolution. In the last half century deindustrialisation has led to many of these modifications remaining on the catchments as non-functioning relics of industry that no longer serve a purpose. It is home to roughly 25% of Scotland's population including Scotland's second largest city.

The estuary and the 13 rivers and coastal streams (burns) together host a wide range of wildlife and habitats from the fast-flowing upland streams to the slower moving rivers with more expansive floodplains. These rivers flood regularly onto adjacent land at times of heavy rainfall. A notable diversity of fish has been recorded in the rivers and streams (burns). Peatland was formerly much more extensive in the catchment including significant areas of raised bog, but much has been lost to historic agricultural improvement. Intensively farmed areas in the more low-lying parts of the catchment present challenges to water quality through eutrophication.

Sub catchments in the south of the region have the highest quantity of man-made barriers to fish passage (weirs), many due to remnants of industry that was heavily prevalent in these areas. Many local communities now see these barriers as culturally significant and aesthetically pleasing, meaning total removal of the barriers is more challenging on many of the rivers. This means an overall lack of in-stream diversity compared to other areas of the catchment. Sediment is also impounded at these barriers, impacting the natural fluvial processes

of the river. The historic industry in these areas still has a lasting effect on the water quality of some of the rivers, with mine-water seep being a large issue, introducing heavy metals and chemicals to the river. This area's highly populated nature also means there are many sewage outfall issues.

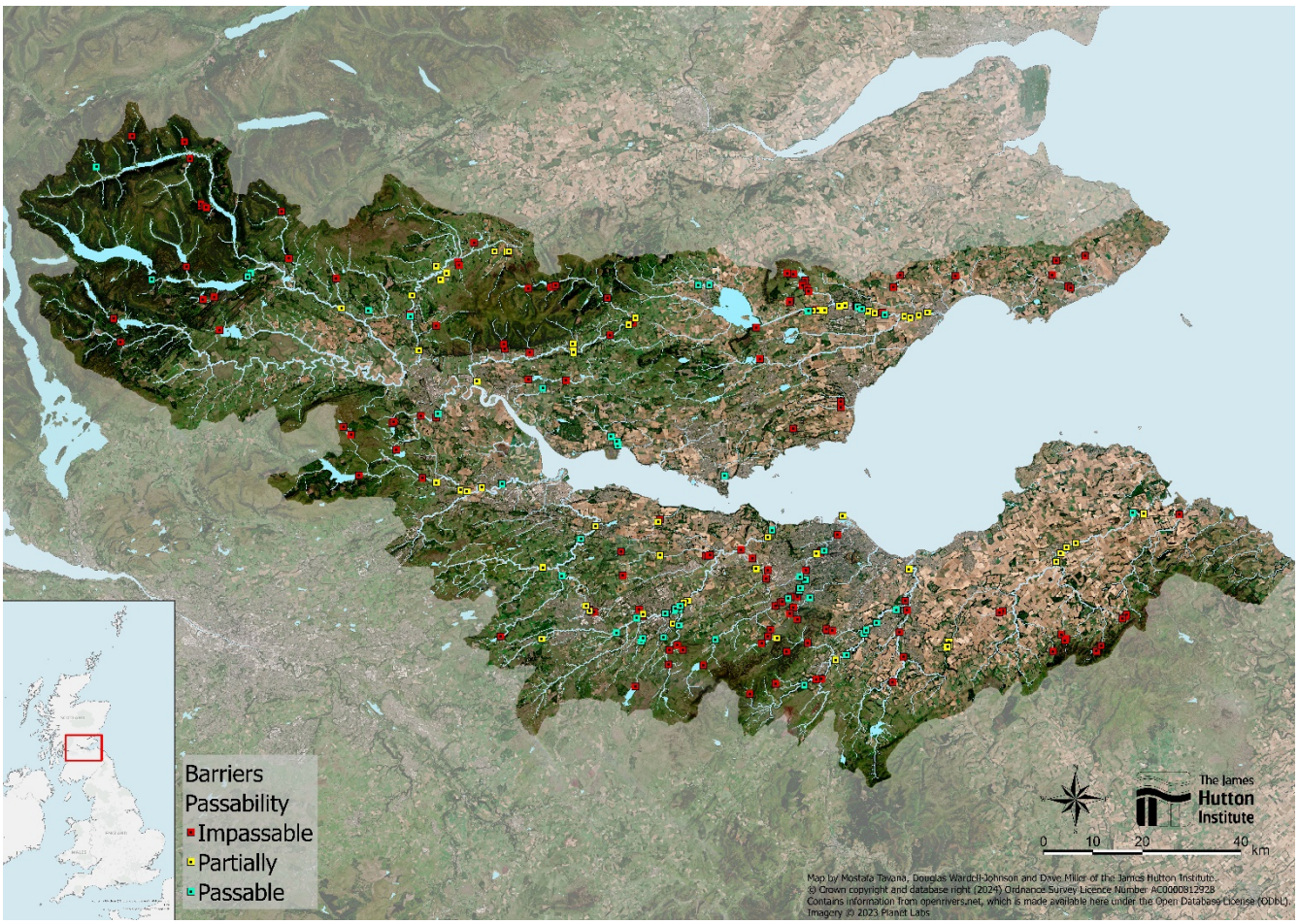


Figure 2 Barriers to Fish migration (Red dots are impassable, yellow partially passable, green passable). Map created by James Hutton Institute.

The west, north-west and northern parts of the catchment are less densely populated and have had less industry present, so face fewer post-industrial legacy issues. Pressures in this part of the catchment stem from agricultural processes, with excess nutrient input and riverbank erosion caused by livestock poaching and introduction of dung into rivers.

Large scale forestry operations also affect the water quality of these areas, with large Sitka spruce monocultures planted within the direct vicinity of rivers having an impact when these blocks are clear felled. Despite the issues, these areas have some of the best water quality in the catchment, but are exposed to other issues, such as landslides which occurred in 2019 which led to a large-scale flooding event and large-scale sediment release. The western and north-western areas of the catchment fall within the Loch Lomond and the Trossachs National Park. The National Park authority doesn't own land within the park but has a role in planning and coordination and provides funds to landowners and conservation charities to further conservation efforts in the area.

Invasive non-native species (INNS) are widespread in the catchment. The riparian zone is particularly susceptible with spread using water. American mink which were released from fur farms are widespread and predate upon native species such as water vole. Plants such as Himalayan Balsam shade out native species and leave banks exposed leading to increased erosion and siltation.

Agriculture has had a profound effect upon the distribution, abundance and diversity of wildlife. Many of the trends that have driven farming practices at a national level have been felt most deeply in the eastern lowlands. Intensification of farming practices through inputs of fertiliser and pesticides and changes in cropping regime has affected the character of freshwaters in the area.

The Forth Catchment contains a significant proportion of the national lowland bog resource. Historical land improvement has significantly reduced the area. The remaining bogs, in common with those in most other places, have suffered damage from drainage and expansion of scrub and planted and natural woodland.

The regional scalability planning within MERLIN seeks to address several linked risks and challenges:

- Climate change adaptation. The impacts of climate change on rivers and peatlands by 2050 is obviously uncertain – but we anticipate increased river water temperatures (https://www.data.gov.uk/dataset/2c3ace72-a2ef-4ad3-8c4d-0d6df88ba056/scotland-river-temperature-monitoring-network-srtmn-riparian-woodland-prioritisation-scores) and changes in rainfall to mean increase incidences and severity of both low and high flows, the latter leading to more flooding, landslides and the mobilisation of nutrients. Increased drought in summer months is also likely leading to low flows, higher river temperatures affecting the fauna. Drying out of peatland may lead to loss of biodiversity and in some cases an increase in emissions of climate gasses. Increased abstraction and the creation of impoundments for both urban and rural water supply may occur. Changes in agricultural practice, such as the timing and crop selection, in response to climate change may also affect freshwaters. Parts of the estuary may also be susceptible to climate change related coastal flooding and sea level change, but this lies out with the scope of the plan.
- Climate mitigation measures to meet NetZero obligations are likely to take place in region raising the potential for green-on-green trade-offs or even conflicts. Examples include plantation forestry that may deliver higher rates of carbon storage but conflicting with biodiversity targets, micro-hydro schemes that limit fish migration, and wind power inappropriate forestry proposals meaning pressure on carbon rich soils and peatlands.
- Biodiversity and ecosystem function loss. In common with much of Europe the Region is already in the midst of a biodiversity crisis due to the loss of species and degradation of the natural environment. This will only be exacerbated and accelerated by climate change.

2.2 Justification for the region

The Forth region was chosen as it represents both urban and rural sub catchments and so highlights many of the pressures that need to be overcome in river, peatland and wetland restoration in Scotland. The region is carrying out both peatland and river/small streams restoration. This allows an opportunity to monitor and evaluate the effectiveness of both peatland and river restoration and assess the combining influence of both in the same catchment. How they cumulatively impact flood resilience and biodiversity improvement, can then be used onwards to 2050 to inform improvements across the catchment and influence other landscape scale projects being initiated elsewhere in the Forth catchment (e.g. with Nature Restoration Fund) and further afield.

Details of each river catchment in the Forth region are listed in the Relevant Materials.

2.3 Linkages and synergies with other initiatives

The project helps bring together several major initiatives for peatland and river restoration which are operating at a larger scale and combines them with a number of initiatives which are specific to the Forth catchment.

Primary policy makers are the Scottish Government, with their biodiversity and conservation body, Nature Scot, providing funds to conservation organisations to combat habitat loss and climate change with the **Scottish Biodiversity strategy.**

The Scottish Governments Agricultural policy has a significant effect as it funds all Agri-Environment Climate Schemes (AECS). At the time of writing, this payment scheme is changing **(See Vision for Agriculture link below)** and in the future it will include Enhanced Conditionality for all Land Managers.

In addition, the Scottish Environment Protection Agency (SEPA), Scotland's environment regulator, also has a strong interest as they oversee delivery of the **Water Framework Directive** and **the River Basin Management Plan**, setting objectives for ecological restoration to 2027. SEPA currently has a **Scottish Adaption Plan** (See link below) that is out for consultation. SEPA have also recently released a guidance document called **'Will the river do the work**: a practical guide for assessing river recovery potential and directing when passive river restoration measures can be used to allow rivers to self-heal'.

Relevant strategies and plan to the Forth Region can be found in References/relevant material.

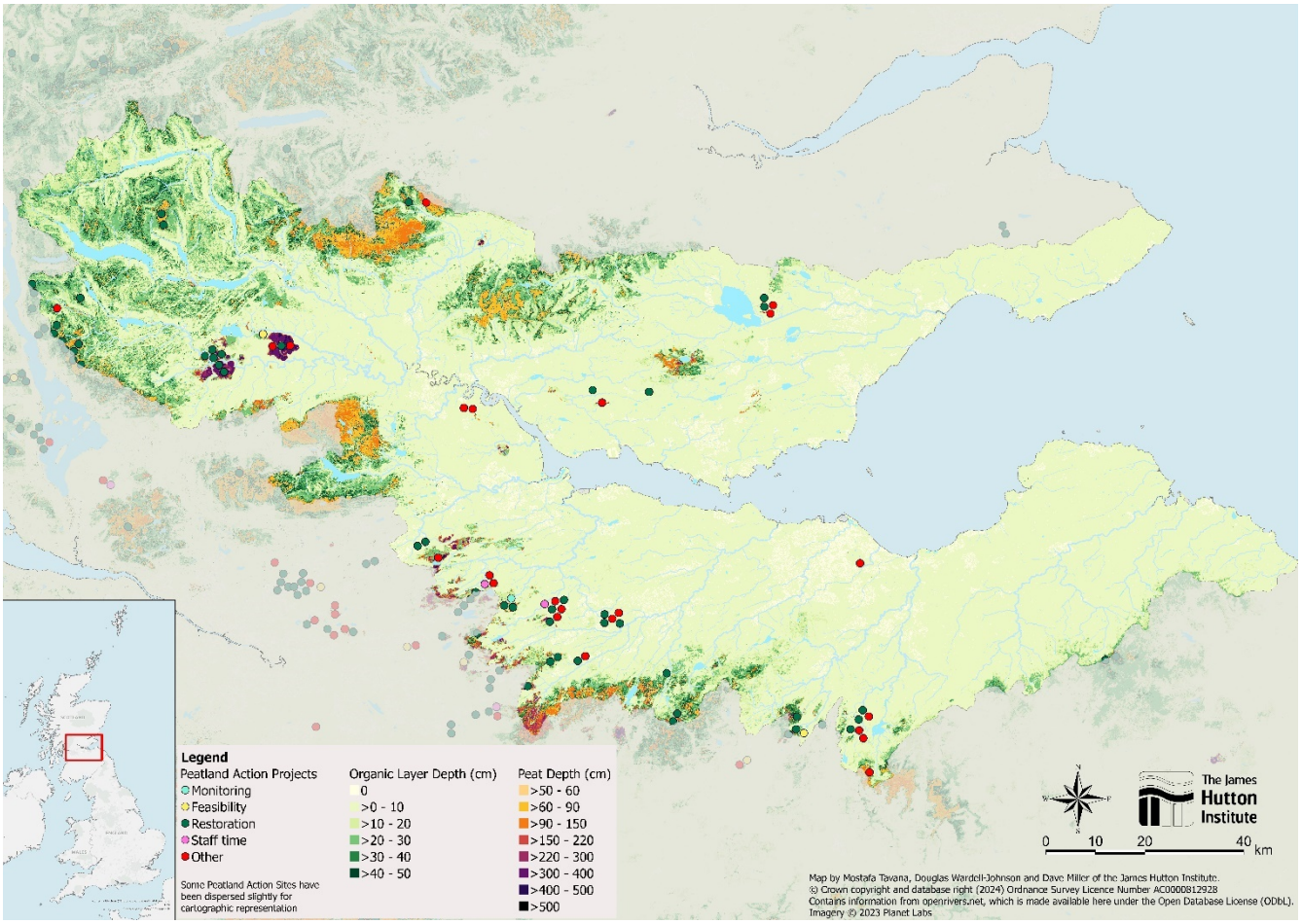


Figure 3 Peatland in the Forth Region (green dots restored). Mapy by James Hutton Institute

The Peatland Plans and The Scottish Climate Change plan set the national context for decisions about restoration of rivers and peatland in the Forth case study.

Peatland Plan (https://www.nature.scot/doc/scotlands-national-peatland-plan-working-our-future)

Scotland's Climate Change Plan (https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/1/), which has an objective of reducing our carbon emissions by 80% by 2050).

National Planning Framework 4 (NPF4) is Scotland's national spatial strategy to planning and development for protecting and enhancing biodiversity. NPF4 has a focus on the climate and nature crises, with the addition of securing positive effects for biodiversity such as exploring options for developing a biodiversity metric. Policies 1, 3 & 5 provide protection of peat, carbon-rich soils and peatland.

Scottish Environmental Protection Agency (SEPA) have regulatory responsibilities for the protection and enhancement of rivers within Scotland.

This is demonstrated through the **River Basin Management Plan** (https://www.sepa.org.uk/environment/water/river-basin-management-planning/) which outlines targets for river and water usage improvements throughout Scotland. This is SEPA's plan for improving water bodies from bad, poor, moderate to good or high status by 2027.

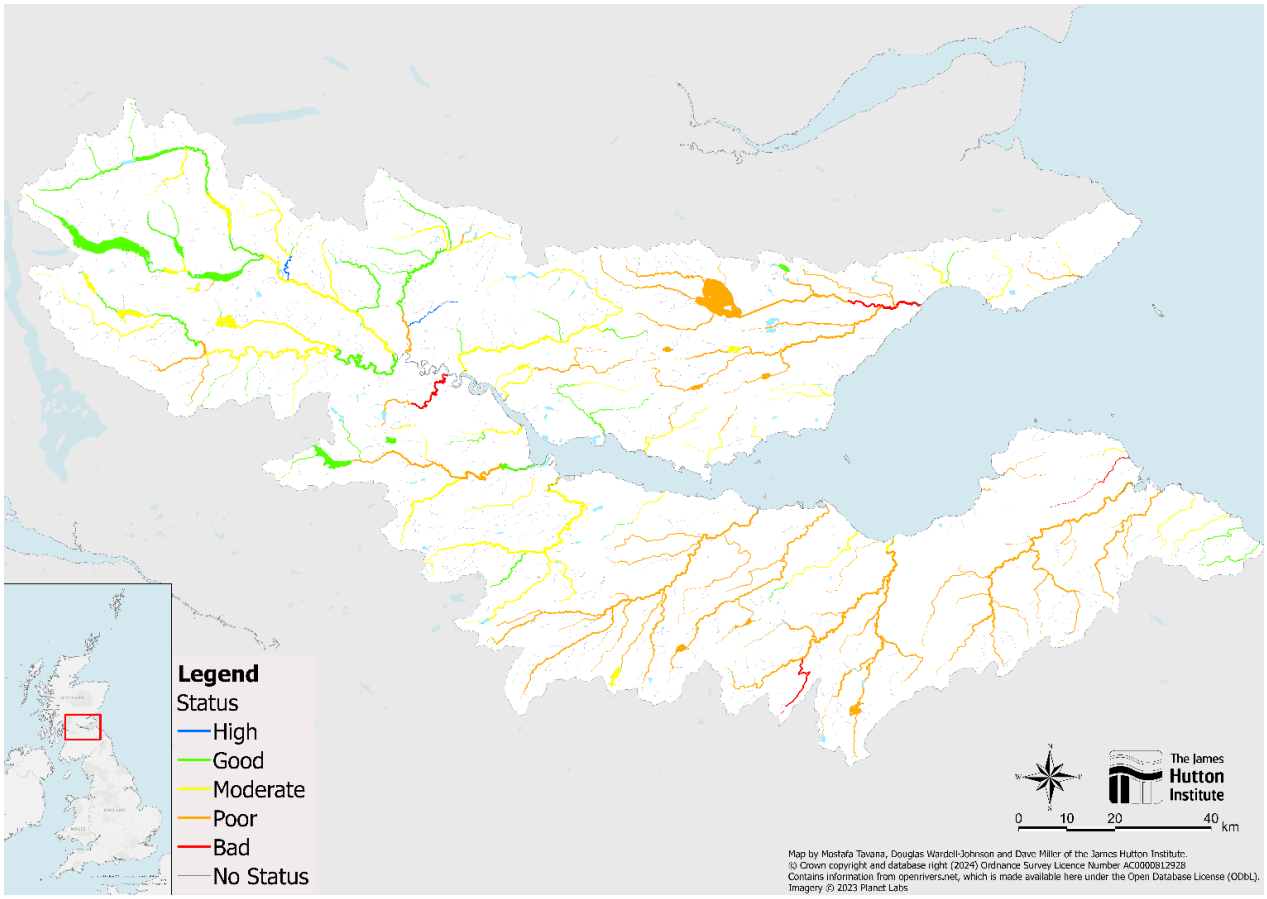


Figure 4 SEPA Status of Rivers in Forth Catchment. Map prepared by James Hutton Institute

Currently out for consultation is SEPA's **Climate Change National Adaptation Plan 2024-2029** (Climate change - national adaptation plan 2024 to 2029: consultation - gov.scot (www.gov.scot), which is a complex picture of risks, opportunities and dependencies between policies broken down into five outcomes; Nature Connects, Communities, Public Services and Infrastructure, 4. Economy, Business and Industry, and International Action.

Guidance from SEPA about whether a river will selfheal: https://www.sepa.org.uk/media/ifcaytdm/will-the-river-do-the-work.pdf

Scottish Water – Route map to improving Urban Wastewater published in 2021 with annual updates-

https://www.scottishwater.co.uk/About-Us/What-We-Do/Urban-Waters-Routemap

The **2023 update highlights** progress made in transforming Scotland's wastewater systems to deliver environmental benefits https://readymag.website/ScottishWater/IUW/

Figure 5 Loch Lomand and Trossachs National Park. Photo credit Forth Rivers Trust

Loch Lomond & Trossachs National Park Loch Lomond & The Trossachs National park have several strategies to focus efforts and tackle the nature crisis. Future Nature aims to stop the decline and restore nature on a large scale, providing a route map for landscape scale nature restoration.

https://www.lochlomond-trossachs.org/park-authority/publications/future-nature

https://www.lochlomond-trossachs.org/park-authority/get-involved/consultations/draft-national-park-partnership-plan-2024-29

Conservation of Wild Salmon – Marine Directorate: The Wild Salmon Strategy is a key document for driving change and trying to halt the decline of Atlantic salmon in Scotland's rivers. The strategies vision is: Scotland's wild Atlantic salmon populations are flourishing and an example of nature's recovery. Available at https://www.gov.scot/publications/scottish-wild-salmon-strategy/

Wild Salmon Strategy - This strategy is key in the prevention of Atlantic salmon becoming extinct in Scotland with it being seen as the route map for Scottish Government in halting this decline. The implementation plan which outlines how the strategy will be delivered gives a number of priority actions which have helped guide this management plan.https://www.gov.scot/publications/wild-salmon-strategy-implementation-plan-2023-2028

Forth ERA - Forth Environmental Resilience Array (Forth-ERA) is the first of its kind – a digital observatory of the Firth of Forth's entire water catchment. A living laboratory providing environmental data and analytics. It will facilitate world-leading scientific research, promote more efficient environmental management and regulation, and stimulate business innovation in support of Scotland's transition to a net zero carbon society.https://www.stir.ac.uk/about/scotlands-international-environment-centre/forth-environmental-resilience-array/

Climate Forth Project - Climate FORTH is the current project being delivered by the Inner Forth Futures Partnership. By responding to local need and demand, it will facilitate and demonstrate the transformative action needed to transition to a climate literate, ready and resilient place. We will explore and share ways for local heritage to be an asset for a sustainable green recovery with multiple benefits. https://www.innerforthlandscape.co.uk/about/climate-ready-forth

INNS Many non-native species contribute positively to our lives, as livestock, crops, timber, garden plants or pets. However, a small proportion (10-15%) of non-native species spread rapidly and cause damage to the environment, economy or human health. INNS are recognised worldwide as one of the top drivers of biodiversity loss. Management of INNS in Scotland is guided by the Non-native species: code of practice. https://www.gov.scot/publications/non-native-species-code-practice/

3 Stakeholders of the RSP

Stakeholders consulted with for the Forth Region Scalability Plan and their level of engagement are identified in Figure 6 (Table of stakeholders) and Figure 7.

ID #	Name of stakeholders	Acronym	Sector	Involvement Status *		Scale Level	Ownership	Descriptions, expectation, interests and responsibility	Web Link
1	Forth Rivers Trust	FRT	Environment,climate and disaster	Involved Involved	Cooperation	Regional	NGO	Member of the case study board	www.forthriverstrust.org
2	Nature Scot	NS	Cross sector	Involved	Empowerment	National	Public	Member of the case study board	www.nature.scot
3	UK Centre for Ecology & Hydrology	UKCEH	Other (Research)	Involved	Cooperation	National	Other	Member of the case study board	www.ceh.ac.uk
4	James Hutton Institute	JHI	Other (Research)	Involved	Cooperation	National	Other	Member of the case study board	www.hutton.ac.uk
5	Stirling University	SU	Other (Research)	Involved	Cooperation	Regional	Other	Member of the case study board	www.stir.ac.uk
6.	Heriot Watt University	HWU	Other (Research)	Involved	Collaboration	Regional	Other	Research Body	www.hw.ac.uk
7	Inner Forth Landscapes	IFL	Environment,climate and disaster	Involved	Collaboration	Regional	Network	Cross organisational project	www.innerforthlandscapes.co.uk
8	Stirling Council	SC	Spatial Planning	Involved	Collaboration	Municipal	Public	Local Authority	www.stirling.gov.uk
9	Edinburgh Council	CEC	Spatial Planning	Involved	Collaboration	Municipal	Public	Local Authority	www.edinburgh.gov.uk
10	Falkirk Council	FC	Spatial Planning	Involved	Collaboration	Municipal	Public	Local Authority	www.falkirk.gov.uk
11	Perth and Kinross Council	PKC	Spatial Planning	Involved	Collaboration	Municipal	Public	Local Authority	www.pkc.gov.uk
12	Clackmannanshire Council	CC	Spatial Planning	Involved	Collaboration	Municipal	Public	Local Authority	www.clacks.gov.uk
13	West Lothian Council	WLC	Spatial Planning	Involved	Collaboration	Municipal	Public	Local Authority	www.westlothian.gov.uk
14	Water of Leith Conservation Trust	WOLCT	Environment,climate and disaster	Involved	Collaboration	Catchment	NGO	NGO driving restoration	www.wateroffleith.org.uk
15	Atlantic Salmon Trust	AST	Environment,climate and disaster	Involved	Collaboration	National	NGO	NGO driving restoration	www.atlanticsalmontrust.org
16	Royal Society for the Protection of Birds	RSPB	Environment,climate and disaster	Involved	Collaboration	National	NGO	NGO driving restoration	www.rspb.org.uk
17	Scottish Environmental Protection Agency	SEPA	Cross sector	Involved	Empowerment	National	Public	Regulatory body	www.sepa.org.uk
18	Peatland Action	PA	Cross sector	Involved	Empowerment	National	Public	Regulatory body	www.nature.scot/climate-change/nature-based-solutions/peatland-action
19	Forestry and Land Scotland	FLS	Forestry	Involved	Collaboration	National	Public	Implementing restoration on their land holding	Home - Forestry and Land Scotland
20	Scottish Water	SW	Water reources	Involved	Consultation	National	Public	Public owned waste processing and drinking water supplying company	www.scottishwater.co.uk
21	Loch Lomand and Trossachs National Park	LLTNP	Spatial Planning	Involved	Consultation	Regional	Public	National Park not land owner but driving restoration	www.lochlomand-trossachs.org
22	Farming Cluster Group Stirlingshire	FCS	Agriculture	Involved	Collaboration	Local	Private	Implementing restoration on their land holding	None
23	L&ND Farming Cluster Group Pentlands	L&ND	Agriculture	Involved	Consultation	Local	Private	Implementing restoration on their land holding	None
24	Farming and Conservation	FC	Agriculture	Involved	Collaboration	Local	Private	Advising farmers about restoration	None
25	Scottish Government	SG	Cross sector	Involved	Empowerment	National	Public	Regulatory body	www.gov.scot
26	Network Rail	NR	Inland navigation	Involved	Information	National	Public	Publically owned . Maintaining rail co	www.networkrail.co.uk
27	Transport Scotland	TS	Inland navigation	Involved	Information	National	Public	Maintaining road connections on a Na	www.transport.gov.scot
28	Scottish Power	SP	Other (Energy)	Involved	Information	National	Public	Maintaining energy provision on a Nat	www.scottishpower.co.uk
29	Penicuik Estate	PE	Agriculture	Involved	Information	Local	Private	Implementing restoration on their land	www.penicuikestate.com
30	Marine Scotland	MS	Environment,climate and disaster	Involved	Information	National	NGO	Regulatory body	www.marinegov.scot
31	Crown Estate Scitland	CES	Other	Involved	Information	National	Private	Implementing restoration on their land	www.crownestatescotland.com
32	Scottish Fisharies Coordinatic	STCC	Fisharies	Involved	Information	National	NGO	NGO driving restoration	www.fms.scot/sfcc
33	Fisharies Management Scotla	FMS	Fisharies	Involved	Information	National	NGO	NGO driving restoration	www.fms.scot/sfcc
34	Game and Wildlife Trust	GWT	Other (Game and wildlife management)	Involved	Information	National	NGO	NGO driving restoration	Game & Wildlife Conservation Trust - The GWCT

Figure 6. Table of stakeholders.

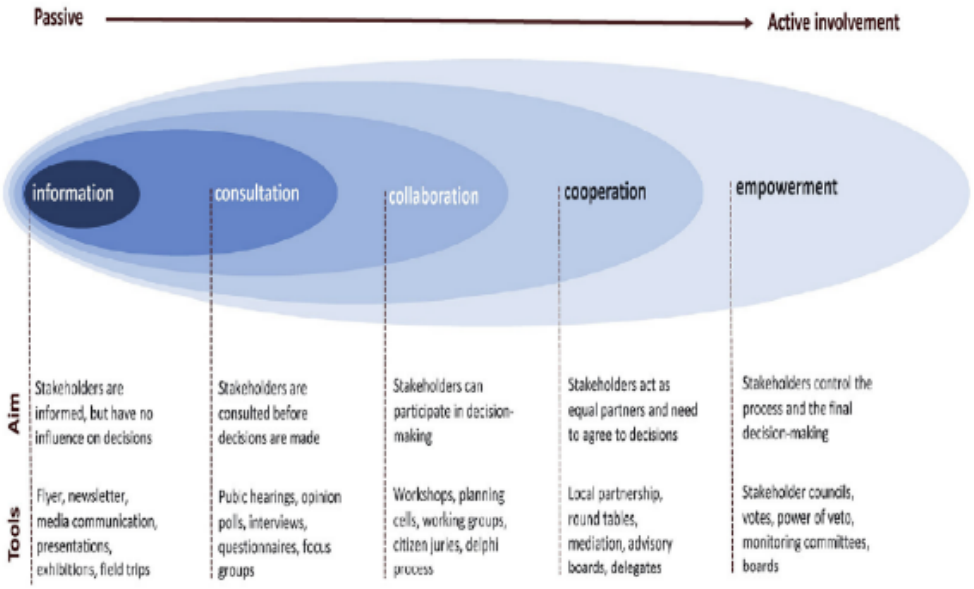


Figure 7: Level of stakeholder engagement

3.1 Further Stakeholder Opportunities.

Future stakeholders to be consulted and collaborated with in more depth are Scottish Water, Fife Council, East Lothian Council and farmer cluster groups in Fife, West Lothian and East Lothian.

The following stakeholders are affected but have not been actively involved in this plan; Local Community Councils, Network Rail, Scottish Power, Penicuik Estate, Marine Scotland, Crown Estate Scotland, Scottish Fisheries Coordination Centre, Fisheries Management Scotland and Game and Wildlife Trust. Local residents and those who may be affected by delivery projects.

Nature Scot and Forth Rivers Trust will own the Forth Regional Scalability plan in the future. It will also be circulated to all stakeholders' details of which can be found in Figure 6 above.

River Restoration Practitioners will implement restoration actions. These include Land Managers, Non-Governmental Organisations and Government Organisations and they will be responsible in some ways for implementing, monitoring and coordinating restoration.

The following stakeholders; Nature Scot (Funders and coordinator), Scottish Environmental Protection Agency (Funder, coordinator and implementation) and Forth Rivers Trust (Implementation, coordination and monitoring) will manage and coordinate the RSP actions.

Scottish Government (Nature Scot, SEPA), Private finance, Local Authorities and stakeholders in the private sector are expected to fund the upscaling of the restoration work.

Monitoring of success will be recorded by implementation partner and enhanced by research institutions such as UKCEH, James Hutton Institute and Universities.

Nature Scot, Forth Rivers Trust will advocate and build constituency for the Regional Scalability Plan.

4 Green deal goals

The EU Green Deal (GD) goals are listed in Figure 8. Primary goals are the main goals that the RSP seeks to achieve. Secondary goals are additional or potential goals to which the RSP can contribute to.

Criterion	Indicator(s)	Means of Verification
Biodiversity net gain	Conservation status and trends of species and habitat of community interest (Habitats Directive) and/or WFD ecological status	HD and WFD reporting on freshwaters and wetlands
Climate regulation	IPCC emission reporting guidelines on net CO_2 equivalent reductions or storage	Measurement or modelling (IPCC 2019 refinement)
Flood resilience	Flood hazard reduction for people (number) in vulnerable communities or volume (m^3) of additional storage capacity created	Measurement or modelling undertaken for the Flood Directive
Drought resilience	Drought risk reduction for vulnerable communities in (number) of people affected	Measurement or modelling of soil moisture and water storage
Health & Well-being	Increased access to nature-centred recreation and eco-tourism for people (number)	Eurostat Health status
Zero pollution Goals	Reduce nitrate and chemical run-off from agricultural land (% of change)	Measurement or modelling of diffuse pollution loadings
Farm to Fork - Sustainable Food Systems	Sustainable agriculture and aquaculture (ha increase)	Eurostat: organic farming and agri-environmental data
Sustainable energy	Energy savings of using NbS and any increase in renewable energy generation capacity in restored area (kWh)	Renewable scheme data from planning database(s)
Sustainable transport	Measures taken to improve active and public transport (increases in numbers) or renewable energy use (kWh)	Incorporated into restoration plans and local/regional data to evaluate impact
Inclusivity (Leaving no one behind)	Change in access to blue-green space - a) overall, b) for disadvantaged communities, i.e. low employment/high deprivation (% change)	Eurostat spatial data and socio-economic indicators available for small areas/high resolution
Circular economy	Business models adapted according to principles of a circular economy (number); Reduced consumption of water and other relevant resources (%)	Business survey and industry data on consumption
Financing the transition	New economic activity (number) company registrations in relevant standard industry classification codes in the region	Company data and postcodes
Green Growth	Employment (% changes) in relevant standard industry classification codes in the region	Eurostat employment data for LAU1

Figure 8: Indicators evaluating impact on Green Deal Goals.

Figure 8. Green Deal goals

The Forth Region Primary goals are set as Biodiversity, Climate Regulation, Flood and Drought Resilience, Zero Pollution goals, Green Economy, Circular economy.

The overall vision is that of a cohesive partnership between Land / Water owners, Local Authorities, Government bodies, non-government Environmental Organisations and Local Communities. This is to enable transformative landscape-scale change in terms of works to improve biodiversity, enhance natural flood management and main-stream climate resilience measures across the Rivers and Peatland in the Forth catchment, while simultaneously allowing stakeholders the means to live, work and thrive on the land. This paves the way for the scaling-up of Biodiversity and Natural Flood management projects deemed to be most effective in reaching nationally set targets, ultimately seeing the protection and re-establishing of vulnerable species and habitats while successfully mitigating against the effects of climate change.

Upper catchments will be a blend of upland woodland and restored, functioning peatland as well as a mosaic of other relevant on hill / mountain habitats with healthy naturalised river systems protected from pollution, Invasive non-native species and climate pressures. These reaches will represent the ideal spawning habitat for Atlantic salmon, Brown trout and Sea trout, as well as being able to support other currently threatened aquatic species such as the European eel and Freshwater pearl mussel.

Mid catchment will consist of farmland sympathetic to the environment with a degree of deintensification and lower input where it makes sense for both the farm business and the environment. More riparian woodland, INNS (Invasive Non-Native Species) plant species control and green bank protection will give riparian habitat more structure and variety that will result in lower sedimentation. Further structure and resilience to diffused pollution can be achieved with 3-D Buffer zones (https://www.gov.uk/government/publications/3d-buffer-strips-designed-to-deliver-more-for-the-environment) along agricultural land. This prevention of unnecessary soil erosion and pollution will improve water quality and reduce siltation, which will improve nursery habitat for Atlantic salmon and prevent unnecessary soil loss for land managers. Reconnected floodplains will create expanded wetlands that not only contribute to the storing and slowing of floodwaters during high rainfall events, but also form vital habitats for plant species, wading birds, amphibians and insects. Recognition and reward of the value generated for wider society by positive management of aquatic systems (reducing flood or enhancing biodiversity) by landowners will be realised, recognised and celebrated adding value to their product.

Lowland areas will effectively blend urban spaces with nature, allowing for the protection of local communities from flood events as well as benefits towards people's health and wellbeing through improved habitats and ecosystems accessible in their local area. Communities should be empowered to get involved in freshwater restoration through opportunities to consult on projects in their local areas, volunteering and citizen science. This will also foster a connection between local people and their river, giving communities a voice with formal stakeholders which secures a long-term interest in the preservation of the river and these habitats on a catchment scale.

Any barriers to fish migration in these areas such as historical weirs will either be removed, or fish passes installed where ownership appropriate. This will allow migratory species such as European eel, Atlantic salmon and Sea trout to have access to as much habitat as possible in each river system, increasing potential breeding opportunities as more natural river habitat is accessible for migration.

The mixed water quality issues coming from both urban wastewater and diffused pollution from arable crops will be addressed. There will be public recognition and reward for arable farmers implementing diversly structured riparian habitat in buffer zones. Wastewater treatment providers and the regulating body should survey outfalls into rivers on an increased scale. This survey data should be publicly available, so people know how much wastewater is entering Scottish rivers. If the public is aware of the issue, it will drive the need for policy change. This is especially relevant in built up urban areas where there is more sewage, more of a public health risk and more stress on biodiversity.

4.1 SMART Green Deals goals relevant for the region: primary goals

Climate related goal(s)

Climate change mitigation and adaptation can be implemented across many measures, such as greater numbers of riparian tree planting and restoration of degraded peatland. These provide benefits on both the local scale in terms of habitat and water retention on the landscape, but also have much wider implications in lowering carbon emissions to combat climate change directly. These measures are also anticipated to make an important contribution to flood and drought management by holding water in the landscape for longer and recharging ground water. Monitoring existing measures would make this quantifiable so flood planners can consider this and build it into future plans.

Biodiversity related goal(s)

Biodiversity is the overarching Green Deal indicator into which the rest slot. The methods used to up-scale this Green Deal indicator may change slightly throughout the timescale to 2050, but the knowledge of what needs to be done to combat habitat loss is well established. However, to upscale it is vital to identify and quantify what habitats we have and restore areas that are lost.

When writing this plan, Biodiversity Net Gain (BNG) had not been formally adopted in Scotland. Currently it is only voluntary and not yet regulated by a government standard or metric. National Planning Framework 4 guidance (https://www.gov.scot/publications/national-planning-framework-4/) on Biodiversity Net Gain is currently broad and general which leaves developers to find their own way of implementing BNG. To achieve the biodiversity net gain goal the standard biodiversity metric tool to calculate the value of units before and after development needs to be agreed upon for Scotland with widescale cross sectoral training rolled out to allow good practice to be adopted quickly.

Upscaled biodiversity efforts will assist in improving the overall resilience of a catchment to the effects of climate change, with species populations reinforced by habitat connectively as opposed to vulnerable, fragmented habitats.

Efforts to improve habitat connectivity and improve climate change mitigation measures will protect aquatic species in periods of intense heat and drought. For example, Atlantic salmon is particularly vulnerable to rising water temperatures during summer months. Slowing the flow during periods of intense rainfall is also vital to salmon, as it ensures that peak flows cannot dislodge vast quantities of spawning gravels during spawning season, increasing the survival rates of more eggs.

Catchment scale control of Invasive non-native plant species focusing on a top of catchment down approach involving local communities through public event, citizen science and volunteering will help raise awareness of the issue while decreasing biodiversity loss of plant species. This will also help with sedimentation loss and flood, drought resilience.

Inclusivity goal(s)/ Goal(s) for local community/public participation

The fostering of positive relationships with landowners is fundamental in the continued delivery and upscaling of works across the Forth Region. The most seamless upscaling will occur on areas of land where the landowner is aware and trusting of the working practices of those delivering the restoration works and has experienced tangible benefits either through community recognition of good practice (social license to operate) increasing the demand of their product, or financially through farm payment systems. It is hoped that land managers will be motivated to become restoration practitioners themselves, which could lead to another option for farm diversification and could create more green jobs within the community.

Focusing on this and using it as a means to showcase successes to other landowners is vital in combining localised efforts into a catchment-wide restoration initiative. Further cultivation of relationships between upstream and downstream residents and stakeholders is very relevant, as it ensures that all parties are aware of each other's individual issues and understand why adaptions need to be made to achieve biodiversity, natural flood management and climate resilience goals.

Due to the predominance of private ownership over large areas of Scotland, and the top-down driven nature of restoration targets, scaling up with inclusive involvement of such stakeholders is envisaged to remain a significant challenge. To overcome this, we need to work with land managers to make adaptions which help biodiversity gain and climate change resilience and benefit farm business.

There is a conceptual barrier to upscaling Nature Based Solutions in the Forth Catchment as it is not currently part of mainstream thinking, especially regarding flood schemes. People tend to think at a local level rather than at a catchment scale. Getting a wider stakeholder engagement where the public have a voice with decision makers and landowners can start to change mindsets and public perception both in rural and urban settings.

Flood and drought goals

Flood and drought resilience go together hand in hand. Flow attenuation measures also store water on the landscape for longer, helping to combat rivers reaching unsustainably low levels. Natural flood management techniques, measures such as leaky dams, wetland scrapes and riparian planting in both the upper and lower reaches, should be increased in all river catchments in the region to combat these extreme periods of either flood or drought.

It has been acknowledged that it would be less of a financial burden for councils to compensate landowners to stagger peak flow on their land upstream than repair flood damage in urban areas downstream. However, there is uncertainty amongst the local authority decision makers who are already finically squeezed delivering essential services, to justify natural flood management options. Combine this with the uncertainty from land managers and nature based solutions become less likely. Increased monitoring of NBS (Nature Based Solutions) for flood management and sharing success stories may encourage adoption of greener solutions. The burden must be shared, and land managers must be compensated and upskilled to learn how to make this social license to operate evolve to make economic sense to the farm business. (See Land Use and Agriculture Just Transition Plans(https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2023/06/transition-land-use-agriculture-discussion-paper/documents/transition-land-use-agriculture/transition-land-use-agriculture/govscot:document/transition-land-use-agriculture.pdf)

Zero-pollution goals

There is a general misconception by the public that Scotland does not have any issues with water quality. Scottish urban rivers are still a big part of the urban wastewater treatment system. The sewage systems are often Victorian in origin and not designed to cope with the increased housing that is needed in the Forth region. For example, the Water of Leith River in Edinburgh has 60 Combined Sewage Overflows on 12 miles of river that

flows through the middle of Scotland's capital city. The public water body (Scottish Water) could be encouraged to monitor more thoroughly and share outfall data of the sewage system into all Scottish rivers. Work needs to be done to raise public awareness of these issues in Scotland so that funds needed to upgrade the sewage system can be raised. Citizen science / volunteer groups can be formed to carry out citizen science monitoring like “River Watch”, “River Fly” Monitoring Schemes and “Outfall Safari” on river sub catchments, But the data must be collated and used to report issues to Scottish Water and Scottish Environmental Protection Agency (regulatory body) and raise public awareness of water quality issues.

Agricultural pollution may be addressed in the long-term by a general increase in landowner awareness of the economic benefit of having more efficient systems for chemical use in place that reduce diffused pollution and save the land manager money. This could take the form of sustainable intensification or agro-ecology. But upskilling to do this has to happen now as the future farm payment scheme expresses this as “Enhanced Conditionality” and it could be compulsory within the timescale of this plan. It will be essential to make funds available to monitor the outcome of this legislative change or the positive benefits may be missed and discontinued in the future.

Where possible materials and contractors for restoration should be sourced locally to reduce carbon emissions.

Green growth goals

There are increasing efforts underway to improve and develop means to finance the transition to a green economy and the restoration of nature. The gap in funding (beyond publicly available funds) for restoring nature in Scotland has been estimated to be between £15-27 billion until 2032 (GFI, eftec, Rayment Consulting, 2021 The Finance Gap for UK Nature). This gap will obviously be even larger over the Scalability Plan timescale to 2050 (though it has not been estimated). More specifically for some of the main Green Deal objectives of the Forth case study, the finance gap to 2032 for restoration of ‘clean water’ in Scotland has been estimated to be £3 billion, and the gap for the protection and restoration of biodiversity at £8 billion (GFI, eftec, Rayment Consulting, 2021). So, there is considerable need for, and therefore opportunity to encourage, the development of new finance models that will provide and facilitate the necessary private and green finance to help achieve the regions goals. Work is underway such as the anticipated successor to the Investment Ready Nature Scotland initiative, but training will need to be provided to help land managers and other restoration practitioners understand private funding and how to access it.

Circular economy – There is a requirement for skilled and experienced workforce with cross sectoral knowledge (Conservationists / Ecologists working with Farming Advisors, Hydrogeomorphologists and Flood specialists) to plan and implement the restoration measures in the Forth, and similarly across Scotland. Using the opportunities highlighted in the MERLIN case studies, and in other initiatives such as Peatland ACTION, will increase this skill base and contribute to the sector's capacity to develop and contribute to nature restoration towards 2050.

As contracts for conservation projects become more widespread and progress from organisations undertaking this work as an extension of their core work, such as the building trade, business opportunities for contractors will increase. There is a perceived bottleneck at present for peatland restoration, due to the capacity of existing skilled restoration contractors. The ever-increasing number of contracts available for restoration and national efforts to increase the skill base, aims to allow a greater diversity of contractors to take advantage of these business opportunities. The increased number of contractors and contracts available will streamline the funding process, allowing as many funds to be granted where they are needed as possible. This has the potential to create a new Green Jobs sector – although thought must be given to adequate training and how contractors can overcome seasonality to allow for staff retention.

4.2 SMART Green Deal goals relevant for the region: secondary goals

Knowledge goals

Funding for long term monitoring is essential to scale up successful methods. Show casing of durable and reliable restoration projects, with the ability to demonstrate accurate metrics applicable to natural flood management goals will be vital in encouraging local authorities (councils) to invest further in natural flood management, as opposed to frequent “grey bank” techniques currently utilised.

These typically involve heavy machinery and concrete intervention which does not align with sustainability / net-zero goals or biodiversity goals, and are often very expensive, easily costing millions of pounds per project.

The Forth was a unique case study within MERLIN as it covered both peatland restoration and river/small streams restoration. This allowed an opportunity over the course of the project to monitor and evaluate the

effectiveness of both peatland and river restoration working together. It is hoped that this monitoring information, demonstrates the combination of these restoration efforts and how they cumulatively impact flood resilience and biodiversity goals. Hopefully, it will encourage more monitoring of this nature so that data can be used to inform, influence and encourage other landscape scale projects that are being initiated elsewhere in the Forth catchment (e.g. with Nature Restoration Fund) Scotland and Europe.

Continuation of efforts to monitor and understand our catchments and how rivers typically interact with the landscape, starting with landowner accounts and interpretations then backed up by data collection, will provide the basis for works carried out to 2050 and beyond. Tying in with overall sustainability, a detailed understanding of the catchment allows the correct nature based solution to be implemented in the correct area at the correct time. This will involve the sharing of collated data across multiple organisations to co-ordinate efforts and minimise unnecessary expenditure of resources, such as two organisations not in collaboration researching the same subject.

Co-design and development of projects could also be achieved in this cross-sectorial approach. Pooling knowledge from different sources and at different scales for experts in a variety of fields could lead to very successful projects.

A catchment wide mapping exercise which records all existing River, Peatland and Estuary restoration in the Forth such as Government funded projects and schemes (Nature Scot - NRF, SEPA WEF, Scottish government AECS) NGO projects (FRT, RSPB etc.), Local Authority projects and large scale multi partnership projects (Forth ERA, Climate Forth Project) would help identify gaps, steer target areas for “easy wins” for future restoration and whether this were privately owned or public land.

Health and wellbeing goals

Health and well-being goals may be addressed on a local scale, as works that take place may allow for more local interest in the newly created habitats. Works carried out during MERLIN, for example wetland creation, from now until 2050 and beyond will become fully developed and vibrantly biodiverse habitats, and therefore these areas will be of value to the physical and mental wellbeing of local people who will be able to enjoy them. It is hoped that by 2050 every river catchment in the Forth will have its own steering group. That each river will have community engagement through volunteering, restoration project consultation and citizen science.

A recent study has found that Biodiversity loss, climate change and Invasive Non-Native species are the biggest environmental driver for infectious disease outbreak (https://www.nature.com/articles/s41586-024-07380-6). Research into this is being done in the Forth Region on a Forth Rivers Trust / MERLIN / Nature Restoration Project by Jyväskylä University. Public events and publishing findings will hopefully highlight this connection and increase public backing for restoration.

Sustainable transport goals

Technologies and restoration techniques will continue to be scaled up to be as sustainable as possible, with means for materials to be sourced locally and nationally rather than internationally, reducing the carbon footprint of projects to align with net-zero goals currently in place.

River and Peatland Restoration projects could be funded by transport providers as they work towards net zero goals and offset biodiversity loss necessary for safety of their infra structure (e.g. tree removal on railway lines). Natural flood management projects are particularly relevant as infrastructure near rivers will become more at risk due to the impact of climate change.

Sustainable food system goals

The food system's interconnectedness requires a systems-thinking approach to sustainability, considering multiple facets simultaneously. Addressing a range of interrelated factors, from enhancing sustainable agricultural practices and reducing food waste across supply chains to adopting healthier, more environmentally friendly diets, is crucial. The sustainable food system goals for the Forth Catchment embody this holistic approach.

The Forth Catchment has unique food system characteristics and holds strategic importance for Scotland. It boasts one of the country's highest concentrations of prime agricultural land. Additionally, Edinburgh, the city with the second-biggest population in Scotland, is situated within the Forth Catchment. This makes the area pivotal for improving aspects such as food security, localised supply chains, and sustainable behavioural change. With the Good Food Nation plan recently being launched and local authorities soon having to implement these at a local scale in 2025, there is great momentum for addressing these issues in the catchment.

Increase agroecological farming in the Forth Catchment. Whilst there are great examples of farms using agroecological practices in the Forth Catchment, there is still scope for greater adoption by a greater number of farmers. Greater adoption of agroecological growing in the Forth catchment can provide multiple benefits, such as reducing carbon emissions by 55-70%, increasing on-farm and beyond-farm biodiversity and providing greater resilience in the face of extreme weather patterns. However, farmers need more support to transition to agroecological farming practices. Making AECS more reliable and adapted to farming needs & cycles, as well as supporting the creation of farmer clusters, are two ways in which the Scottish government can support farmers to adopt agroecological practices.

Increase crop production dedicated to food for human consumption. Only 9% of Scotland's agricultural land is suitable for growing crops. A very small part of that prime agricultural land is used to grow food for human consumption. Instead, a big majority goes to cereals,for livestock feed, beer and whisky production, making Scotland more reliant on imports to feed its population. To increase Scotland's food security, a greater proportion of crop production needs to be grown with a greater diversity for human consumption. This also includes increasing the production of vegetables, fruits and pulses. With a big proportion of prime agricultural land used for crop production being in the Forth catchment, the area is strategically important for driving that change.

Drive behavioural change towards more sustainable diets. Edinburgh, the second most populous city in Scotland, is located in the Forth Catchment, which has significant potential to influence consumption patterns. Encouraging consumers to buy locally grown, seasonal foods can support shifts in agricultural practices. Additionally, reducing mass-produced meat consumption in favour of better-quality, sustainably raised options can lower environmental impacts. This shift not only aids agricultural sustainability but also promotes healthier, more nutritious diets for the population.

Continue food waste reduction beyond the 33% reduction by 2025 set by the Scottish government. In 2021, Zero Waste Scotland estimated that 1.038 million tonnes of food waste was disposed of 2021, with a majority coming from household waste. This food has a significant carbon footprint, biodiversity impact, and freshwater use, all of which could have been avoided. Globally, it takes a land mass larger than China and 25% of all freshwater consumption globally to grow the food each year that ultimately never gets eaten. Given Edinburgh's substantial share of Scotland's households, there is significant potential to make a considerable impact on nationwide food waste reduction efforts within the Forth catchment.

Reduce agricultural emissions by 30% from 2021 levels by 2032 in accordance with Scottish government targets. Although agriculture in Scotland has significant potential for carbon sequestration, it is currently the second largest emitter of greenhouse gases, responsible for 26% of total emissions. This reduction relies on efforts across the agricultural sector in the Forth Catchment, including installing renewable energy on farms where suitable. Additionally, adopting agroecological practices is crucial as these increase soil organic matter and integrate trees, hedges, and other perennials through agroforestry and/or by strategically dedicating land to nature enhancement.

https://www.gov.scot/policies/agriculture-and-the-environment/agriculture-and-climate-change/#:~:text=However%2C%20to%20meet%20agriculture's%20emission,from%202021%20levels%20by%202032.

Scotland's Food Atlas: Mapping Out a Sustainable Food Future - Nourish (nourishscotland.org)

Sustainable energy goals

Climate mitigation measures to meet NetZero obligations are likely to take place in the region raising the potential for green-on-green trade-offs or even conflicts. Examples include plantation forestry that may deliver higher rates of carbon storage but conflicting with biodiversity targets, micro-hydro schemes that limit fish migration, and wind power inappropriate forestry proposals meaning pressure on carbon rich soils and peatlands. Special care and communication between Net Zero / Climate Change, Biodiversity sectors must be implemented to achieve maximum success in both areas.

5 From general goals to actions

5.1 Climate Goal

Action 1 Climate regulation upscaling will see wide-scale identification of peatland sites

(Land Use Transformations (arcgis.com)

Action 2 Create a dataset measured in hectarage of restorable sites for Peatland (Peatland Action)

Action 3 Make data available for all restoration practitioners (Peatland Action, Nature Scot)

Action 4 110,000 Ha Peatland restored by 2026

Action 5 250,000 Ha Peatland restored by 2030

5.2 Biodiversity Goal

Action 1 Wide scale identification of restoration projects already carried out in the Forth Region to identify significant gaps causing habitat fragmentation. Combined with existing Land Use data and "Will the river do the work" SEPA data to find priority sites for upscaling restoration. (Nature Scot, Scottish Environmental Protection Agency, James Hutton Institute)

Action 2 Remove or otherwise circumvent barriers to fish migration like unpassable weirs and culverts. Use Scottish Environmental Protection Agency map of Barriers and Forth Rivers Trust update.

Action 3 Develop a regional scale INNS (Invasive Non-Native Species) initiative involving all stakeholders – (example Scottish Invasive Species Initiative in the North of Scotland). (Forth Rivers Trust and Nature Scot)

Action 4 Work with all stakeholders in the region to plant more riparian woodland and establish 3D Buffer strips along rivers. Distribute research and advice (Forestry and land Scotland) regarding best practice for tree protection against grazing from livestock and wild animals (Deer, Beavers, Voles etc.) (Scottish Wildlife Trust River Woods, Forestry Land Scotland, Woodland Trust, Universities, Nature Scot)

Action 5 Regulate Biodiversity Net Gain with a government standard/metric and roll out widescale cross sector training about the standard / metric

5.3 Inclusivity goal

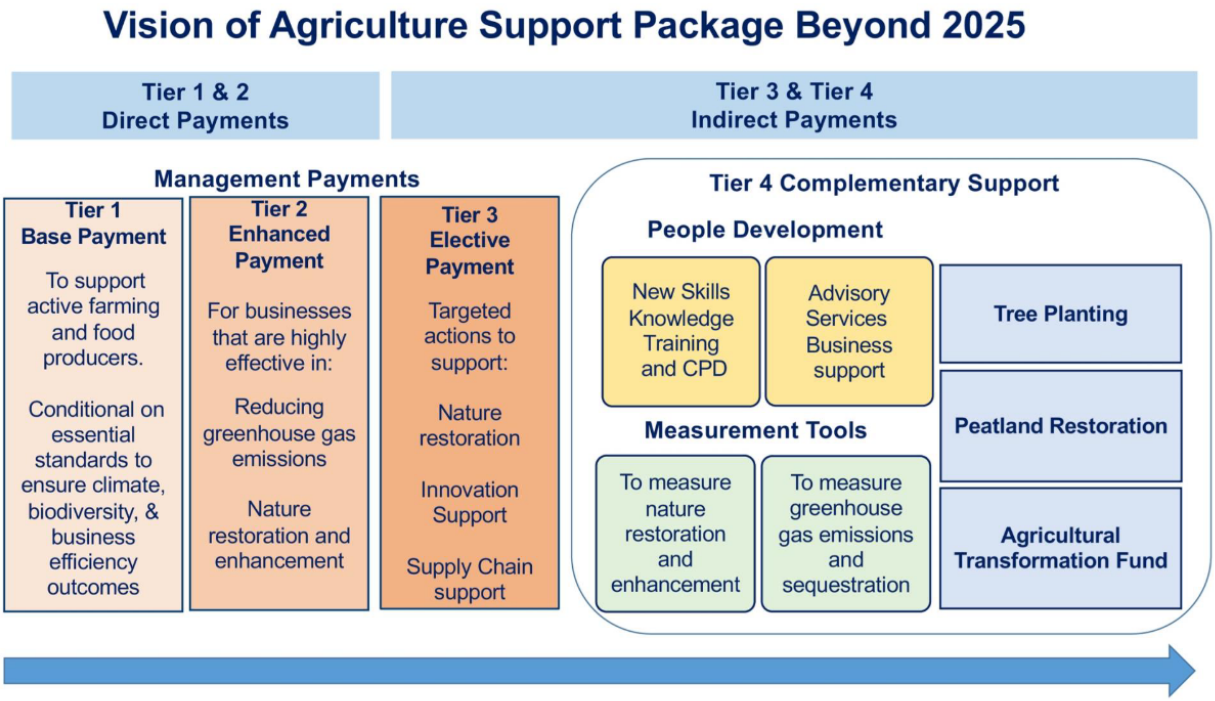


Figure 9. Vision of Agriculture Support Beyond 2025.Illustration prepared by James Hutton Institute.

Action 1 -. Payment processes for stakeholders and landowners will be scaled up to ensure the sacrifice of land for biodiversity is financially viable. D4 Enhanced Conditionality Screening Synthesis | Land Use Transformations (hutton.ac.uk) (Scottish Government)

Action 2 - More flexible Agri-environment schemes (Scottish Government)

Action 3 – Set up maintenance schemes to encourage land managers to take up restoration on their land. (Scottish government)

Action 4 - Regard land managers as active conservation agents and provide relevant training (grant scheme, green finance, offsetting, nature based solutions, natural flood management, biodiversity). (Scottish Rural Agricultural College)

Action 5 - Give farmers feedback regarding biodiversity enhancement and Natural Flood Management on their land after restoration (survey results), allow them to get pride from the wider community and society. Spend money on tools and staff time for restoration practitioners to provide the information to farmers

Action 6 -Communicate effectively with land management community via workshops for farm cluster groups in each catchment, farm visits and local social media platforms rather than through policy and large documents that they have not got the time to consult with.

Action 7 – Engage the community in their catchments through events, citizen science and / or volunteering

5.4 Other primary goals

Flood and Drought

Action 1 – Monitor the effectiveness of natural flood management techniques in various circumstances to make the most effective decisions regarding which techniques are best implemented where.

Action 2 - Encourage local authorities (councils) to invest further in nature based solutions for natural flood management, as opposed to frequent “grey-bank” techniques.

Zero Pollution

Action 1 Encourage Scottish water to monitor and share outfall of sewage data into rivers to raise public awareness of the funds needed to upgrade of sewage system to reduce wastewater pollution of Scottish rivers.

Action 2 - Form more citizen science / volunteer projects to monitor sewage outfall / water quality issues on all rivers in the catchment.

Action 3 - Upskill land managers / farmers to reduce use of fertilisers and herbicides could save them money and benefit environment.

Action 4 – Where possible source materials and contractors locally to reduce carbon emissions

Green Growth

Action 1 Development of new finance models that will provide and facilitate the necessary private and green finance to help achieve restoration on a regional scale

Action 2 Address skill shortages for contractors via provision of training. Where can they look for restoration work? How can they overcome the seasonal nature of the work so that they build up the experience of their operatives without losing them during seasons they cannot work (e.g. bird nesting season).

5.5 Other secondary goals

Knowledge Goals

Action 1- Create a steering group for each river catchment group in the region inviting a core group of stakeholders from Government, Community, Local Government, Conservation Non-Governmental Organisations and Farmer cluster groups to attend.

Action 2- Write a catchment management for each river catchment with steering group.

Action 3- Showcase successful restoration projects between catchments in the region

Action 4- Monitor the cumulatively effects of both river, peatland, woodland and other habitat restoration working together to impact flood, biodiversity and climate change resilience.

Action 5- Inform and influence other landscape scale projects that are being initiated elsewhere in the Forth catchment (e.g. with Nature Restoration Fund) and also seek to integrate peatland, river woodland and other habitat restoration at scale.

Action 6 – Publicise findings with stakeholders especially the general public to encourage people to think about catchment scale restoration – not just what is happening in their local area.

Health and wellbeing

Action 1- Each river catchment will have community engagement through volunteering, restoration project consultation, public events and citizen science encouraging people to get involved in restoration. Having a purpose, being outside, social contact and regular exercise are all factors that improve people's mental and physical wellbeing.

Action 2-Determine the link and publish findings between restoration biodiversity enhancement and the spread of viruses in the Forth Catchment to emphasise the need and encourage public backing for restoration.

Sustainable transport goals

Action 1-Draw up a list of useful locally sourced material providers (e.g. timber yards, quarries) and share with restoration practitioners working in the catchment.

Action 2-Develop funding mechanisms for transport providers to fund Restoration Projects.

Sustainable food systems goals

Action 1-Increase agroecological farming in the Forth Catchment.

Action 2-Increase crop production dedicated to food for human consumption

Action 3-Drive behavioural change towards more sustainable diets

Action 4-Continue food waste reduction beyond the 33% reduction by 2025

Action 5-Reduce agricultural emissions by 30% from 2021 levels by 2032

Sustainable energy goals

Action 1- Build communication links and understanding between sectors (Green Energy, Green Transport, Nature Scot, Environmental Non-Governmental Organisations) to reduce conflict and achieve maximum success for both Net Zero Goals and Biodiversity targets.

Graphics as a summary

The right technique for river restoration at any given location is based on many variables. While full scale restoration will be necessary in some locations, in others it is perceived that the river will be able to “Selfheal” in situ with little or moderate intervention (Helen Reid 2024 - “Will the River do the work”). Assessing the river's ability to selfheal is a good place to start when thinking about which technique is appropriate.

https://www.sepa.org.uk/media/ifcaytdm/will-the-river-do-the-work.pdf

Restoring River Function - If a reach has “moderate” ability to selfheal the technique drawings found in **Appendix A (pg. 32 – 39)** could make a big difference to restoring river function in a relatively short amount of time.

Peatland Restoration

NatureScot through Peatland Action have produced a technical compendium. This covers actions such as:

Restoration of Artificial Drains;

Scrub Removal and;

Forest to Bog restoration

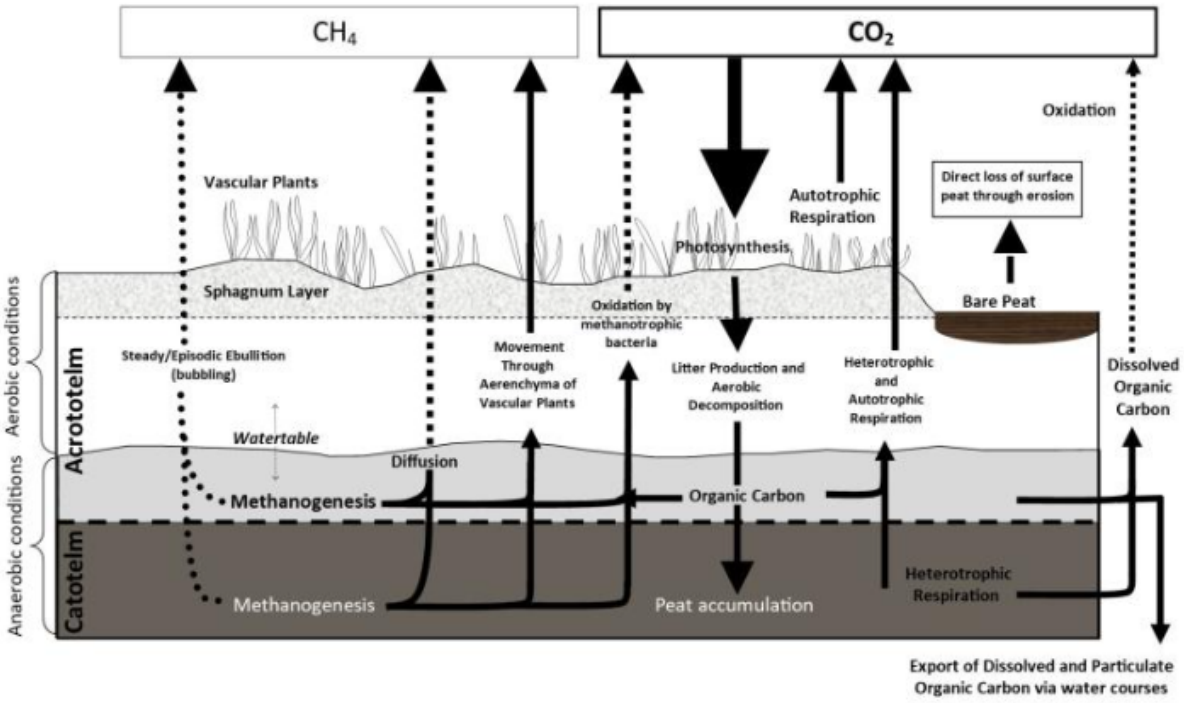


Figure 10 Peatland Climate Change Mitigation. Illustration by Nature Scot.

6 Timeline

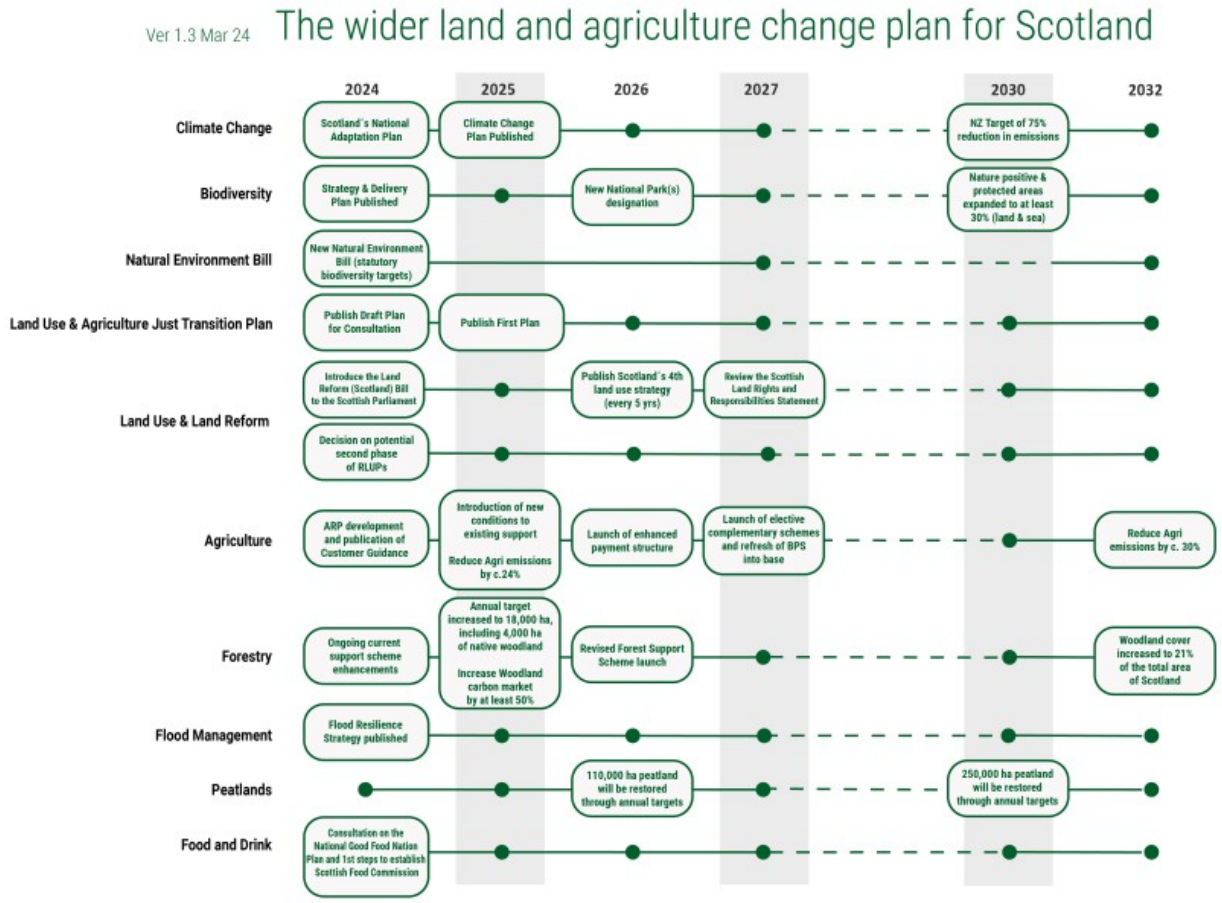


Figure 11 Wider land and agricultural change plan for Scotland James Hutton Institute. Illustration prepared by James Hutton Institute

	period (2-yr interval)					period (5 yr Intervals		
	2025-2026	2027 - 2028	2029-2030	2031 - 2032	2032 - 2034	2035-2039	2040 -2044	2045 - 2049
Climate Change Goal								X
Action 1 Wide scale ID Peatland sites		X						
Action 2 Peatland Data Set		X						
Action 3 Assessiable Dataset		X						
Action 4 110,000 Ha Peatland restored	X							
Action 5 250, 000 ha Peatland restored	X	X	X					
Biodiversity Goal								X
Action 1 Map Restoration to ID habitat fragmentation	X							
Action 2 Ease all Barrier to fish passage	X	X	X	X	X			
Action 3 Develop regional INNS Program	X	X						
Action 4 Restoring River function, Floodplain reconnection,	X	X	X					
Action 5 Regulate Biodiversity Net Gain and roll out training	X	X	X					
Inclusivity Goal								X
Action 1 Enhnaced payment structe Restoration	X	X						
Action 2 - More Flexible Agri - environment Scheme	X	X						
Action 3 - Funding for maintence of restoration measure	X	X						
Action 4 - Land Manager training for Green Finance	X	X						
Action 5 Tools and Funding to feed back biodiversity to land	X	X						
Action 6 Community engagment for every river in the catchr	X	X	X	X	X	X		
Flood and Drought								X
Action 1 Monitor NFM	X	X						
Action 2 Local Authority NFM Investment	X	X	X	X	X			
Zero Pollution								X
Action 1 Monitor Waste Water Discharge	X	X						
Action 2 - Citizen Science To Monitor Pollution all rivers	X	X	X	X	X			
Action 3 - Upskill land managers to reduce diffused pollutic	X	X	X					
Action 4 - Create local material and contractor database	X							
Green Growth								
Action 1 Develop green / private finance model	X	X						
Action 2 Address skill shortage for restoration contractors	X	X	X					
Knowleadge Goals					X	X	X	X
Action 1 Create steering group for each river sub catchment	X	X	X					
Action 2 Catchment Managment Plan for each river sub cat	X	X	X					
Action 3 Showcase successful restoration projects	X	X	X	X	X	X	X	X
Action 4 Monitor the combined effects of Peatland, River, W	X	X	X	X	X	X	X	X
Action 5 Inform, inspire and influence other restoration prac	X	X	X	X	X	X	X	X
Action 6 Publicise Action and Development with public	X	X	X	X	X	X	X	X
Health and Wellbeing					X	X	X	X
Action 1 Every river catchment has community engagment,	X	X	X	X	X			
Action 2 Determine and pubicise link between restoration a	X	X	X	X	X			
Sustainable Transport Goals								X
Database of Local Material contractors per river sub catchn	X	X						
Develop funding mechanism for transport provides to fund	X	X	X					
Sustainable food systems								
Action 1 Increase agro ecological farming	X	X	X	X	X	X	X	X
Action 2 Increase crop production dedicated to food	X	X	X	X				
Action 3 Drive behavioural change to sustainable diet	X	X	X	X				
Action 4 Continue food waste reduction	X	X	X	X				
Action 5 Reduce agricultural emissions	X	X	X	X				
Sustainable energy								X
Action 1 Build communication and links between sectors to	X	X	X	X	X	X	X	X

Figure 12 Goal and Action Timeline

7 Budget

The Green Finance Institute identified a spending gap of £15billion -£27 billion for Scotland for funding for nature for the 10 years between 2022 and 2032. With £3 Billion on clean water and £8 billion on protecting and restoring biodiversity. No figure was given for Natural Flood management in Scotland. Climate mitigation through bio-carbon which includes peatland restoration and management was estimated at £9 billion. Based on this wide estimate the budget could be in the 10s of Billion Euros over the first ten years.

Funding for river restoration is available, in Scotland, through the Water Environment Fund (**WEF**) The funding of environmental improvements in 2013/14 the last year published was

Project Type	Spend
Works - Morphology Improvements	£1,296,172
Works - Fish Barriers	£123,720
Scoping - Morphology Improvements	£119,596
Scoping - Fish Barriers	£274,873
INNS Control	£179,728
Habitat Restoration	£30,000
	£2,024,089

Funding is now focused on Repairing damaged urban rivers often in deprived areas to enhance the environment for the communities that live there and removing and easing barriers to migrating fish and improving vital fish stocks.

The Scottish Government's Nature Restoration Fund (**NRF**) supports projects to help tackle the nature-climate crises, working to restore Scotland's biodiversity and increase resilience to climate change, while improving the health and wellbeing of local communities. (NRF) is a competitive fund, which specifically encourages applicants with projects that restore wildlife and habitats on land and sea and address the twin crises of biodiversity loss and climate change. Freshwater restoration is currently one of the priorities. The NRF is a commitment in the current Programme for Government for multi-year funding as part of overall investment in the natural economy. Since its launch in 2021, the Nature Restoration Fund has supported more than 140 projects, Scotland wide, worth nearly £40 million.

Peatland ACTION - Scottish Government announced a £250 million ten-year funding package, with a target of restoring 250,000 hectares of degraded peatlands nationally by 2030. With peatland restoration funding being available through the Peatland ACTION Programme. In 2022/23 Scotland put 7,500ha of peatland on the road to recovery. In 2023/24, the restoration aim was for 6,100ha of restoration, which is likely to have been achieved. We hope to maintain this level of delivery in 2024/25 and put in place the foundations for NatureScot Peatland ACTION itself to deliver 10,000 ha of restoration in 2025/26.

Peatland Code To make peatland restoration economically attractive additional funding sources are required. One such source of funding is the sale of ecosystem services, such as climate benefit. To access these voluntary carbon markets buyers, need to be given assurance that the climate benefits being sold are real, quantifiable, additional and permanent. The Peatland Code, operated by the IUCN Peatland Programme, is the primary mechanism for private funding and generation of carbon credits for UK peat restoration. It provides a voluntary certification standard for UK peatland projects wishing to market the greenhouse gas reduction benefits of peatland restoration and provides assurances to voluntary carbon market buyers that the climate benefits being sold are real, quantifiable, additional and permanent.

Support for farm businesses is available through the **Agri-Environment and Climate Scheme** (AECS) NatureScot carried out some work on behalf of Scottish Government to monitor and evaluate the Agri-Environment and Climate Scheme looking at uptake and spending in the period 2015-18.

There was a high level of adoption of water margins management with a wide geographical distribution. Water Margins managed under the scheme to help improve water quality was estimated as more than 1,060 hectares with a committed funding of £6 million during the period. 'Converting arable land at risk of erosion or flooding' and 'management of flood plains' options had limited uptake. There is an estimated area of 7,400 hectares of carbon rich soils (lowland bogs and wetlands) in the 2015-18 round contracts, contributing to climate change

and biodiversity targets, with a £5 million budget committed. Peatland restoration capital work can also be funded under AECS, and it was estimated that £2.3 million was spent or committed on restoration activities during the period.

AECS provides both capital and management payments for river wetland and peatland restoration and management. Example 2023 payments are;

Lowland Bog Management	
Ditch Blocking Peat Dams	£13ea
Ditch Blocking Plastic Piling Dams	£62-385 ea
Control of Scrub Light vegetation	£900/ha
Management with grazing	£89.75/ha
Management without grazing	£37.41/ha
Water Quality and Flood Risk	
Management of floodplain	£57.43/ha/yr
Restoring (protecting) River Banks	£185-210/m
Embankment Breaching lowering or removal	actuals

The **Scottish Invasive Species initiative** (SISI) operates out with the Forth Catchment. It is a 4-year partnership project tackling invasive non-native species alongside rivers and water courses in northern Scotland. They are funded by the Heritage Lottery Fund, NatureScot and through in-kind support from project partners and volunteers - the total project value is some £3.24M. The project area is some 29,500km2 - over a third of Scotland and almost one and half times the size of Wales and encompasses Perthshire, Angus, Aberdeenshire, Moray and Highland.

The Scottish Government and NatureScot, working in partnership with the National Lottery Heritage Fund, with the support of the Green Finance Institute, have announced a second round of a grant scheme to support projects that shape and grow the use of private investment and market-based mechanisms to finance the restoration of Scotland's nature. Through the Facility for Investment Ready Nature in Scotland (**FIRNS**), grants of up to £160,000 will be offered to organisations and partnerships to help develop a viable business case and financial model, to attract investment in projects that can restore and improve the natural environment. FIRNS will help selected projects to bridge the gap between the conceptual idea and the investment ready proposition capable of attracting private capital and finance.

FIRNS will support the development of natural capital markets in two broad ways. Firstly, by creating a pipeline of investible projects that is ready to meet demand from responsible buyers and investors in values-led, high-integrity natural capital-based markets. FIRNS grants will help pay for the costs of the development of business and governance models for nature-based projects seeking to attract buyers and investors.

Secondly, FIRNS will help in the development of supportive elements needed for the success of natural capital markets. FIRNS' grants in this case will pay towards the costs of exploring and developing natural capital market infrastructure such as codes, standards and aggregating mechanisms.

The Flow Country Partnership operating elsewhere in Scotland out with the case study area seeks to demonstrate a sustainable model of financing peatland restoration that offers comprehensive environmental benefits that extend beyond carbon sequestration.

Their approach based on a World Heritage Site application is community-centric, ensuring that the commercial gains from carbon credits not only contribute to the global fight against climate change but also bring tangible benefits to local communities in the North Highlands.

Some restoration work is carried out within the statutory and advisory framework for protection of sites. Some work is also carried out through the national spatial strategy for planning and development which has a focus on the climate and nature crises.

Work is also carried out by Non-governmental organisations both in partnership and using their own resources and through charitable funds.

8 Uncertainties and assumptions/ boundary conditions

Funding gap Most of the public money for freshwater conservation in Scotland comes either directly or indirectly through Scottish Government. The Government spent almost £50 Billion on all its priorities in 2023-24. The Green Finance Institute identified a Scottish ten-year funding gap of £3 billion on clean water and £8 billion on protecting and restoring biodiversity. Climate mitigation through bio-carbon which includes peatland restoration and management was estimated at £9 billion. Even if these estimates include other actions, a larger amount of funding than is available from public sources alone is likely to be required to fully achieve the benefits of river and peatland restoration.

Work is being undertaken to address this gap. NatureScot, Esmée Fairbairn Foundation and the National Lottery Heritage Fund launched a grant scheme, Investment Ready Nature in Scotland, to help organisations and partnerships develop projects in Scotland that use private investment and market-based mechanisms to help finance the restoration of the natural environment in Scotland.

Subsequently, The Scottish Government and NatureScot, working in partnership with the National Lottery Heritage Fund, with the support of the Green Finance Institute, announced a second round of a grant scheme to support projects that shape and grow the use of private investment and market-based mechanisms to finance the restoration of Scotland's nature. Through the Facility for Investment Ready Nature in Scotland (FIRNS), grants of up to £160,000 will be offered to organisations and partnerships to help develop a viable business case and financial model, to attract investment in projects that can restore and improve the natural environment.

Even in the current financial climate funding therefore remains a significant challenge and there is always uncertainty around global financial and political pressures which may adversely affect the supply in future.

Skills gap Positive management and conservation of freshwaters relies upon a variety of roles, each with their own skill set, required in order to achieve high quality outcomes.

Some river restoration activities, such as re-meandering, are highly technical. They are usually carried out by consultants and only a limited number of suitable consultancies are available. Contractors with the specialist skills to carry out some of the capital works can also be in short supply. Some of the machinery is expensive and specialist to purchase limiting the number of businesses investing.

Bodies such as the Freshwater Biological Association and the River Restoration Centre provide courses which support river restoration

NatureScot has teamed up with Graduate Career Advantage Scotland (GCAS) and Fisheries Management Scotland (FMS) to run a Working with Rivers placement scheme. This scheme will support a number of graduates who are looking to gain experience and skills in the river restoration sector for a period of six months.

SRUC in partnership with Peatland Action run a peatland restoration course designed to address the skills gap covering an overview of peatland ecology and hydrology and an understanding of the causes of peatland degradation and allowing participants to develop expertise in mapping and surveying peatland, before designing effective interventions for the restoration of the site.

As conservation action becomes more widespread ecology and land management training increasingly include relevant elements.

Restoration projects also often include finance and partnership elements and it is important that these skills are supported too.

Long-Term Managment Land managers may seek payment to incentivise their management of the land to benefit biodiversity, flood-management and climate change Carbon credits through the IUCN peatland code is currently seen as the most likely mechanism for the support of the management of much of the peatland in the long term.

Many river restoration projects are only supported for capital works. They are designed to set the conditions that natural processes will take over and deliver the biodiversity, flood-management and climate change mitigation benefits that are the aim of the scheme. There are some elements however that require ongoing investment such as grazing management to allow riparian tree planting to succeed. Land management support payments may be required to support this. Flood plain reconnection may require changes to management of the adjacent land. Funding and advice is currently available through woodland and agricultural advisers and support schemes.

Indirect Drivers The IPBES report, and others have identified there to be people's disconnect with nature and the consequent lack of recognition for the value and importance of nature. If people do not feel connected to nature, and therefore don't care for nature and see its importance, they are more likely to over-exploit and not take seriously the impacts of climate change, pollution and invasive non-native species.

It is important to engage with all stakeholders to ensure political support and understanding of the benefits of the work and the value it provides. Sometimes certain sectors may be resistant to change, and it is important to understand the issues and perceptions. Lack of monitoring evidence that restoration is a cost-effective solution can undermine these messages.

Climate change Climate change currently seems to be developing broadly in line with the predicted assumptions. However, there are a number of tipping points which if triggered may have uncertain outcomes. Most modelling is at a global or national scale. Some of the climate events seen recently are relatively small scale, affecting a catchment or part of a catchment. Freshwaters are complex biological systems, and the impacts can be hard to predict or mitigate. Invasive non-native species may be encouraged by changes to the climate. There is a horizon scanning process in place to consider these impacts. Keystone native species may also be adversely affected by change either directly or through competition or changes to the physical environment. Climate change is likely to increase popular support for nature-based solutions as a cost-effective mitigation measure but may make delivery more challenging.

Relevant materials

Relevant to FORTH

Explore | Forth Rivers Trust (https://forthriverstrust.org/rivers-wildlife/explore/)

The Forth Region was set as a boundary as Scotland has 41 District Salmon Fishery Boards (DSFBs), including the River Tweed Commission. DSFBs are constituted under the Salmon and Freshwater Fisheries (Consolidation) (Scotland) Act 2003. Boards are associations of fishery owners and must include a representative of salmon anglers and tenant netsmen. Scottish Environmental Protection Agency (SEPA), NatureScot, Local Authorities, Crown Estate Scotland and National Park Authority staff and other local stakeholders attend many DSFB meetings, and such input is very beneficial. The MERLIN project boundary maps to the Forth DSFB who through the Trust are a partner in the delivery and clearly form a route to engagement with key stakeholders.

Also, Scotland has been separated into 14 Local Plan Districts for flood risk management purposes. These districts are based on river catchments and coastal areas which cross administrative and institutional boundaries. Flooding demands a collaborative and coordinated response from the organisations and individuals, as flooding is best understood and managed as a natural process. A piecemeal response will not work (SEPA 2015).

Forth Estuary Local Plan District – Flood Risk Management Plan SEPA available at https://www2.sepa.org.uk/frmstrategies/forth-estuary.html

Forth Fisheries Management Plan also effected the choice as it is a working document outlining projects to improve the catchments which will be developed whilst providing information to the public on the importance of the rivers for wildlife, communities, and visitors. Available at https://arcg.is/1SuT5r

Not all river catchments in this region have a management plan – but the following are available;

Forth and Teith Management Plan-available at https://storymaps.arcgis.com/stories/dc03bc7442ac4768b3e0b7b9bdafedf3

Dreelburn Management Plan available at https://storymaps.arcgis.com/stories/04cccb470cb545f387eba214070eb160

Water of Leith Management Plan-available at https://www.waterofleith.org.uk/management/

Forth Rivers Trust 2045 Strategy for all the Forth's Rivers available at https://forthriverstrust.org/wp-content/uploads/2024/05/FRT-Strategy-2045-FINAL.pdf

Relevant to policies

The most important policy context at present is the **Scottish Biodiversity Strategy** which provides a route map for Scotland to help inform government priorities to halt the decline in biodiversity and start to revert the nature crisis.

https://www.gov.scot/publications/scottish-biodiversity-strategy-2045-tackling-nature-emergency-scotland-2/

The basis for the SBS delivery plan includes action to accelerate restoration and regeneration and to protect nature on land and sea. It includes freshwater and peatland and upland targets.

The proposed **Natural Environment Bill** includes the introduction of statutory nature recovery targets which will be binding on government in the same way that climate change targets require Ministers work towards meeting net zero targets.

https://www.gov.scot/publications/tackling-nature-emergency-consultation-scotlands-strategic-framework-biodiversity/pages/5/

Deer numbers have the potential to affect restoration proposals through grazing of woodland planting and in some cases erosion on soils. Consultation is taking place on **Managing Deer for Climate and Nature**. The proposals build on the recommendations of the independent Deer Working Group, expanding them in several areas to reflect the need to meet Scottish Biodiversity Strategy and net zero targets.

https://www.gov.scot/publications/managing-deer-climate-nature-consultation/

The Scottish Governments Agricultural policy, Vision for Agriculture and Route map, published in March 2022, outlines the long term vision to transform how the government will support farming and food production in Scotland to become a global leader in sustainable and regenerative agriculture.

Scottish Agricultural Policy has a significant effect and is changing at the time of this plan. The vision and Route map are a guide to what this may look like in the future.

Vision for Agriculture - https://www.gov.scot/publications/next-step-delivering-vision-scotland-leader-sustainable-regenerative-farming/

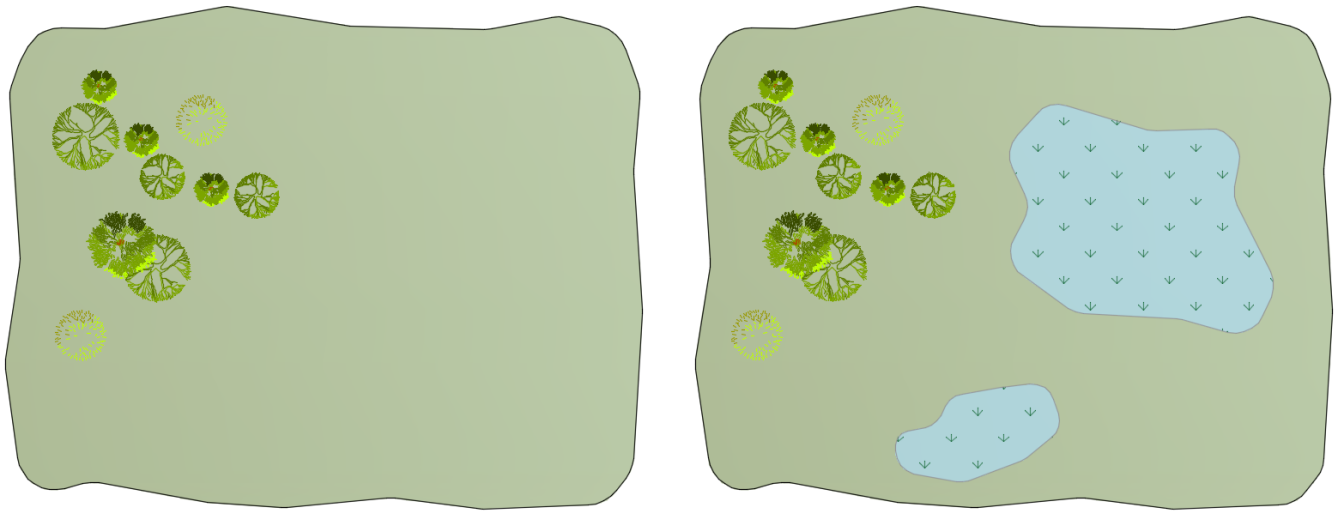
Agricultural Reform Route Map - https://www.ruralpayments.org/topics/agricultural-reform-programme/arp-route-map/

Agricultural and Rural Communities (Scotland) Bill will require future agriculture support to be delivered under a new five yearly rural support plan. Proposals have been made for protection of peatlands and wetlands being built into cross compliance under Tier 1 through Good Agricultural and Environmental Condition and the introduction of a biodiversity audit element to compulsory whole farm planning proposed from 2025 under Tier 1 https://www.parliament.scot/-/media/files/legislation/bills/s6-bills/agriculture-and-rural-communities-scotland-bill/stage-3/bill-as-passed.pdf

Appendix A Techniques for River Restoration.

SCRAPES / PONDS

Used to retain water within the floodplain to reduce flood impact and create wetland and habitat. Scrapes / ponds can be both permanent pools or ephemeral (dry up over time)

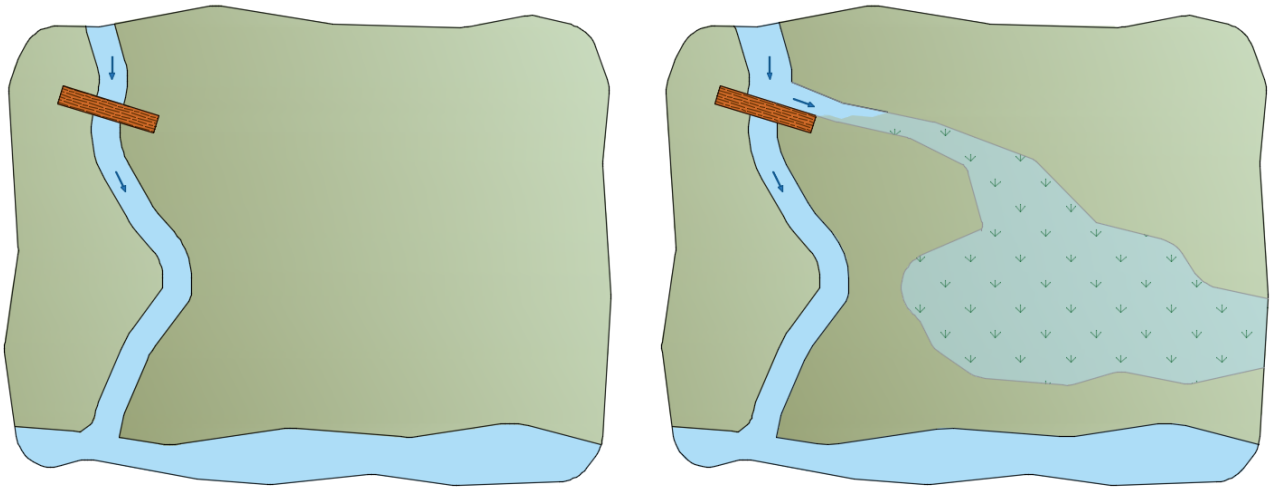


Before
No specific water holding capacity

After
Scrapes / ponds (water retained in floodplain)

HIGH WATER DEFLECTOR TO WETLAND OR SCRAPE

Used to deflect a portion of water out of channel towards a wetland or scrape during a flood to reduce flood impact and create wetland and habitat.

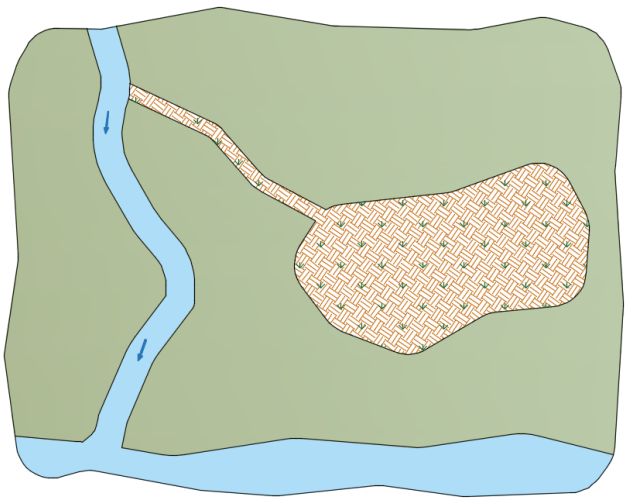


Before
Normal water level

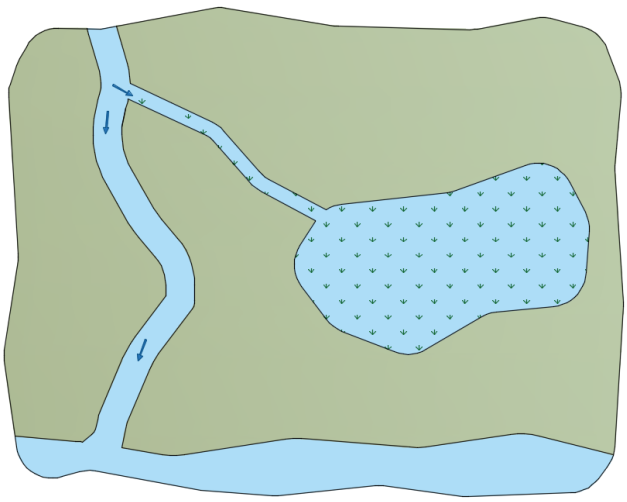
After
High water level
(water deflected to floodplain)

HIGH WATER OVERFLOW CHANNEL TO WETLAND OR SCRAPE

Used to re-direct a portion of water out of channel towards a wetland or scrape when in flood to reduce flood impact and create wetland and habitat.



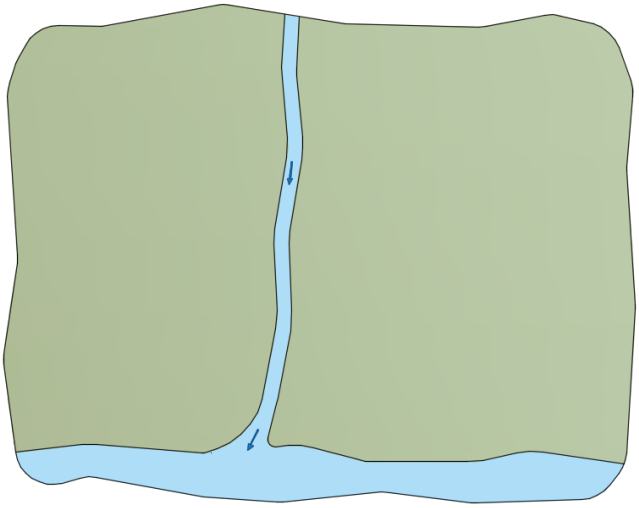
Before
Normal water level



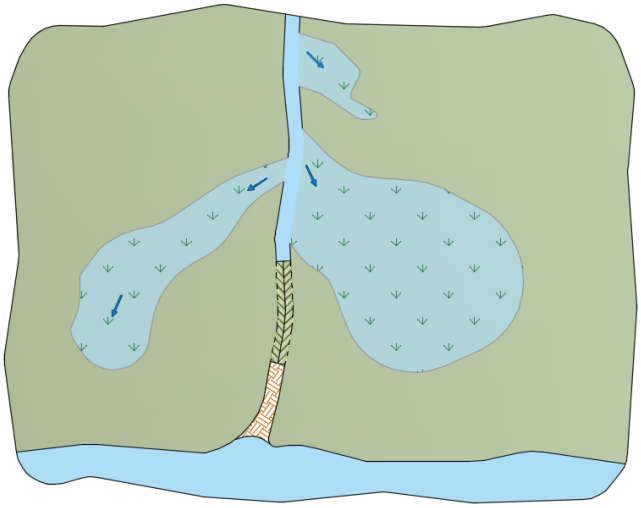
After
High water level
(water redirected to floodplain)

DITCH BLOCKING OR 'ZIPPING'

Used to retain water within the floodplain to reduce flood impact and create wetland and habitat.



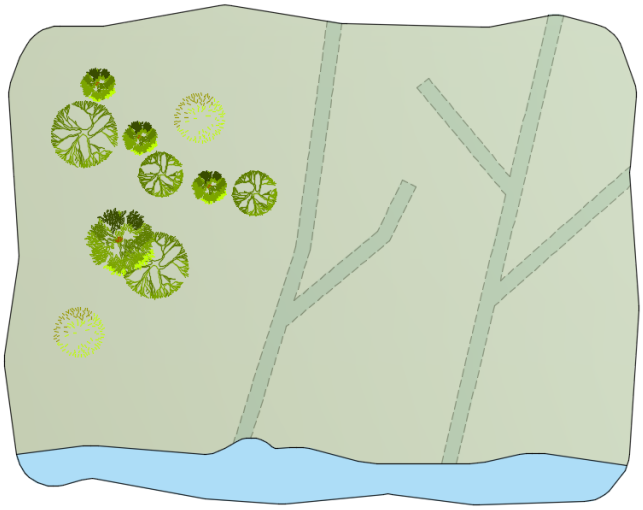
Before
Water rapidly drained from catchment



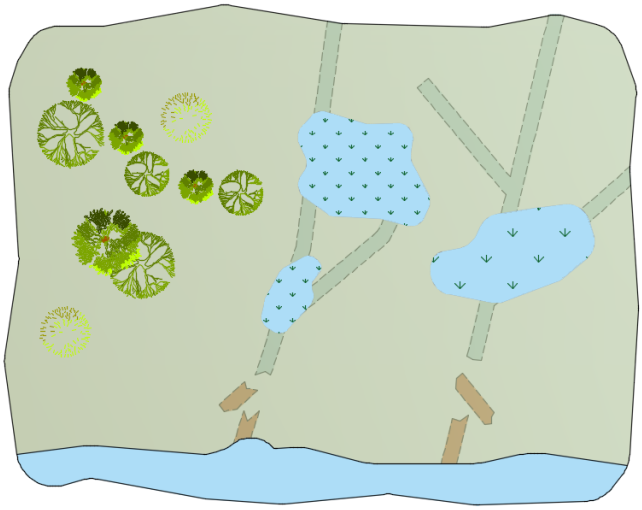
After
Water retained in floodplain

DRAIN BREAKING

Breaking of agricultural sub-surface drains to retain water within the floodplain and reduce flood impact and create wetland and habitat.



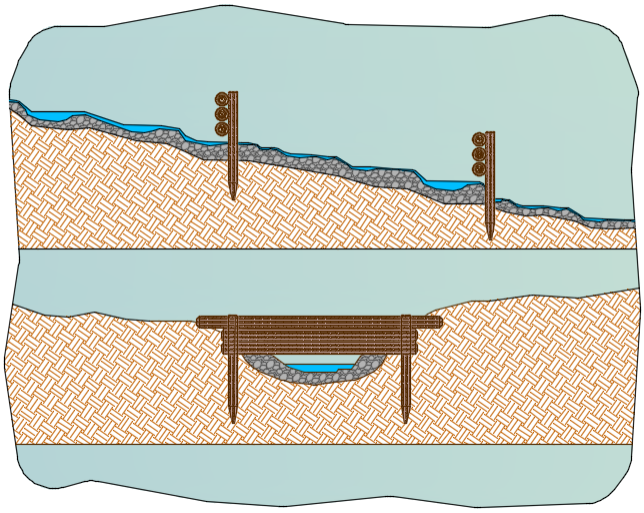
Before
Water drained from catchment



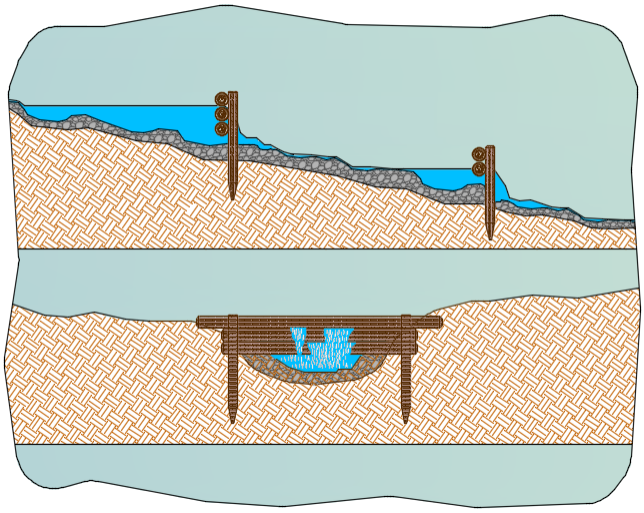
After
Water retained in floodplain

LEAKY DAMS

On rivers, used to slow the flow of floodwater and de-synchronises the high-water peaks within the catchment area and adds capacity to the upper catchment. In wetlands, used to slow the release of water within the wetland. Can be made of logs, planks, willow screens or other materials as required.



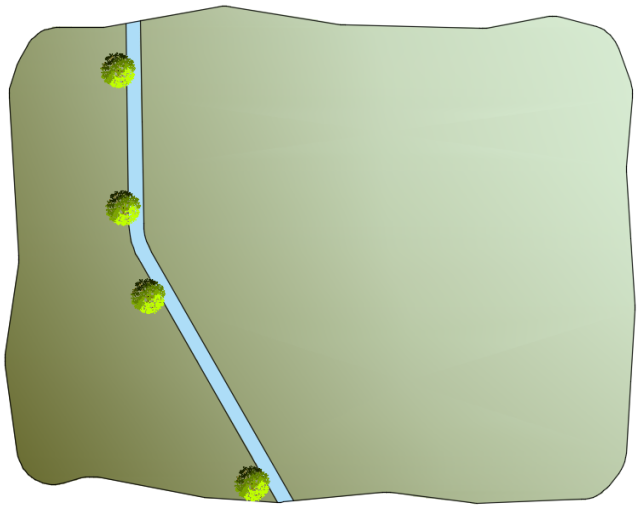
Before
Normal water level
(no interruption to flow)



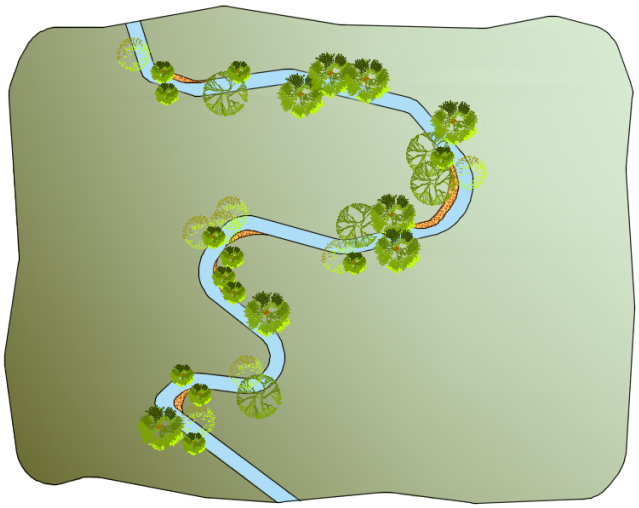
After
High water level
(water retained and slowly released through the dam)

REMEANDERING

Channel re-meandered used to slow the flow (reduce flood impact) and create both habitat and hydromorphological diversity.



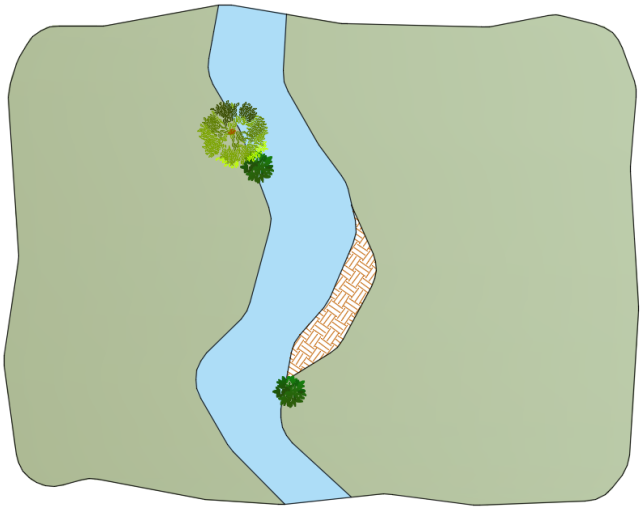
Before
Unrestricted, uniform waterway



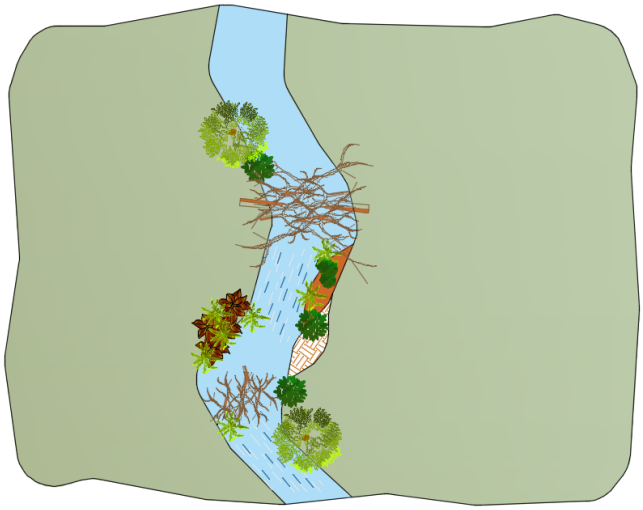
After
Diverse habitat and improved hydromorphology

LARGE WOODY DEBRIS (LWD)

Large woody debris (LWD) placed in-channel to protect banks from erosion, improve sinuosity and improves habitat. Helps trap organic matter (e.g. leaves) which provide nutrients vital to aquatic insects and fish.



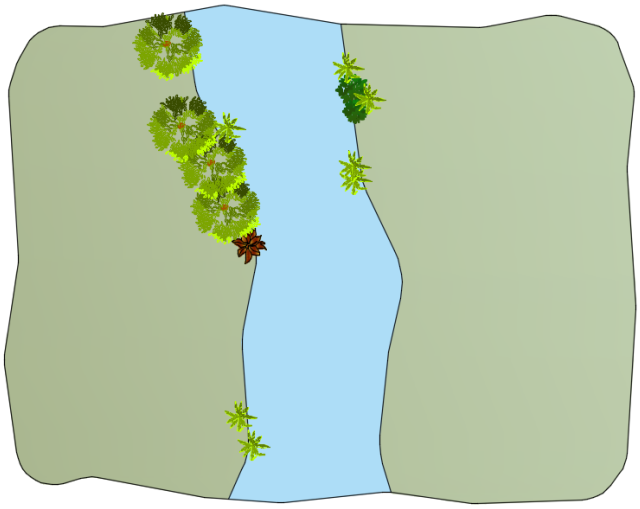
Before
Non-diverse habitat lacking in nutrients, banks
subject to erosion.



After
Nutrient rich, diverse habitat, stable

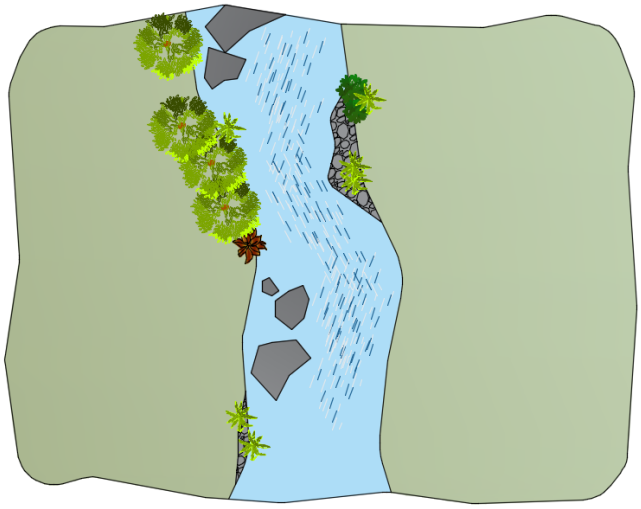
HYDROMORPHOLOGICAL IMPROVEMENTS – RIFFLES, POOLS AND STREAMS

Placement of boulders, stones and woody debris to create riffles, runs and pools to create improve hydromorphology and habitat.



Before

Uniform flow and depth, no hydro-morphological diversity.

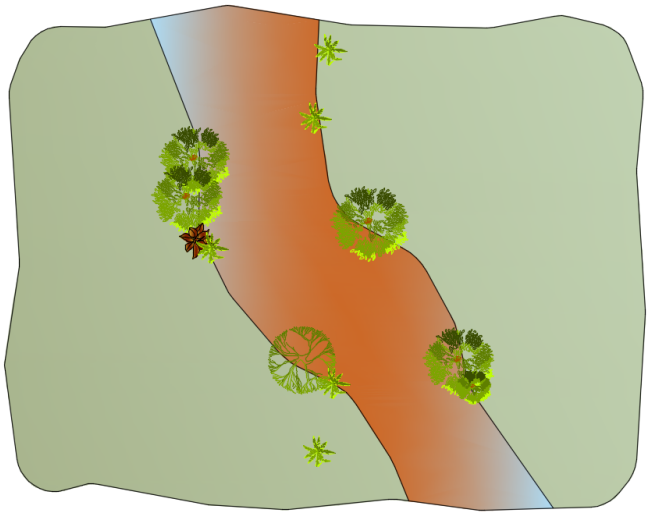


After

Riffles, pools and streams creating diverse habitats

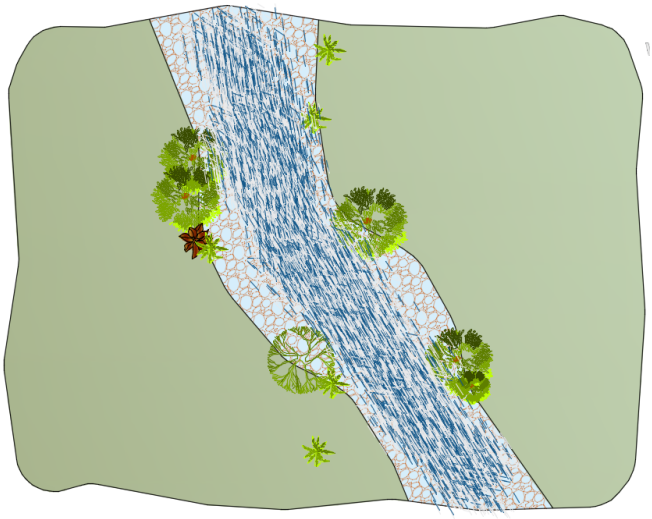
CHANNEL SUBSTRATE IMPROVEMENTS - RIFFLES, POOLS AND STREAMS

Artificially installed gravels, cobble and boulder to create riffles, pools, streams and habitat.



Before

Silted channel bed.

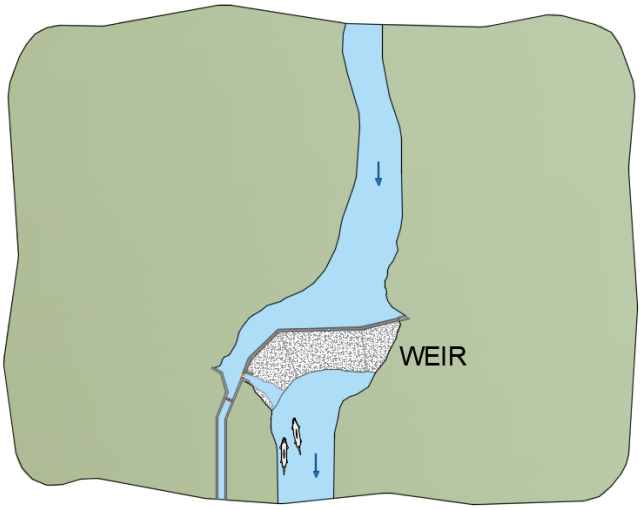


After

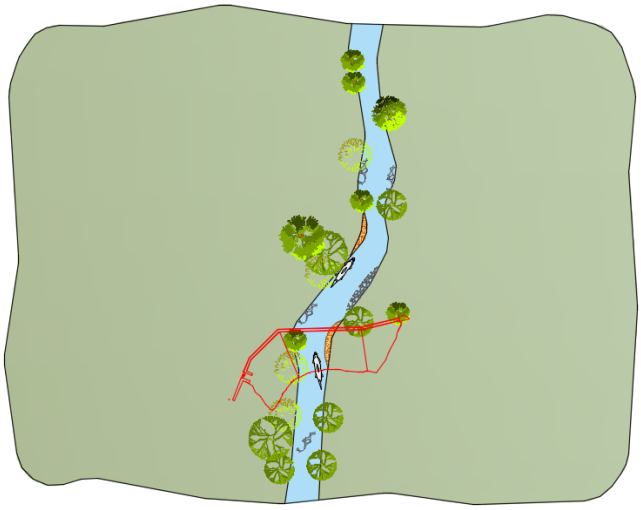
Artificially installed gravel, cobble and boulder (diverse hydro-morphology and habitat)

ARTIFICIAL BARRIER REMOVAL

Removal of artificial barriers (weirs, dams, structures etc) to allow free movement of fish and sediments.



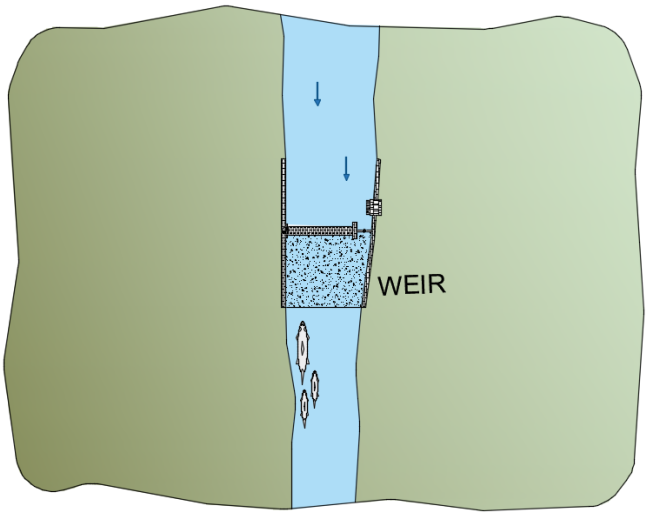
Before
Artificial barrier



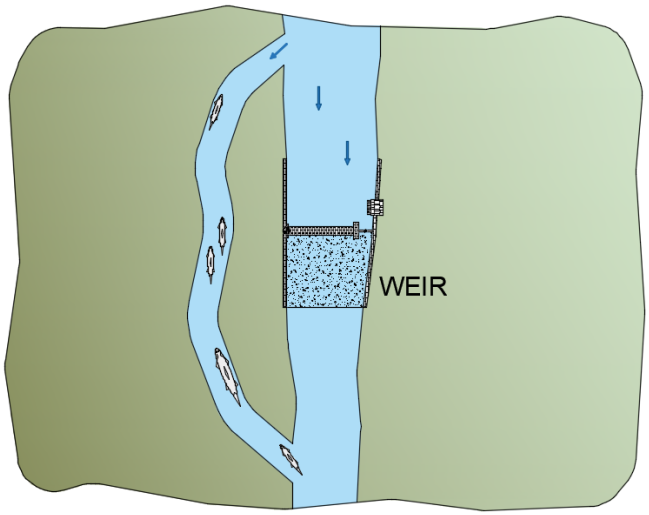
After
Barrier removal, channel restoration

ARTIFICIAL BARRIER BYPASS CHANNEL

Bypass channel installed around artificial barrier to allow free movement of fish species. Used when barrier removal is not possible.



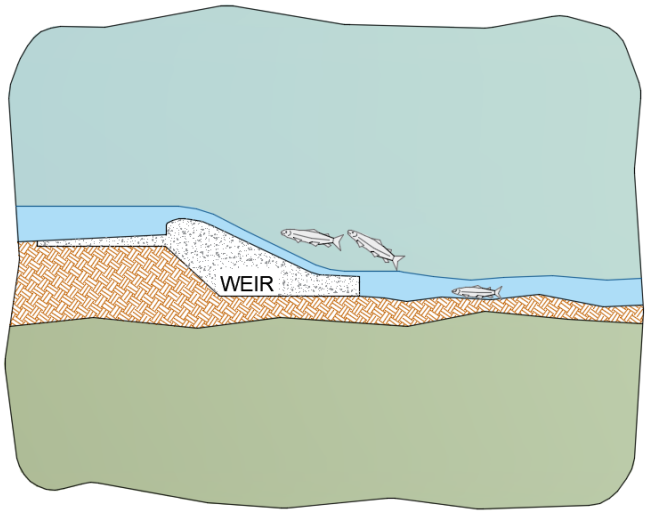
Before
Artificial barrier



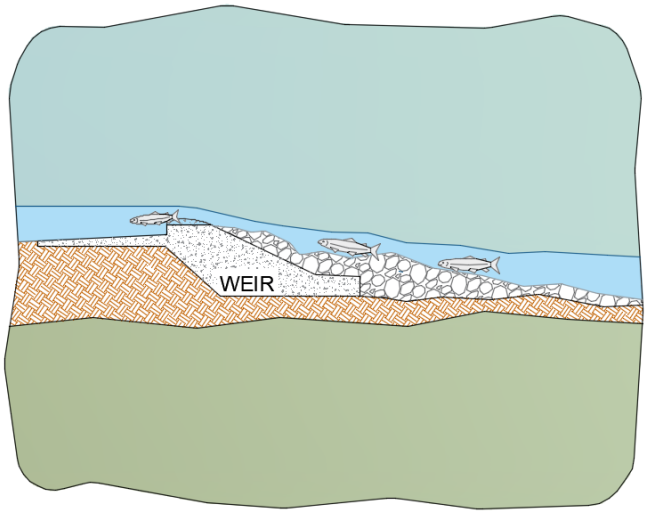
After
Bypass channel installed

ARTIFICIAL BARRIER ROCK RAMP

Installed to allow free movement of fish species where other preferential easement options are not possible.



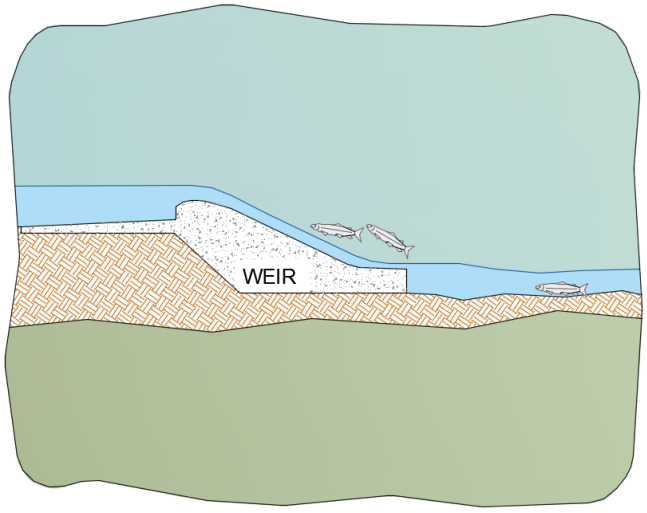
Before
Artificial barrier



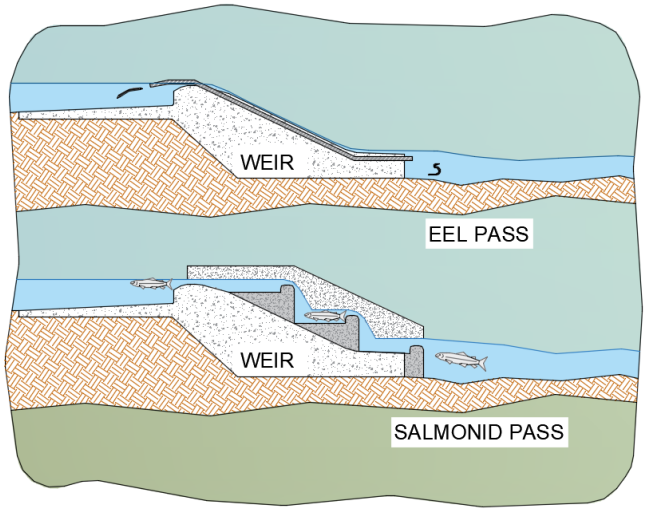
After
Rock ramp installed

ARTIFICIAL BARRIER FISH PASS

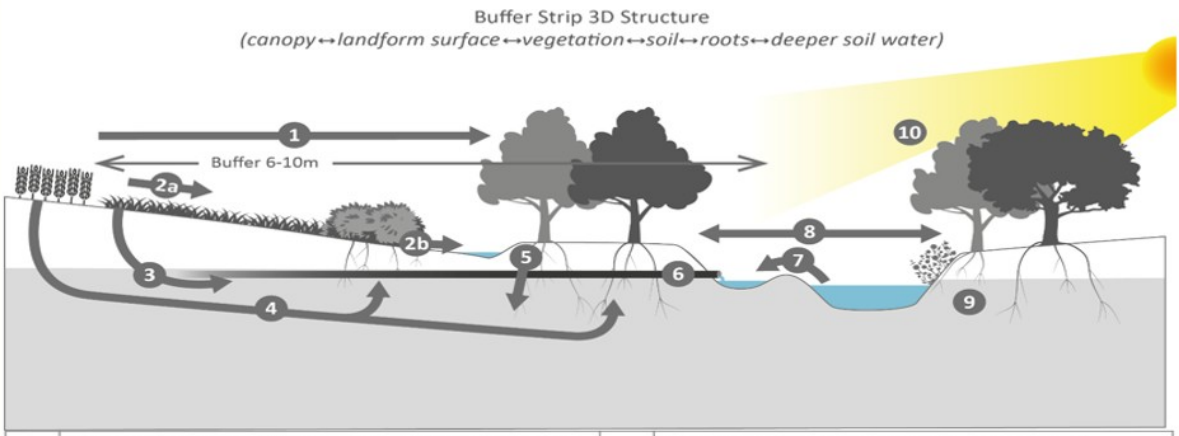
Installed to allow free movement of fish species where other preferential easement options are not possible. There are many solutions and styles of fish pass. Fish passes often need to accommodate both salmonids and eels.



Before
Artificial barrier



After
Fish pass installed



1	Reduced airborne spray drift of agrochemicals due to interception by tree canopy	6	Stopping direct discharges from soil drains to watercourses allows time for pollution removal
2	Filtering pollutants in runoff by trapping particles amongst vegetation (2a) and by water retention in hollows created by resculptured ground profiles (2b).	7	Altered bank profiles promote rewetting, water retention and sediment trapping
3	Improved infiltration and delayed vertical drainage promotes natural processing of nutrients and other contaminants by soil microbes and plants	8	Growth of riparian and aquatic vegetation increases channel 'roughness' and leaf litter inputs, aiding processing and removal of pollutants
4	Nutrient uptake and utilisation by growing vegetation	9	Tree rooting stabilises banks reducing erosion and sediment input
5	Enhanced levels of soil organic matter aids natural attenuating processes in soils	10	Increased shading cools water temperature and reduces thermal stress to aquatic life

Figure: 3D Buffer Zone (Scottish Government)