Case Study: Pennal 2050 Natural Flood Management

Dyfi Catchment

Figure 1 Pennal 2050 was the Wales Rural Network Awards 2022 winner for best Landscapes, Nature and Forestry project.

Project Location	Pennal and associated land on estuary – Gwynedd, Powys and Ceredigion. Slo-flo element of project in Gwynedd
Lead Delivery Organisation	Partneriaeth Pennal
Key Partners	Natural Resources Wales (NRW), Forest Research, New Dovey Fishery (1929) Association (Dyfi River freeholder), Snowdonia National Park and Gwynedd County Council
Main funding stream(s) for project delivery	Sustainable Management Scheme, Welsh Government Rural Communities - Rural Development Programme 2014-2020 (funded by the European Agricultural Fund for Rural Development and the Welsh Government)

1. NFM Measures Implemented

Implemented measures include:

- Leaky barriers: 15 Cwm Brechiau and 5 Cwm Dŵr.
- Culverts diverting from watercourses: Approximately 20.
- Woodland/hedging/river support - e.g. planting, fencing off water (Clean Water), fencing off hedges and woodland, approximately 50 interventions.
- Natural resource mitigation of riverbank erosion (one) - local stone, wall.
- Anti-water-erosion measures: on footpaths, tracks, Wales Coast path and feeder walks including diverting water to land, installation of water storage/drainage cattle grids to divert track flow, etc., approximately 15 measures.
- Maintenance/upgrade/planting of water channels/ditches and track or path interceptions of water flow, sluice gates, etc., that reduce the concentration of flow and slow its overland flow (existing).
- Soil Health, Management and Clean Waters: training provided to cover land management of 7,000 plus acres.

In addition, there has been some biodiversity training, modelling for improvements and implementation of new habitats and management of existing including: saltmarsh, flood plain, ancient woodland, new woodland, ponds, rivers etc. across 7,000 acres, in 40 places.

2. Key drivers for the project

2.1. Flood Risk Management

Precipitation from the hills surrounding the Dyfi, combined with the tidal river acting as a rising wall, can cause back-flooding of residential properties in the village, the main A493 from Machynlleth to Aberdyfi and fertile farmland and properties nearby. NFM measures implemented in the forestry and on agricultural land should dissipate or create lag in some of these waters with the potential to reduce the amount and speed of water coming down from the hillsides. A mix of soft and harder engineered measures have been implemented.

2.2. Wider Environmental Enhancements

Tree and hedgerow planting will allow for absorption of exhaust gasses from busy main road and generate oxygen. Clean water measures will help reduce sediment, soil and stones and nutrients entering watercourses and fencing/hedging reduce contamination of watercourses by livestock. The scheme has allowed benchmarking of species in the area, created new habitats and preserved others. Local issues have been identified and collaborative action taken on a landscape scale. The group is rolling out its initiative, with landowners and communities, across the Dyfi catchment.

2.3. Societal Benefits

The project has created social cohesion by providing links to other organisations in the area enabling greater understanding and inter-action. Meetings and training events, when allowed and with appropriate safeguards, have provided access to

social interaction during Covid periods. The next generation, i.e. children in the primary federation in the area have had input to the project from early days and benefit from invertebrate, moth and bird monitoring, nature walks with ecologists, STEM lessons linked to climate change (project has supplied weather station and underwater drone observatory) as well as visits to see different types of farming activities, e.g. on dairy and sheep farms. Experts in their field (e.g. University researchers) have talked about their projects and consultants providing modelling have explained how big data is turned into maps and other information. The inclusiveness of the project has been reflected in a wide range of ages and people from all backgrounds taking part in activities which are inclusive. The project has put on community events and supported walks and the local agricultural show. Approximately 20 newsletters have been produced to date, one multi-lingual (eight languages) website developed following a workshop with accommodation providers.

3. Project Description

Pennal 2050 is a farmer-led community project stretching from Dyfi bridge near Machynlleth to almost the coastal town of Aberdyfi covering adjoining landowners across approx 7000 acres of land from hilltop to valley floor. Pennal 2050 was Wales Rural Network Awards 2022 winner for best Landscapes, Nature and Forestry project.

In terms of scenery, Pennal ranks with the world's best and its flora and fauna reflect the range of landscapes from the heather-clad hilltops to the Afon Dyfi, one of the best sea trout rivers in Europe.

Culture and heritage abound with major Roman defences and links to the Prince of Wales Owain Glyndwr.

Here the landowners, residents and businesses in the Dyfi catchment are combining to develop resilience to climate change and the other threats facing rural areas.

Our farming community leads the way in maintaining this landscape, which includes a UNESCO biosphere and Dyfi Estuary Site of Special Scientific Interest (SSSI).

Our community initiative brings together people and nature in the long-term to:

- Improve biodiversity by improving and linking habitats.
- Tackle the effects of climate change.
- Encourage rural resilience and economic activity.

We aim to encourage residents to take positive steps to improve their surroundings through path improvements and better access to green and blue spaces for their own health and well-being and that of future generations by taking environmental actions including volunteering and joining in community activities. Our junior Ecoguardians at school are planting trees, learning how big data can make maps for modelling change and finding out what species live in our area.

The key strands of our project are:

Eco-Steps – includes planting hedges, trees to provide wildlife corridors. We are assessing and monitoring our natural resource capital – our green assets.

Clear Waters – includes reducing soil and water erosion to improve water quality.

Slo-Flo – includes using the management of natural resources to reduce the amount of water running into the village during intense rain events and the threat of flooding.

Moor Healthy – includes better management of our uplands by reducing bracken and using cattle as well as sheep to graze the hilltops to encourage wildlife such as sky larks and grouse to breed.

These measures are underpinned by advanced modelling to inform our activities which have been funded over five years.

We have a project steering group which is made up of various agency and community reps (e.g. education, businesses).

We aim to develop our project to ensure that we carry on our work to 2050 – when children of today will have their own children living and working in Pennal. The holistic approach with integrated solutions delivery carried out in line with the Well-being Future Generations Act (WFGA) methods of working and its seven goals.

Full project details at:

- https://visitpennal.wales/hafan/
- https://visitpennal.wales/en/home/

E-mail address: pennalpartners@aol.com

4. Key Project Outcomes

4.1. Successes

Initial planning included review of evidence, particularly that in the “Working with Natural Processes – Evidence Directory” (2017). This evidence informed the need for specification of leaky barriers, monitoring and evaluation, etc., although we found that the nature of the watercourse (steepness of valley, meanders, availability of materials nearby) affected the way we finally constructed the leaky barriers.

Geomorphological advice informed the positioning of the leaky barriers so it was less likely to be washed away by changes in stream flow.

After six months the slo-flo elements (e.g. woody debris and barriers) were starting to show signs of success with surrounding land getting wetter, less water going into watercourses because of new culverts (photo below) dispersing water onto land and more sedimentation at woody debris sites.

The benefit of leaky barriers has been evidenced at other schemes, e.g. Pickering which was visited by project manager to inform the Pennal scheme. The effect as Pennal is increasing at, currently, 18 months with habitat gain.

We found that one installation on forestry land and one on farmland were washed away. We now have sensors (through SENSUM - Smart SENSing of landscapes Undergoing hazardous hydrogeological Movement - led by the University of Exeter in collaboration with the Universities of Plymouth and East Anglia) in some of the current forestry wood debris which will help to track any movement in future and disintegration to inform future schemes. Contractors repaired several leaky barriers during their 12 month follow-up inspections, particularly after storm events.

We think the collaborative action response, such as we have seen with the SMS fund, has certainly spurred us into action and made us learn more about the landscape and how we should be protecting it and its flora and fauna. Agencies working with farmers and other landowners should be a primary action and we would like to be seen as part of the solution as we have generations of knowledge about our landscape which, as we have seen with our 2050 scheme, can be successfully harnessed in partnership working and inform ground-truthing of any modelling.

We have ancient Atlantic woodland (Celtic Rainforests) with fantastic examples of lichen and liverwort. As mentioned elsewhere here there are 1,325 hectares of Ancient Semi Natural Woodland and 1,359 hectares of Plantations on Ancient Woodland Sites (PAWS), giving a total land cover of 3.5% for ancient woodland in the catchment (Forest Research). We want to protect these. Trees are great – the right species, in the right places and planted in the right way at the right time for that landscape and its biodiversity and able to survive future climactic conditions.

We are also expanding our group to include more landowners in the Dyfi catchment and planning with national institutions and universities an innovative range of new measures to enable further actions to benefit the biodiversity of the area along with climate change mitigation across a far wider area. We aim to achieve funding to implement these measures more fully and are already being visited as an exemplar with researchers, academics and others coming from all parts of the UK and even globally, from as far away as northern India.

Flood mitigation, carbon storage, biodiversity, hydromorphology and landscape issues are being addressed through some bespoke modelling, together with the development of an adaptive local plan looking forward thirty years to address needs of future generations in line with the Environment Act and WFGA.

4.2. Lessons Learnt

Careful study of previous projects and research documents allowed us to develop an appropriate and sustainable project.

A great deal of time and effort was required to do all the planning, seek consents, go out to tender, legal and statutory requirements, ensuring monitoring and evaluation, etc. - far more than initially predicted.

We and our research partners aim to produce academic papers for peer review and best practice use.

The need to build in funding flexibility for unforeseen issues, e.g. extra monitoring devices in certain places, additional management time due to complexity, additional wildlife survey requirements.

Ensuring we did not affect species within the catchment during works and the timing of these during months when it can be a difficult time to build in watercourses due to increased flows.

Liaising with the freeholders of 15 miles of the Dyfi river (New Dyfi Fishery Association) allowed us to consider the passage of fish where appropriate and make allowances for this in the construction of slo-flo elements.

4.3. Monitoring and Maintenance

In the planning stage of the project, Partneriaeth Pennal contacted Forest Research and was provided with flow meters, etc., for a couple of Dyfi tributaries which would allow for some pre-installation benchmarking. More meters have since been installed. The Group also worked with Snowdonia National Park to carry out some pre-installation drone survey footage for bench-marking.

The Project negotiated a licence with NRW to carry out the activities in the NRW forestry area and applied for water consents for all structures from Gwynedd County Council. It had to develop specifications and tender documentation in liaison with NRW to meet NRW's required safe working processes and procedures, health and safety, Covid assessment, welfare, risk assessment, etc., and the Project Manager had to undergo Forestry Plus first aid training and carry environmental spill kits, first aid and disinfection kit, etc. There has been co-operation across the project with the Countryside and Access officers, highways and other agencies such as the Woodland Trust and Coed Cymru. Liaison has been maintained with NRW forestry and land officers, its geomorphologists, civil engineers and biodiversity officers as well as the land agent.

The project negotiated a 12-month follow-up monitoring and repairs of the leaky barriers on NRW land with the installation contractor including fixed point photography and had to employ its own civil engineering consultancy to check works here and ones on agricultural land. Following that period, the work has been taken on by NRW and Forest Research. In addition, the project had to comply with EU, Welsh Government and RPW/WEFO regulations/requirements on procurement and claims management.

The project also liaised with landowners to allow Universities to deliver at least four major research projects with access to watercourses, permission to install remote sensors in woody debris and consent to set up LoRAn hubs to feedback information for research purposes which should enable the catchment to continue to support relevant research across climate change and related issues into the future.

5. Project Photographs

Figure 2 Fluvial flooding of residential properties, acting as a driver for the implementation of the project.

Figure 3 Example of a leaky barrier implemented as part of the project.

Figure 4 Example of a new flow control culvert implemented as part of the scheme.

Figure 5 Example of woody debris accumulation in forestry land as part of the project.